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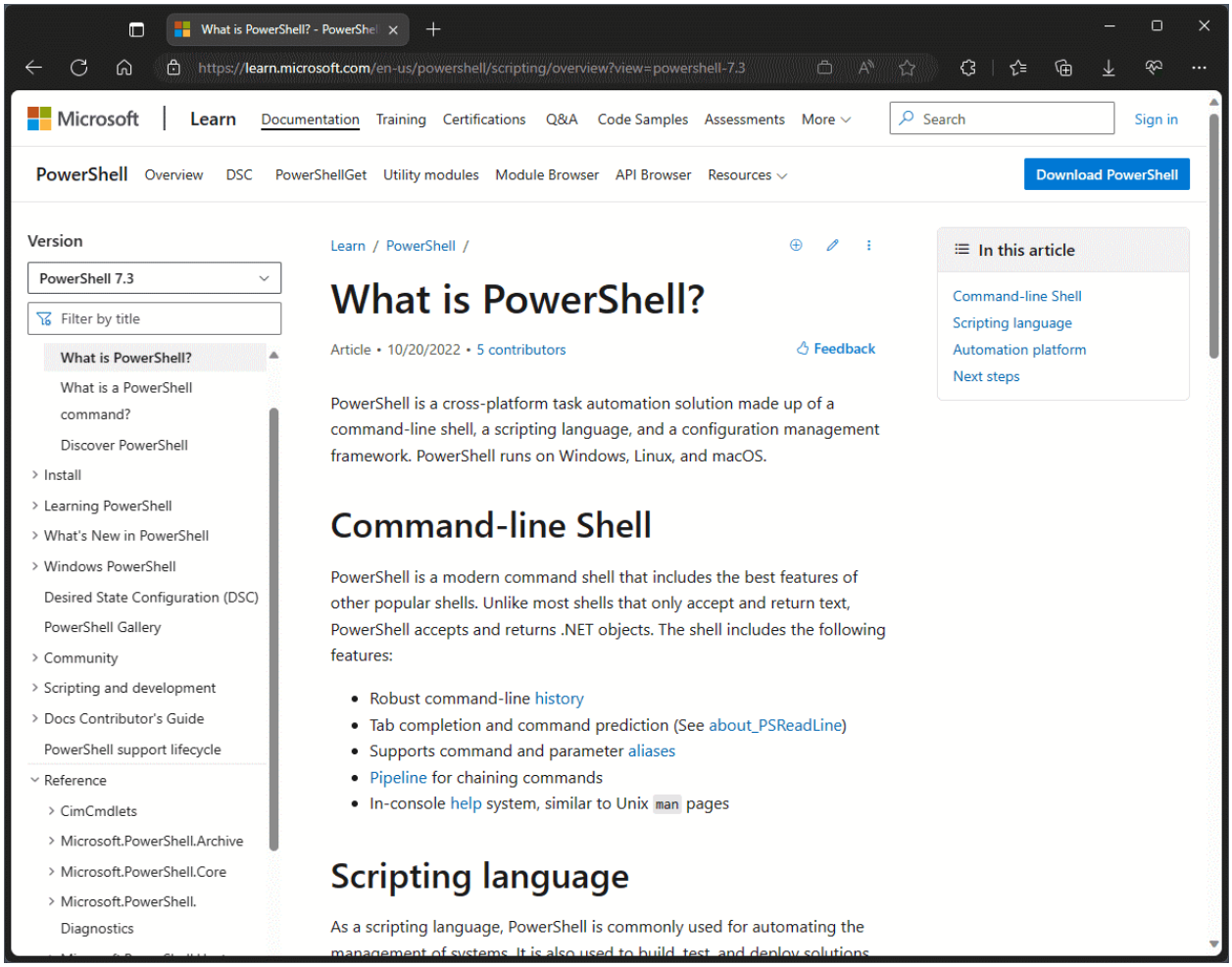
How to use the PowerShell documentation

Article • 05/12/2023

Welcome to the PowerShell online documentation. This site contains cmdlet reference for the following versions of PowerShell:

- PowerShell 7.4 (preview)
- PowerShell 7.3
- PowerShell 7.2 (LTS-current)
- PowerShell 5.1

Navigating the documentation



The web page contains multiple elements that help you navigate the documentation.

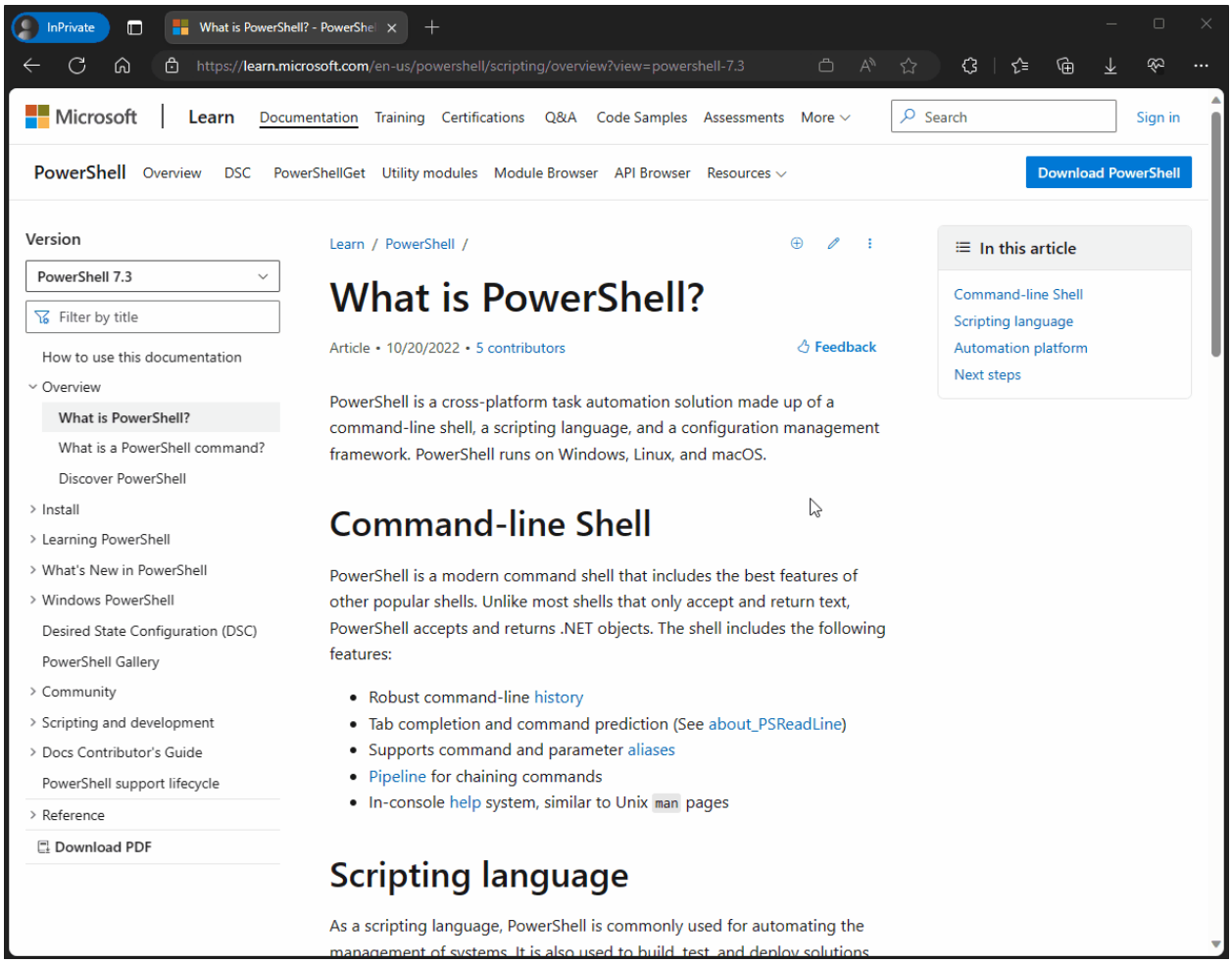
- **Site level navigation** - The site level navigation appears at the top of the page. It contains links to other content on the Microsoft Learn platform.

- **Related content navigation** - The related content bar is immediately below the site level navigation. It contains links to content related to the current docuemntation set, which is PowerShell in this case.
- **Version selector** - The version selector appears above the Table of Contents (TOC) and controls which version of the cmdlet reference appears in the TOC.
- **Table of Contents** - The TOC on the left side of the page is divided into two sections: conceptual and reference. Notice the line between the **Reference** node of the TOC. The conceptual documents appear above the line. Reference content is listed in **Reference** node below the line.
- **Action buttons** - The action buttons provide a way to add content to a collection, provide feedback, edit the content, or share the content with others.

Selecting the version of PowerShell

Use the version selector located above the TOC to select the version of PowerShell you want. By default, the page loads with the most current stable release version selected. The version selector controls which version of the cmdlet reference appears in the TOC under the **Reference** node. Some cmdlets work differently in different versions of PowerShell you are using. Be sure you are viewing the documentation for the correct version of PowerShell.

The version selector doesn't affect conceptual documentation. The conceptual documents appear above the **Reference** node in the TOC. The same conceptual articles appear for every version selected. If there are version-specific differences, the documentation makes note of those differences.



You can verify the version of PowerShell you are using by inspecting the `$PSversionTable.PSVersion` value. The following example shows the output for Windows PowerShell 5.1.

PowerShell

```
$PSVersionTable.PSVersion
```

Output

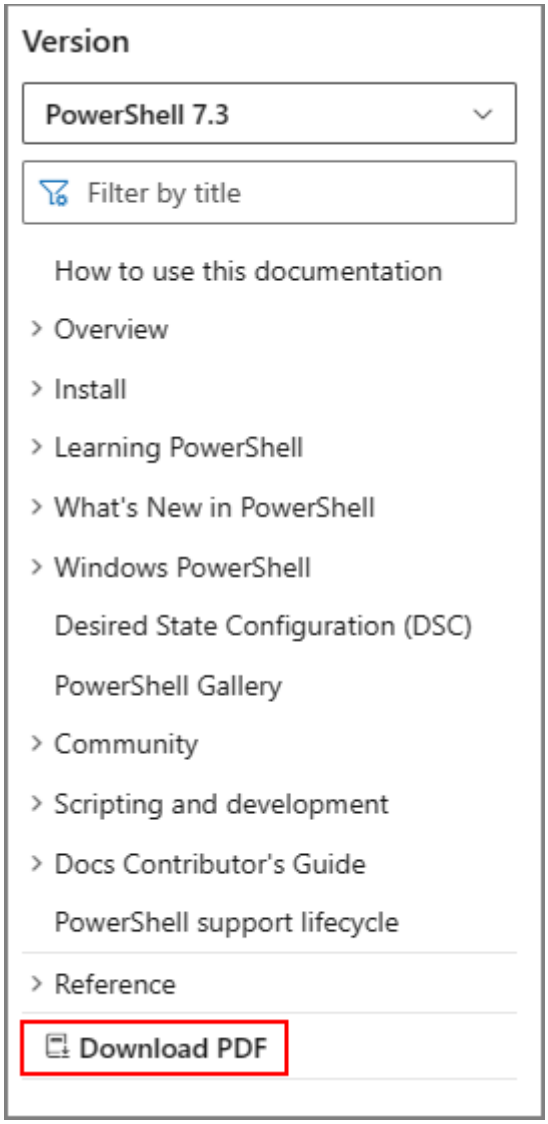
```
Major  Minor  Build  Revision
-----  -----  -----  --------
5      1      22621  963
```

Finding articles

There are two ways to search for content in Docs. The simplest way is to use the filter box under the version selector. Just enter a word that appears in the title of an article. The filter displays a list of matching articles. You can also select the option to search the entire site from that list.

Downloading the documentation as a PDF

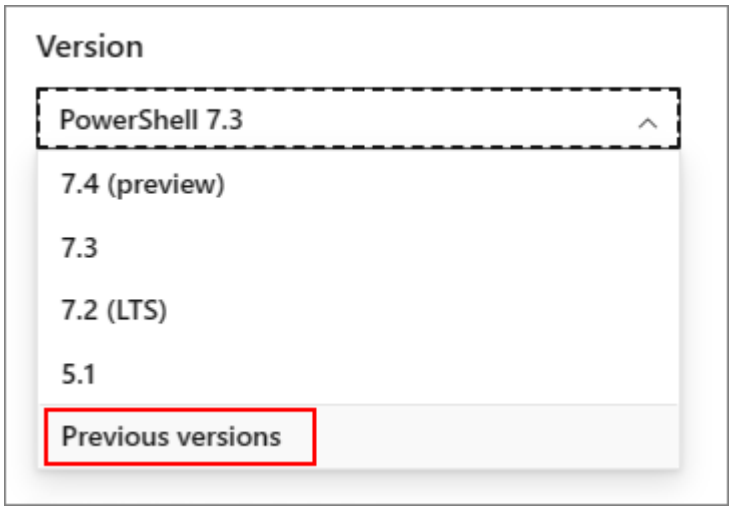
To download the documentation as a PDF, click the **Download PDF** button at the bottom of the TOC.



- If you are viewing a conceptual article, the Learn platform creates a PDF containing all the conceptual content for the selected version.
- If you are viewing a reference article, the Learn platform creates a PDF containing all the reference content for the selected version.

Finding articles for previous versions

Documentation for older versions of PowerShell is archived in our Previous Versions site. You can choose **Previous Versions** from the version selector.



This site contains documentation for the following topics:

- PowerShell 3.0
- PowerShell 4.0
- PowerShell 5.0
- PowerShell 6
- PowerShell 7.0
- PowerShell 7.1
- PowerShell Workflows
- PowerShell Web Access

What is PowerShell?

Article • 06/28/2023

PowerShell is a cross-platform task automation solution made up of a command-line shell, a scripting language, and a configuration management framework. PowerShell runs on Windows, Linux, and macOS.

Command-line Shell

PowerShell is a modern command shell that includes the best features of other popular shells. Unlike most shells that only accept and return text, PowerShell accepts and returns .NET objects. The shell includes the following features:

- Robust command-line history
- Tab completion and command prediction (See about_PSReadLine)
- Supports command and parameter aliases
- Pipeline for chaining commands
- In-console help system, similar to Unix `man` pages

Scripting language

As a scripting language, PowerShell is commonly used for automating the management of systems. It's also used to build, test, and deploy solutions, often in CI/CD environments. PowerShell is built on the .NET Common Language Runtime (CLR). All inputs and outputs are .NET objects. No need to parse text output to extract information from output. The PowerShell scripting language includes the following features:

- Extensible through functions, classes, scripts, and modules
- Extensible formatting system for easy output
- Extensible type system for creating dynamic types
- Built-in support for common data formats like CSV, JSON, and XML

Automation platform

The extensible nature of PowerShell has enabled an ecosystem of PowerShell modules to deploy and manage almost any technology you work with. For example:

Microsoft

- Azure

- Windows
- Exchange
- SQL

Third-party

- AWS
- VMWare
- Google Cloud

Configuration management

PowerShell Desired State Configuration (DSC) is a management framework in PowerShell that enables you to manage your enterprise infrastructure with configuration as code. With DSC, you can:

- Create declarative configurations and custom scripts for repeatable deployments
- Enforce configuration settings and report on configuration drift
- Deploy configuration using push or pull models

Next steps

Getting started

Are you new to PowerShell and don't know where to start? Take a look at these resources.

- Installing PowerShell
- PowerShell Bits tutorials
- PowerShell 101
- Microsoft Virtual Academy videos
- PowerShell Learn modules

PowerShell in action

Take a look at how PowerShell is being used in different scenarios and on different platforms.

- PowerShell remoting over SSH
- Getting started with Azure PowerShell
- Building a CI/CD pipeline with DSC

- Managing Microsoft Exchange

What is a PowerShell command (cmdlet)?

Article • 11/17/2022

Commands for PowerShell are known as cmdlets (pronounced command-lets). In addition to cmdlets, PowerShell allows you to run any command available on your system.

What is a cmdlet?

Cmdlets are native PowerShell commands, not stand-alone executables. Cmdlets are collected into PowerShell modules that can be loaded on demand. Cmdlets can be written in any compiled .NET language or in the PowerShell scripting language itself.

Cmdlet names

PowerShell uses a *Verb-Noun* name pair to name cmdlets. For example, the `Get-Command` cmdlet included in PowerShell is used to get all the cmdlets that are registered in the command shell. The verb identifies the action that the cmdlet performs, and the noun identifies the resource on which the cmdlet performs its action.

Next steps

To learn more about PowerShell and how to find other cmdlets, see the PowerShell Bits tutorial Discover PowerShell.

For more information about creating your own cmdlets, see the following resources:

Script-based cmdlets

- about_Functions_Advanced
- about_Functions_CmdletBindingAttribute
- about_Functions_Advanced_Methods

Compiled cmdlets (PowerShell SDK docs)

- Cmdlet overview

Discover PowerShell

Article • 03/29/2023

PowerShell is a command-line shell and a scripting language in one. PowerShell started out on Windows to help automate administrative tasks. Now, it runs cross platform and can be used for various tasks.

The thing that makes PowerShell unique is that it accepts and returns .NET objects, rather than text. This feature makes it easier to connect different commands in a *pipeline*.

What can PowerShell be used for?

Usage of PowerShell has grown since the days when it was Windows-only. It's still used for Windows task automation, but today, you can use it for tasks like:

- **Cloud management**. PowerShell can be used to manage cloud resources. For example, you can retrieve information about cloud resources, as well as update or deploy new resources.
- **CI/CD**. It can also be used as part of a Continuous Integration/Continuous Deployment pipeline.
- **Automate tasks for Active Directory and Exchange**. You can use it to automate almost any task on Windows like creating users in Active Directory and mailboxes in Exchange.

There are many more areas of usage but the preceding list gives you a hint that PowerShell has come a long way.

Who uses PowerShell?

PowerShell is a powerful tool that can help people working in a multitude of roles. Traditionally, PowerShell has been used by the System Administrator role but is now being used by people calling themselves DevOps, Cloud Ops, and even Developers.

PowerShell cmdlets

PowerShell comes with hundreds of preinstalled commands. PowerShell commands are called cmdlets (pronounced *command-lets*).

The name of each cmdlet consists of a *Verb-Noun* pair. For example, `Get-Process`. This naming convention makes it easier to understand what the cmdlet does. It also makes it easier to find the command you're looking for. When looking for a cmdlet to use, you can filter on the verb or noun.

Using cmdlets to explore PowerShell

When you first pick up PowerShell, it might feel intimidating as there seems to be so much to learn. PowerShell is designed to help you learn a little at a time, as you need it.

PowerShell includes cmdlets that help you discover PowerShell. Using these three cmdlets, you can discover what commands available, what they do, and what types they operate on.

- `Get-Verb`. Running this command returns a list of verbs that most commands adhere to. The response includes a description of what these verbs do. Since most commands follow this naming convention, it sets expectations on what a command does. This helps you select the appropriate command and what to name a command, should you be creating one.
- `Get-Command`. This command retrieves a list of all commands installed on your machine.
- `Get-Member`. It operates on object based output and is able to discover what object, properties and methods are available for a command.
- `Get-Help`. Invoking this command with the name of a command as an argument displays a help page describing various parts of a command.

Using these commands, you can discover almost anything you need to know about PowerShell.

Verb

Verb is an important concept in PowerShell. It's a naming standard that most cmdlets follow. It's also a naming standard you're expected to follow when you write your own commands. The idea is that the *Verb* says what you're trying to do, like read or maybe change data. PowerShell has a standardized list of verbs. To get a full list of all possible verbs, use the `Get-Verb` cmdlet:

PowerShell

```
Get-Verb
```

The cmdlet returns a long list of verbs. The **Description** provides context for what the verb is meant to do. Here's the first few rows of output:

Output

```
Verb    AliasPrefix   Group     Description
----    -----------   -----     -----------
Add     a             Common    Adds a resource to a container, or attaches
an item to another item
Clear   cl            Common    Removes all the resources from a container
but does not delete the container
Close   cs            Common    Changes the state of a resource to make it
inaccessible, unavailable, or unusab…
Copy    cp            Common    Copies a resource to another name or to
another container
Enter   et            Common    Specifies an action that allows the user to
move into a resource
Exit    ex            Common    Sets the current environment or context to
the most recently used context
...
```

Find commands with Get-Command

The `Get-Command` cmdlet returns a list of all available commands installed on your system. The list you get back is quite large. You can limit the amount of information that comes back by filtering the response using parameters or helper cmdlets.

Filter on name

You can filter the output of `Get-Command` using different parameters. Filtering allows you to find commands that have certain properties. The **Name** parameter allows you to find a specific command by name.

PowerShell

```
Get-Command -Name Get-Process
```

Output

```
CommandType     Name              Version    Source
-----------     ----              -------    ------
Cmdlet          Get-Process       7.0.0.0    Microsoft.PowerShell.Management
```

What if you want to find all the commands that work with processes? You can use a wildcard `*` to match other forms of the string. For example:

PowerShell

```
Get-Command -Name *-Process
```

Output

```
CommandType     Name              Version    Source
-----------     ----              -------    ------
Cmdlet          Debug-Process     7.0.0.0    Microsoft.PowerShell.Management
Cmdlet          Get-Process       7.0.0.0    Microsoft.PowerShell.Management
Cmdlet          Start-Process     7.0.0.0    Microsoft.PowerShell.Management
Cmdlet          Stop-Process      7.0.0.0    Microsoft.PowerShell.Management
Cmdlet          Wait-Process      7.0.0.0    Microsoft.PowerShell.Management
```

Filtering on Noun and Verb

There are other parameters that filter on verb and noun values. The verb part of a command's name is the leftmost part. The verb should be one of the values returned by the `Get-Verb` cmdlet. The rightmost part of a command is the noun part. A noun can be anything.

- **Filter on verb**. In the command `Get-Process`, the verb part is `Get`. To filter on the verb part, use the **Verb** parameter.

  PowerShell

  ```
  Get-Command -Verb 'Get'
  ```

  This example lists all commands that use the verb `Get`.

- **Filter on noun**. In the command `Get-Process`, the noun part is `Process`. To filter on the noun, use the **Noun** parameter. The following example returns all cmdlets the have nouns starting with the letter `U`.

  PowerShell

  ```
  Get-Command -Noun U*
  ```

Also, you can combine parameters to narrow down your search, for example:

```
```

PowerShell

```
Get-Command -Verb Get -Noun U*
```

Output

```
CommandType     Name                               Version    Source
-----------     ----                               -------    ------
Cmdlet          Get-UICulture                      7.0.0.0
Microsoft.PowerShell.Utility
Cmdlet          Get-Unique                         7.0.0.0
Microsoft.PowerShell.Utility
Cmdlet          Get-Uptime                         7.0.0.0
Microsoft.PowerShell.Utility
```

Use helper cmdlets to filter results

You can also use other cmdlets to filter results.

- `Select-Object`. This versatile command helps you pick out specific properties from one or more objects. You can also limit the number of items you get back. The following example returns the **Name** and **Source** property values for the first 5 commands available in the current session.

  PowerShell

  ```
  Get-Command | Select-Object -First 5 -Property Name, Source
  ```

  Output

  ```
  Name                       Source
  ----                       ------
  Add-AppPackage             Appx
  Add-AppPackageVolume       Appx
  Add-AppProvisionedPackage  Dism
  Add-AssertionOperator      Pester
  Add-ProvisionedAppPackage  Dism
  ```

  For more information, see Select-Object.

- `Where-Object`. This cmdlet lets you filter the objects returned based on the values of properties. The command takes an expression that can test the value of a property. The following example returns all processes where the `ProcessName` starts with `p`.

PowerShell

```
Get-Process | Where-Object {$_.ProcessName -like "p*"}
```

The `Get-Process` cmdlet returns a collection of process objects. To filter the response, *pipe* the output to `Where-Object`. Piping means that two or more commands are connected via a pipe `|` character. The output from one command is sent as the input for the next command. The filter expression for `Where-Object` uses the `-like` operator to match processes that start with the letter `p`.

Explore objects with Get-Member

Once you've been able to locate the cmdlet you want, you want to know more about what output it produces. The `Get-Member` cmdlet displays the type, properties, and methods of an object. Pipe the output you want to inspect to `Get-Member`.

PowerShell

```
Get-Process | Get-Member
```

The result displays the returned type as `TypeName` and all the properties and methods of the object. Here's an excerpt of such a result:

Output

```
TypeName: System.Diagnostics.Process

Name        MemberType     Definition
----        ----------     ----------
Handles     AliasProperty  Handles = Handlecount
Name        AliasProperty  Name = ProcessName
...
```

Using the **MemberType** parameter you can limit the information returned.

PowerShell

```
Get-Process | Get-Member -MemberType Method
```

By default PowerShell only displays a few properties. The previous example displayed the `Name`, `MemberType` and `Definition` members. You can use `Select-Object` to specify

properties you want to see. You For example, you want to display only the `Name` and `Definition` properties:

PowerShell

```
Get-Process | Get-Member | Select-Object Name, Definition
```

Search by parameter type

`Get-Member` showed us that `Get-Process` returns **Process** type objects. The **ParameterType** parameter of `Get-Command` can be used to find other commands that take **Process** objects as input.

PowerShell

```
Get-Command -ParameterType Process
```

Output

```
CommandType     Name                          Version    Source
-----------     ----                          -------    ------
Cmdlet          Debug-Process                 7.0.0.0
Microsoft.PowerShell.Managem…
Cmdlet          Enter-PSHostProcess           7.1.0.0
Microsoft.PowerShell.Core
Cmdlet          Get-Process                   7.0.0.0
Microsoft.PowerShell.Managem…
Cmdlet          Get-PSHostProcessInfo         7.1.0.0
Microsoft.PowerShell.Core
Cmdlet          Stop-Process                  7.0.0.0
Microsoft.PowerShell.Managem…
Cmdlet          Wait-Process                  7.0.0.0
Microsoft.PowerShell.Managem…
```

Knowing the output type of a command can help narrow down your search for related commands.

Additional resources

- Get-Command
- Get-Member
- Select-Object

Install PowerShell on Windows, Linux, and macOS

Learn about installing PowerShell on Windows, Linux, and macOS.

Windows

OVERVIEW

Install PowerShell on Windows

Supported Windows releases

Install Windows PowerShell 5.1

macOS

OVERVIEW

Install on macOS

Supported macOS releases

Linux

OVERVIEW

Linux overview

Alpine

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Raspberry Pi OS

Red Hat Enterprise Linux

Ubuntu

Q&A

GET STARTED

Alternate install methods

Community supported Linux

Using PowerShell in Docker

Arm Processor support

Microsoft Update FAQ for PowerShell

PowerShell Support Lifecycle

Installing PowerShell on Windows

Article • 06/30/2023

There are multiple ways to install PowerShell in Windows. Each install method is designed to support different scenarios and workflows. Choose the method that best suits your needs.

- Winget - Recommended way to install PowerShell on Windows clients
- MSI package - Best choice for Windows Servers and enterprise deployment scenarios
- ZIP package - Easiest way to "side load" or install multiple versions
  - Use this method for Windows Nano Server, Windows IoT, and Arm-based systems
- .NET Global tool - A good choice for .NET developers that install and use other global tools
- Microsoft Store package - An easy way to install for casual users of PowerShell but has limitations

> **Note**
>
> The installation commands in this article are for the latest stable release of PowerShell. To install a different version of PowerShell, adjust the command to match the version you need. The following links direct you to the release page for each version in the PowerShell repository on GitHub.
>
> - Stable release: **https://aka.ms/powershell-release?tag=stable**
> - LTS release: **https://aka.ms/powershell-release?tag=lts**
> - Preview release: **https://aka.ms/powershell-release?tag=preview**
>
> Download links for every package are found in the **Assets** section of the Release page. The **Assets** section may be collapsed, so you may need to click to expand it.

Install PowerShell using Winget (recommended)

Winget, the Windows Package Manager, is a command-line tool enables users to discover, install, upgrade, remove, and configure applications on Windows client computers. This tool is the client interface to the Windows Package Manager service.

The `winget` command-line tool is bundled with Windows 11 and modern versions of Windows 10 by default as the **App Installer**.

> **Note**
>
> See the **winget documentation** for a list of system requirements and install instructions. `Winget` doesn't currently run on Windows servers.

The following commands can be used to install PowerShell using the published `winget` packages:

Search for the latest version of PowerShell

PowerShell

```
winget search Microsoft.PowerShell
```

Output

```
Name               Id                            Version Source
-----------------------------------------------------------------
PowerShell         Microsoft.PowerShell          7.3.5.0 winget
PowerShell Preview Microsoft.PowerShell.Preview 7.4.0.3 winget
```

Install PowerShell or PowerShell Preview using the `id` parameter

PowerShell

```
winget install --id Microsoft.Powershell --source winget
winget install --id Microsoft.Powershell.Preview --source winget
```

> **Note**
>
> On Windows systems using X86 or X64 processor, `winget` installs the MSI package. On systems using the Arm64 processor, `winget` installs the Microsoft Store (MSIX) package. For more information, see **Installing from the Microsoft Store**.

Installing the MSI package

To install PowerShell on Windows, use the following links to download the install package from GitHub.

- PowerShell-7.3.5-win-x64.msi
- PowerShell-7.3.5-win-x86.msi

Once downloaded, double-click the installer file and follow the prompts.

The installer creates a shortcut in the Windows Start Menu.

- By default the package is installed to `$env:ProgramFiles\PowerShell\<version>`
- You can launch PowerShell via the Start Menu or `$env:ProgramFiles\PowerShell\<version>\pwsh.exe`

> **Note**
>
> PowerShell 7.3 installs to a new directory and runs side-by-side with Windows PowerShell 5.1. PowerShell 7.3 is an in-place upgrade that replaces PowerShell 7.0 and lower.
>
> - PowerShell 7.3 is installed to `$env:ProgramFiles\PowerShell\7`
> - The `$env:ProgramFiles\PowerShell\7` folder is added to `$env:PATH`
> - Folders for previously released versions are deleted
>
> If you need to run PowerShell 7.3 side-by-side with other versions, use the **ZIP install** method to install the other version to a different folder.

Support for Microsoft Update in PowerShell 7.2 and newer

PowerShell 7.2 and newer has support for Microsoft Update. When you enable this feature, you'll get the latest PowerShell 7 updates in your traditional Microsoft Update (MU) management flow, whether that's with Windows Update for Business, WSUS, Microsoft Endpoint Configuration Manager, or the interactive MU dialog in Settings.

The PowerShell 7.3 MSI package includes following command-line options:

- `USE_MU` - This property has two possible values:
  - `1` (default) - Opts into updating through Microsoft Update, WSUS, or Configuration Manager
  - `0` - Don't opt into updating through Microsoft Update, WSUS, or Configuration Manager
- `ENABLE_MU`
  - `1` (default) - Opts into using Microsoft Update for Automatic Updates

- `0` - Don't opt into using Microsoft Update

> **Note**
>
> Enabling updates may have been set in a previous installation or manual configuration. Using `ENABLE_MU=0` doesn't remove the existing settings. Also, this setting can be overruled by Group Policy settings controlled by your administrator.

For more information, see the PowerShell Microsoft Update FAQ.

Install the MSI package from the command line

MSI packages can be installed from the command line allowing administrators to deploy packages without user interaction. The MSI package includes the following properties to control the installation options:

- `ADD_EXPLORER_CONTEXT_MENU_OPENPOWERSHELL` - This property controls the option for adding the `Open PowerShell` item to the context menu in Windows Explorer.
- `ADD_FILE_CONTEXT_MENU_RUNPOWERSHELL` - This property controls the option for adding the `Run with PowerShell` item to the context menu in Windows Explorer.
- `ENABLE_PSREMOTING` - This property controls the option for enabling PowerShell remoting during installation.
- `REGISTER_MANIFEST` - This property controls the option for registering the Windows Event Logging manifest.
- `ADD_PATH` - This property controls the option for adding PowerShell to the Windows PATH environment variable.
- `DISABLE_TELEMETRY` - This property controls the option for disabling PowerShell's telemetry by setting the `POWERSHELL_TELEMETRY_OPTOUT` environment variable.

The following example shows how to silently install PowerShell with all the install options enabled.

PowerShell

```
msiexec.exe /package PowerShell-7.3.5-win-x64.msi /quiet
ADD_EXPLORER_CONTEXT_MENU_OPENPOWERSHELL=1
ADD_FILE_CONTEXT_MENU_RUNPOWERSHELL=1 ENABLE_PSREMOTING=1
REGISTER_MANIFEST=1 USE_MU=1 ENABLE_MU=1 ADD_PATH=1
```

For a full list of command-line options for `Msiexec.exe`, see Command line options.

Installing the ZIP package

PowerShell binary ZIP archives are provided to enable advanced deployment scenarios. Download one of the following ZIP archives from the current release page.

- PowerShell-7.3.5-win-x64.zip
- PowerShell-7.3.5-win-x86.zip
- PowerShell-7.3.5-win-arm64.zip

Depending on how you download the file you may need to unblock the file using the `Unblock-File` cmdlet. Unzip the contents to the location of your choice and run `pwsh.exe` from there. Unlike installing the MSI packages, installing the ZIP archive doesn't check for prerequisites. For remoting over WSMan to work properly, ensure that you've met the prerequisites.

Use this method to install the ARM-based version of PowerShell on computers like the Microsoft Surface Pro X. For best results, install PowerShell to the to `$env:ProgramFiles\PowerShell\7` folder.

Install as a .NET Global tool

If you already have the .NET Core SDK installed, you can install PowerShell as a .NET Global tool.

```
dotnet tool install --global PowerShell
```

The dotnet tool installer adds `$HOME\.dotnet\tools` to your `$env:PATH` environment variable. However, the currently running shell doesn't have the updated `$env:PATH`. You can start PowerShell from a new shell by typing `pwsh`.

Installing from the Microsoft Store

PowerShell 7.3 can be installed from the Microsoft Store. You can find the PowerShell release in the Microsoft Store site or in the Store application in Windows.

Benefits of the Microsoft Store package:

- Automatic updates built right into Windows
- Integrates with other software distribution mechanisms like Intune and Configuration Manager

- Can install on Windows systems using x86, x64, or Arm64 processors

Known limitations

By default, Windows Store packages run in an application sandbox that virtualizes access to some filesystem and registry locations. Changes to virtualized file and registry locations don't persist outside of the application sandbox.

This sandbox all blocks any changes to the application's root folder. Any system-level configuration settings stored in `$PSHOME` can't be modified. This includes the WSMAN configuration. This prevents remote sessions from connecting to Store-based installs of PowerShell. User-level configurations and SSH remoting are supported.

The following commands need write to `$PSHOME`. These commands aren't supported in a Microsoft Store instance of PowerShell.

- `Register-PSSessionConfiguration`
- `Update-Help -Scope AllUsers`
- `Enable-ExperimentalFeature -Scope AllUsers`
- `Set-ExecutionPolicy -Scope LocalMachine`

For more information, see Understanding how packaged desktop apps run on Windows.

Changes for PowerShell 7.2

Beginning in PowerShell 7.2, the PowerShell package is now exempt from file and registry virtualization. Changes to virtualized file and registry locations now persist outside of the application sandbox. However, changes to the application's root folder are still blocked.

> **ⓘ Important**
>
> You must be running on Windows build 1903 or higher for this exemption to work.

Installing a preview version

Preview releases of PowerShell 7 install to `$env:ProgramFiles\PowerShell\7-preview` so they can be run side-by-side with non-preview releases of PowerShell. PowerShell 7.4 is the next preview release.

Upgrading an existing installation

For best results when upgrading, you should use the same install method you used when you first installed PowerShell. Each installation method installs PowerShell in a different location. If you aren't sure how PowerShell was installed, you can compare the installed location with the package information in this article. If you installed via the MSI package, that information appears in the **Programs and Features** Control Panel.

> **Note**
>
> When upgrading, PowerShell won't upgrade from an LTS version to a non-LTS version. It only upgrades to the latest version of LTS, for example, from 7.2.3 to 7.2.12. To upgrade from an LTS release to a newer stable version or the next LTS, you need to install the new version with the MSI for that release.
>
> When the installed version isn't an LTS version, PowerShell upgrades to the latest stable version.

Deploying on Windows 10 IoT Enterprise

Windows 10 IoT Enterprise comes with Windows PowerShell, which we can use to deploy PowerShell 7.

PowerShell

```
# Replace the placeholder information for the following variables:
$deviceip = '<device ip address'
$zipfile = 'PowerShell-7.3.5-win-arm64.zip'
$downloadfolder = 'u:\users\administrator\Downloads'  # The download
location is local to the device.
    # There should be enough  space for the zip file and the unzipped
contents.

# Create PowerShell session to target device
Set-Item -Path WSMan:\localhost\Client\TrustedHosts $deviceip
$S = New-PSSession -ComputerName $deviceIp -Credential Administrator
# Copy the ZIP package to the device
Copy-Item $zipfile -Destination $downloadfolder -ToSession $S

#Connect to the device and expand the archive
Enter-PSSession $S
Set-Location u:\users\administrator\Downloads
Expand-Archive .\PowerShell-7.3.5-win-arm64.zip

# Set up remoting to PowerShell 7
Set-Location .\PowerShell-7.3.5-win-arm64
```

```
# Be sure to use the -PowerShellHome parameter otherwise it tries to create
a new
# endpoint with Windows PowerShell 5.1
.\Install-PowerShellRemoting.ps1 -PowerShellHome .
```

When you set up PowerShell Remoting you get an error message and are disconnected from the device. PowerShell has to restart WinRM. Now you can connect to PowerShell 7 endpoint on device.

PowerShell

```
# Be sure to use the -Configuration parameter. If you omit it, you connect
to Windows PowerShell 5.1
Enter-PSSession -ComputerName $deviceIp -Credential Administrator -
Configuration PowerShell.7.3.5
```

Deploying on Windows 10 IoT Core

Windows 10 IoT Core adds Windows PowerShell when you include *IOT_POWERSHELL* feature, which we can use to deploy PowerShell 7. The steps defined above for Windows 10 IoT Enterprise can be followed for IoT Core as well.

For adding the latest PowerShell in the shipping image, use Import-PSCoreRelease command to include the package in the workarea and add *OPENSRC_POWERSHELL* feature to your image.

> **Note**
>
> For ARM64 architecture, Windows PowerShell isn't added when you include *IOT_POWERSHELL*. So the zip based install doesn't work. You need to use `Import-PSCoreRelease` command to add it in the image.

Deploying on Nano Server

These instructions assume that the Nano Server is a "headless" OS that has a version of PowerShell already running on it. For more information, see the Nano Server Image Builder documentation.

PowerShell binaries can be deployed using two different methods.

1. Offline - Mount the Nano Server VHD and unzip the contents of the zip file to your chosen location within the mounted image.
2. Online - Transfer the zip file over a PowerShell Session and unzip it in your chosen location.

In both cases, you need the Windows x64 ZIP release package. Run the commands within an "Administrator" instance of PowerShell.

Offline Deployment of PowerShell

1. Use your favorite zip utility to unzip the package to a directory within the mounted Nano Server image.
2. Unmount the image and boot it.
3. Connect to the built-in instance of Windows PowerShell.
4. Follow the instructions to create a remoting endpoint using the "another instance technique".

Online Deployment of PowerShell

Deploy PowerShell to Nano Server using the following steps.

PowerShell

```
# Replace the placeholder information for the following variables:
$ipaddr = '<Nano Server IP address>'
$credential = Get-Credential # <An Administrator account on the system>
$zipfile = 'PowerShell-7.3.5-win-x64.zip'
# Connect to the built-in instance of Windows PowerShell
$session = New-PSSession -ComputerName $ipaddr -Credential $credential
# Copy the file to the Nano Server instance
Copy-Item $zipfile c:\ -ToSession $session
# Enter the interactive remote session
Enter-PSSession $session
# Extract the ZIP file
Expand-Archive -Path C:\PowerShell-7.3.5-win-x64.zip -DestinationPath
'C:\Program Files\PowerShell 7'
```

If you want WSMan-based remoting, follow the instructions to create a remoting endpoint using the "another instance technique".

PowerShell remoting

PowerShell supports the PowerShell Remoting Protocol (PSRP) over both WSMan and SSH. For more information, see:

- SSH Remoting in PowerShell
- WSMan Remoting in PowerShell

The following prerequisites must be met to enable PowerShell remoting over WSMan on older versions of Windows.

- Install the Windows Management Framework (WMF) 5.1 (as necessary). For more information about WMF, see WMF Overview.
- Install the Universal C Runtime on Windows versions predating Windows 10. It's available via direct download or Windows Update. Fully patched systems already have this package installed.

Supported versions of Windows

The following table is a list of PowerShell releases and the versions of Windows they're supported on. These versions are supported until either the version of PowerShell reaches end-of-support or the version of Windows reaches end-of-support.

- The ✅ icon indicates that the version of the OS or PowerShell is still supported
- The 🟡 icon indicates the version of PowerShell is no longer supported on that version of the OS
- The 🚧 icon indicates that we haven't finished testing PowerShell on that OS
- The ❌ icon indicates that the version of the OS or PowerShell isn't supported
- When both the version of the OS and the version of PowerShell have a ✅ icon, that combination is supported

Windows	7.2 (LTS-current)	7.3	7.4 (preview)
✅ Windows Server 2016, 2019, or 2022	✅	✅	✅
✅ Windows Server 2012 R2	✅	✅	✅
✅ Windows Server Core (2012 R2 or higher)	✅	✅	✅
✅ Windows Server Nano (1809 or higher)	✅	✅	✅
✅ Windows 11	✅	✅	✅
✅ Windows 10 1607+	✅	✅	✅

> **Note**
>
> Support for a specific version of Windows is determined by the Microsoft Support Lifecycle policies. For more information, see:

- Windows client lifecycle FAQ
- Modern Lifecycle Policy FAQ

PowerShell is supported on Windows for the following processor architectures.

Windows	7.2 (LTS-current)	7.3	7.4 (preview)
Nano Server Version 1803+	x64	x64	x64
Windows Server 2012 R2+	x64, x86	x64, x86	x64, x86
Windows Server Core 2012 R2+	x64, x86	x64, x86	x64, x86
Windows 10 or 11 Client	x64, x86, Arm64	x64, x86, Arm64	x64, x86, Arm64

You can check the version that you are using by running `winver.exe`.

Installation support

Microsoft supports the installation methods in this document. There may be other third-party methods of installation available from other sources. While those tools and methods may work, Microsoft can't support those methods.

Install PowerShell on Linux

Article • 01/10/2023

PowerShell can be installed on different Linux distributions. Most Linux platforms and distributions have a major release each year, and provide a package manager that's used to install PowerShell. This article lists the currently supported Linux distributions and package managers.

The rest of this article is a breakdown of each Linux distribution that PowerShell supports. All PowerShell releases remain supported until either the version of PowerShell reaches end-of-support or the Linux distribution reaches end-of-life.

For the best compatibility, choose a long-term release (LTS) version.

Alpine

The following table lists the supported PowerShell releases and the versions of Alpine they're supported on. These versions are supported until either the version of PowerShell reaches end-of-support or the version of Alpine reaches end-of-life.

- The ✅ icon indicates that the version of the OS or PowerShell is still supported
- The 🟡 icon indicates the version of PowerShell is no longer supported on that version of the OS
- The 🚧 icon indicates that we haven't finished testing PowerShell on that OS
- The ❌ icon indicates that the version of the OS or PowerShell isn't supported
- When both the version of the OS and the version of PowerShell have a ✅ icon, that combination is supported

Alpine	7.2 (LTS-current)	7.3	7.4 (preview)
✅ 3.15	🚧	🚧	🚧
✅ 3.14	✅	✅	✅

Alpine 3.15 is in the process of being tested.

PowerShell is supported on Alpine for the following processor architectures.

Alpine	7.2 (LTS-current)	7.3	7.4 (preview)
All supported versions	x64	x64	x64

PowerShell hasn't been tested on Alpine using Arm processors.

For more information, see Install PowerShell on Alpine.

Debian

Debian uses APT (Advanced Package Tool) as a package manager.

The following table is a list of currently supported PowerShell releases and the versions of Debian they're supported on. These versions remain supported until either the version of PowerShell reaches end-of-support or the version of Debian reaches end-of-life.

- The ✅ icon indicates that the version of the OS or PowerShell is still supported
- The 🟡 icon indicates the version of PowerShell is no longer supported on that version of the OS
- The 🚧 icon indicates that we haven't finished testing PowerShell on that OS
- The ❌ icon indicates that the version of the OS or PowerShell isn't supported
- When both the version of the OS and the version of PowerShell have a ✅ icon, that combination is supported

Debian	7.2 (LTS-current)	7.3	7.4 (preview)
✅ 11	✅	✅	✅
✅ 10	✅	✅	✅

PowerShell is supported on Debian for the following processor architectures.

Debian	7.2 (LTS-current)	7.3	7.4 (preview)
Version 9+	x64	x64	x64

For more information, see Install PowerShell on Debian.

Red Hat Enterprise Linux (RHEL)

RHEL 7 uses yum and RHEL 8 uses the dnf package manager.

The following table is a list of currently supported versions of PowerShell and the versions of RHEL they're supported on. These versions remain supported until either the version of PowerShell reaches end-of-support or the version of RHEL reaches end-of-support.

- The ✅ icon indicates that the version of the OS or PowerShell is still supported

- The 🟡 icon indicates the version of PowerShell is no longer supported on that version of the OS
- The 🚧 icon indicates that we haven't finished testing PowerShell on that OS
- The ❌ icon indicates that the version of the OS or PowerShell isn't supported
- When both the version of the OS and the version of PowerShell have a ✅ icon, that combination is supported

RHEL	7.2 (LTS-current)	7.3	7.4 (preview)
✅ 9	✅	✅	✅
✅ 8	✅	✅	✅
✅ 7	✅	✅	❌

PowerShell is supported on RHEL for the following processor architectures.

RHEL	7.2 (LTS-current)	7.3	7.4 (preview)
All supported versions	x64	x64	x64

For more information, see Install PowerShell on RHEL.

Ubuntu

Ubuntu uses APT (Advanced Package Tool) as a package manager.

The following table is a list of currently supported PowerShell releases and the versions of Ubuntu they're supported on. These versions remain supported until either the version of PowerShell reaches end-of-support or the version of Ubuntu reaches end-of-support.

- The ✅ icon indicates that the version of the OS or PowerShell is still supported
- The 🟡 icon indicates the version of PowerShell is no longer supported on that version of the OS
- The 🚧 icon indicates that we haven't finished testing PowerShell on that OS
- The ❌ icon indicates that the version of the OS or PowerShell isn't supported
- When both the version of the OS and the version of PowerShell have a ✅ icon, that combination is supported

Ubuntu	7.2 (LTS-current)	7.3	7.4 (preview)
✅ 22.04 (LTS)	✅	✅	✅

Ubuntu	7.2 (LTS-current)	7.3	7.4 (preview)
✅ 20.04 (LTS)	✅	✅	✅
✅ 18.04 (LTS)	✅	✅	✅

Only the LTS releases of Ubuntu are officially supported. Microsoft does not support interim releases or their equivalent. Interim releases are community supported. For more information, see Community supported distributions.

PowerShell is supported on Ubuntu for the following processor architectures.

Ubuntu	7.2 (LTS-current)	7.3	7.4 (preview)
All supported versions	x64, Arm32	x64, Arm32	x64, Arm32

For more information, see Install PowerShell on Ubuntu.

Raspberry Pi OS

Raspberry Pi OS (formerly Raspbian) is a free operating system based on Debian.

> **Important**
>
> .NET isn't supported on ARMv6 architecture devices, including Raspberry Pi Zero and Raspberry Pi devices prior to Raspberry Pi 2.

For more information, see Install PowerShell on Raspberry Pi OS.

Community supported distributions

There are many distributions of Linux that aren't officially supported by Microsoft. In some cases, PowerShell may be supported by the community for these releases. For more information, see Community support for PowerShell on Linux.

CentOS and Fedora distributions are no longer supported. The versions of these operating systems that were supported have reached their end-of-life dates. We aren't supporting any newer versions.

Alternate installation methods

There are three other ways to install PowerShell on Linux, including Linux distributions that aren't officially supported. You can try to install PowerShell using the PowerShell Snap Package. You can also try deploying PowerShell binaries directly using the Linux `tar.gz`. For more information, see Alternate ways to install PowerShell on Linux.

Installing PowerShell on Alpine Linux

Article • 06/28/2023

All packages are available on our GitHub releases page. After the package is installed, run `pwsh` from a terminal. Run `pwsh-preview` if you installed a preview release. Before installing, check the list of Supported versions below.

> **Note**
>
> PowerShell 7.3 is an in-place upgrade that removes previous versions of PowerShell.
>
> If you need to run PowerShell 7.3 side-by-side with a previous version, reinstall the previous version using the **binary archive** method.

Installation steps

Installation on Alpine is based on downloading tar.gz package from the releases page. The URL to the package depends on the version of PowerShell you want to install.

- PowerShell 7.3.5 - `https://github.com/PowerShell/PowerShell/releases/download/v7.3.5/powershell-7.3.5-linux-alpine-x64.tar.gz`
- PowerShell 7.2.12 - `https://github.com/PowerShell/PowerShell/releases/download/v7.2.12/powershell-7.2.12-linux-alpine-x64.tar.gz`

Then, in the terminal, execute the following shell commands to install PowerShell 7.3:

sh

```
# install the requirements
sudo apk add --no-cache \
    ca-certificates \
    less \
    ncurses-terminfo-base \
    krb5-libs \
    libgcc \
    libintl \
    libssl1.1 \
    libstdc++ \
    tzdata \
    userspace-rcu \
    zlib \
```

```
    icu-libs \
    curl

sudo apk -X https://dl-cdn.alpinelinux.org/alpine/edge/main add --no-cache \
    lttng-ust

# Download the powershell '.tar.gz' archive
curl -L
https://github.com/PowerShell/PowerShell/releases/download/v7.3.5/powershell
-7.3.5-linux-alpine-x64.tar.gz -o /tmp/powershell.tar.gz

# Create the target folder where powershell will be placed
sudo mkdir -p /opt/microsoft/powershell/7

# Expand powershell to the target folder
sudo tar zxf /tmp/powershell.tar.gz -C /opt/microsoft/powershell/7

# Set execute permissions
sudo chmod +x /opt/microsoft/powershell/7/pwsh

# Create the symbolic link that points to pwsh
sudo ln -s /opt/microsoft/powershell/7/pwsh /usr/bin/pwsh

# Start PowerShell
pwsh
```

Uninstall PowerShell from Alpine

sh

```
sudo rm -rf /usr/bin/pwsh /opt/microsoft/powershell
```

PowerShell paths

- `$PSHOME` is `/opt/microsoft/powershell/7/`
- User profiles are read from `~/.config/powershell/profile.ps1`
- Default profiles are read from `$PSHOME/profile.ps1`
- User modules are read from `~/.local/share/powershell/Modules`
- Shared modules are read from `/usr/local/share/powershell/Modules`
- Default modules are read from `$PSHOME/Modules`
- PSReadLine history is recorded to `~/.local/share/powershell/PSReadLine/ConsoleHost_history.txt`

The profiles respect PowerShell's per-host configuration, so the default host-specific profiles exists at `Microsoft.PowerShell_profile.ps1` in the same locations.

PowerShell respects the XDG Base Directory Specification on Linux.

Supported versions

The following table lists the supported PowerShell releases and the versions of Alpine they're supported on. These versions are supported until either the version of PowerShell reaches end-of-support or the version of Alpine reaches end-of-life.

- The ✅ icon indicates that the version of the OS or PowerShell is still supported
- The 🟡 icon indicates the version of PowerShell is no longer supported on that version of the OS
- The 🚧 icon indicates that we haven't finished testing PowerShell on that OS
- The ❌ icon indicates that the version of the OS or PowerShell isn't supported
- When both the version of the OS and the version of PowerShell have a ✅ icon, that combination is supported

Alpine	7.2 (LTS-current)	7.3	7.4 (preview)
✅ 3.15	🚧	🚧	🚧
✅ 3.14	✅	✅	✅

Alpine 3.15 is in the process of being tested.

PowerShell is supported on Alpine for the following processor architectures.

Alpine	7.2 (LTS-current)	7.3	7.4 (preview)
All supported versions	x64	x64	x64

PowerShell hasn't been tested on Alpine using Arm processors.

Installation support

Microsoft supports the installation methods in this document. There may be other methods of installation available from other third-party sources. While those tools and methods may work, Microsoft can't support those methods.

Installing PowerShell on Debian Linux

Article • 07/14/2023

All packages are available on our GitHub releases page. After the package is installed, run `pwsh` from a terminal. Run `pwsh-preview` if you installed a preview release. Before installing, check the list of Supported versions below.

> **Note**
>
> PowerShell 7.3 is an in-place upgrade that removes previous versions of PowerShell.
>
> If you need to run PowerShell 7.3 side-by-side with a previous version, reinstall the previous version using the **binary archive** method.

Debian uses APT (Advanced Package Tool) as a package manager.

Installation via direct download

PowerShell 7.2 introduced a universal package that makes installation easier. Download the universal package from the releases page onto the Debian 10 machine. The link to the current version is:

- PowerShell 7.3.6 - `https://github.com/PowerShell/PowerShell/releases/download/v7.3.6/powershell_7.3.6-1.deb_amd64.deb`
- PowerShell 7.2.13 - `https://github.com/PowerShell/PowerShell/releases/download/v7.2.13/powershell-lts_7.2.13-1.deb_amd64.deb`

Installation on Debian 11 via Package Repository

PowerShell for Linux is published to package repositories for easy installation and updates.

The preferred method is as follows:

```
sh
```

```
# Save the public repository GPG keys
curl https://packages.microsoft.com/keys/microsoft.asc | sudo gpg --yes --
dearmor --output /usr/share/keyrings/microsoft.gpg

# Register the Microsoft Product feed
sudo sh -c 'echo "deb [arch=amd64 signed-
by=/usr/share/keyrings/microsoft.gpg]
https://packages.microsoft.com/repos/microsoft-debian-bullseye-prod bullseye
main" > /etc/apt/sources.list.d/microsoft.list'

# Install PowerShell
sudo apt update && sudo apt install -y powershell

# Start PowerShell
pwsh
```

Installation on Debian 10 via Package Repository

PowerShell for Linux is published to package repositories for easy installation and updates.

The preferred method is as follows:

sh

```
# Download the Microsoft repository GPG keys
wget https://packages.microsoft.com/config/debian/10/packages-microsoft-
prod.deb

# Register the Microsoft repository GPG keys
sudo dpkg -i packages-microsoft-prod.deb

# Update the list of products
sudo apt-get update

# Install PowerShell
sudo apt-get install -y powershell

# Start PowerShell
pwsh
```

Uninstallation

sh

```
sudo apt-get remove powershell
```

PowerShell paths

- `$PSHOME` is `/opt/microsoft/powershell/7/`
- User profiles are read from `~/.config/powershell/profile.ps1`
- Default profiles are read from `$PSHOME/profile.ps1`
- User modules are read from `~/.local/share/powershell/Modules`
- Shared modules are read from `/usr/local/share/powershell/Modules`
- Default modules are read from `$PSHOME/Modules`
- PSReadLine history is recorded to `~/.local/share/powershell/PSReadLine/ConsoleHost_history.txt`

The profiles respect PowerShell's per-host configuration, so the default host-specific profiles exists at `Microsoft.PowerShell_profile.ps1` in the same locations.

PowerShell respects the XDG Base Directory Specification on Linux.

Supported versions

The following table is a list of currently supported PowerShell releases and the versions of Debian they're supported on. These versions remain supported until either the version of PowerShell reaches end-of-support or the version of Debian reaches end-of-life.

- The ✅ icon indicates that the version of the OS or PowerShell is still supported
- The 🟡 icon indicates the version of PowerShell is no longer supported on that version of the OS
- The 🚧 icon indicates that we haven't finished testing PowerShell on that OS
- The ❌ icon indicates that the version of the OS or PowerShell isn't supported
- When both the version of the OS and the version of PowerShell have a ✅ icon, that combination is supported

Debian	7.2 (LTS-current)	7.3	7.4 (preview)
✅ 11	✅	✅	✅
✅ 10	✅	✅	✅

PowerShell is supported on Debian for the following processor architectures.

Debian	7.2 (LTS-current)	7.3	7.4 (preview)
Version 9+	x64	x64	x64

Installation support

Microsoft supports the installation methods in this document. There may be other methods of installation available from other third-party sources. While those tools and methods may work, Microsoft cannot support those methods.

Installing PowerShell on Raspberry Pi OS

Article • 07/14/2023

All packages are available on our GitHub releases page. After the package is installed, run `pwsh` from a terminal. Run `pwsh-preview` if you installed a preview release.

> **Note**
>
> PowerShell 7.3 is an in-place upgrade that removes previous versions of PowerShell.
>
> If you need to run PowerShell 7.3 side-by-side with a previous version, reinstall the previous version using the **binary archive** method.

Raspberry Pi OS

Raspberry Pi OS (formerly Raspbian) is a free operating system based on Debian.

> **Important**
>
> .NET isn't supported on ARMv6 architecture devices, including Raspberry Pi Zero and Raspberry Pi devices prior to Raspberry Pi 2.

Install on Raspberry Pi OS

Download the tar.gz package from the releases page onto your Raspberry Pi computer. The links to the current versions are:

- PowerShell 7.3.6 - `https://github.com/PowerShell/PowerShell/releases/download/v7.3.6/powershell-7.3.6-linux-arm32.tar.gz`
- PowerShell 7.2.13 - `https://github.com/PowerShell/PowerShell/releases/download/v7.2.13/powershell-7.2.13-linux-arm32.tar.gz`

Use the following shell commands to download and install the package. Change the URL to match the PowerShell version that you want to install.

sh

```
###################################
# Prerequisites

# Update package lists
sudo apt-get update

# Install dependencies
sudo apt-get install libssl1.1 libunwind8 -y

###################################
# Download and extract PowerShell

# Grab the latest tar.gz
wget
https://github.com/PowerShell/PowerShell/releases/download/v7.3.6/powershell
-7.3.6-linux-arm32.tar.gz

# Make folder to put powershell
mkdir ~/powershell

# Unpack the tar.gz file
tar -xvf ./powershell-7.3.6-linux-arm32.tar.gz -C ~/powershell

# Start PowerShell
~/powershell/pwsh
```

Optionally, you can create a symbolic link to start PowerShell without specifying the path to the `pwsh` binary.

sh

```
# Start PowerShell from bash with sudo to create a symbolic link
sudo ~/powershell/pwsh -command 'New-Item -ItemType SymbolicLink -Path
"/usr/bin/pwsh" -Target "$PSHOME/pwsh" -Force'

# alternatively you can run following to create a symbolic link
# sudo ln -s ~/powershell/pwsh /usr/bin/pwsh

# Now to start PowerShell you can just run "pwsh"
```

Uninstallation - Raspberry Pi OS

sh

```
rm -rf ~/powershell
```

PowerShell paths

- `$PSHOME` is `/opt/microsoft/powershell/7/`
- User profiles are read from `~/.config/powershell/profile.ps1`
- Default profiles are read from `$PSHOME/profile.ps1`
- User modules are read from `~/.local/share/powershell/Modules`
- Shared modules are read from `/usr/local/share/powershell/Modules`
- Default modules are read from `$PSHOME/Modules`
- PSReadLine history is recorded to `~/.local/share/powershell/PSReadLine/ConsoleHost_history.txt`

The profiles respect PowerShell's per-host configuration, so the default host-specific profiles exists at `Microsoft.PowerShell_profile.ps1` in the same locations.

PowerShell respects the XDG Base Directory Specification on Linux.

Installation support

Microsoft supports the installation methods in this document. There may be other methods of installation available from other third-party sources. While those tools and methods may work, Microsoft can't support those methods.

The Raspberry Pi OS is available for Arm 64 processors. PowerShell hasn't been tested on Arm 64 for the Raspberry Pi OS.

Installing PowerShell on Red Hat Enterprise Linux (RHEL)

Article • 06/30/2023

All packages are available on our GitHub releases page. After the package is installed, run `pwsh` from a terminal. Run `pwsh-preview` if you installed a preview release. Before installing, check the list of Supported versions below.

> **Note**
>
> PowerShell 7.3 is an in-place upgrade that removes previous versions of PowerShell.
>
> If you need to run PowerShell 7.3 side-by-side with a previous version, reinstall the previous version using the **binary archive** method.

RHEL 7 uses yum and RHEL 8 uses the dnf package manager.

Installation via Package Repository

PowerShell for Linux is published to official Microsoft repositories for easy installation and updates.

On RHEL 9:

The PowerShell RPMs aren't published to the RHEL 9 repository yet. For RHEL 9, you need to install PowerShell via direct download.

On RHEL 8:

sh

```
# Register the Microsoft RedHat repository
curl https://packages.microsoft.com/config/rhel/8/prod.repo | sudo tee
/etc/yum.repos.d/microsoft.repo

# Install PowerShell
sudo dnf install --assumeyes powershell

# Start PowerShell
pwsh
```

As superuser, register the Microsoft repository once. After registration, you can update PowerShell with `sudo dnf upgrade powershell`.

On RHEL 7:

```sh
# Register the Microsoft RedHat repository
curl https://packages.microsoft.com/config/rhel/7/prod.repo | sudo tee
/etc/yum.repos.d/microsoft.repo

# Install PowerShell
sudo yum install --assumeyes powershell

# Start PowerShell
pwsh
```

As superuser, register the Microsoft repository once. After registration, you can update PowerShell with `sudo yum update powershell`.

Installation via direct download

Starting with version 7.2, PowerShell is distributed as a universal RPM package. Previous versions of PowerShell had separate package for each OS. Download the RPM package you need onto your CentOS machine.

- PowerShell 7.3.5 - `https://github.com/PowerShell/PowerShell/releases/download/v7.3.5/powershell-7.3.5-1.rh.x86_64.rpm`
- PowerShell 7.2.12- `https://github.com/PowerShell/PowerShell/releases/download/v7.2.12/powershell-lts-7.2.12-1.rh.x86_64.rpm`

Use the following shell command to install the latest RPM package on the target version of RHEL. Change the URL in the following shell commands to match the version you need.

On RHEL 9:

```sh
sudo dnf install
https://github.com/PowerShell/PowerShell/releases/download/v7.3.5/powershell
-7.3.5-1.rh.x86_64.rpm
```

On RHEL 8:

```sh
sudo dnf install
https://github.com/PowerShell/PowerShell/releases/download/v7.3.5/powershell
-7.3.5-1.rh.x86_64.rpm
```

On RHEL 7:

```sh
sudo yum install
https://github.com/PowerShell/PowerShell/releases/download/v7.3.5/powershell
-7.3.5-1.rh.x86_64.rpm
```

Uninstallation - Red Hat Enterprise Linux (RHEL) 7

```sh
sudo yum remove powershell
```

Support for Arm processors

PowerShell 7.2 and newer supports running on RHEL using a 64-bit Arm processor. Use the binary archive installation method of installing PowerShell that is described in Alternate ways to install PowerShell on Linux.

PowerShell paths

- `$PSHOME` is `/opt/microsoft/powershell/7/`
- User profiles are read from `~/.config/powershell/profile.ps1`
- Default profiles are read from `$PSHOME/profile.ps1`
- User modules are read from `~/.local/share/powershell/Modules`
- Shared modules are read from `/usr/local/share/powershell/Modules`
- Default modules are read from `$PSHOME/Modules`
- PSReadLine history is recorded to `~/.local/share/powershell/PSReadLine/ConsoleHost_history.txt`

The profiles respect PowerShell's per-host configuration, so the default host-specific profiles exists at `Microsoft.PowerShell_profile.ps1` in the same locations.

PowerShell respects the XDG Base Directory Specification on Linux.

Supported versions

The following table is a list of currently supported versions of PowerShell and the versions of RHEL they're supported on. These versions remain supported until either the version of PowerShell reaches end-of-support or the version of RHEL reaches end-of-support.

- The ✅ icon indicates that the version of the OS or PowerShell is still supported
- The 🟡 icon indicates the version of PowerShell is no longer supported on that version of the OS
- The 🚧 icon indicates that we haven't finished testing PowerShell on that OS
- The ❌ icon indicates that the version of the OS or PowerShell isn't supported
- When both the version of the OS and the version of PowerShell have a ✅ icon, that combination is supported

RHEL	7.2 (LTS-current)	7.3	7.4 (preview)
✅ 9	✅	✅	✅
✅ 8	✅	✅	✅
✅ 7	✅	✅	❌

PowerShell is supported on RHEL for the following processor architectures.

RHEL	7.2 (LTS-current)	7.3	7.4 (preview)
All supported versions	x64	x64	x64

Installation support

Microsoft supports the installation methods in this document. There may be other methods of installation available from other third-party sources. While those tools and methods may work, Microsoft cannot support those methods.

Installing PowerShell on Ubuntu

Article • 06/28/2023

All packages are available on our GitHub releases page. After the package is installed, run `pwsh` from a terminal. Run `pwsh-preview` if you installed a preview release. Before installing, check the list of Supported versions below.

> **Note**
>
> PowerShell 7.3 is an in-place upgrade that removes previous versions of PowerShell.
>
> If you need to run PowerShell 7.3 side-by-side with a previous version, reinstall the previous version using the **binary archive** method.

Ubuntu uses APT (Advanced Package Tool) as a package manager.

Installation via Package Repository

PowerShell for Linux is published to package repositories for easy installation and updates. The URL to the package varies by OS version:

- Ubuntu 22.04 - `https://packages.microsoft.com/config/ubuntu/22.04/packages-microsoft-prod.deb`
- Ubuntu 20.04 - `https://packages.microsoft.com/config/ubuntu/20.04/packages-microsoft-prod.deb`
- Ubuntu 18.04 - `https://packages.microsoft.com/config/ubuntu/18.04/packages-microsoft-prod.deb`

Use the following shell commands to install PowerShell on the target OS.

> **Note**
>
> This only works for supported versions of Ubuntu.

sh

```
# Update the list of packages
sudo apt-get update
# Install pre-requisite packages.
sudo apt-get install -y wget apt-transport-https software-properties-common
# Download the Microsoft repository GPG keys
```

```
wget -q "https://packages.microsoft.com/config/ubuntu/$(lsb_release -
rs)/packages-microsoft-prod.deb"
# Register the Microsoft repository GPG keys
sudo dpkg -i packages-microsoft-prod.deb
# Delete the the Microsoft repository GPG keys file
rm packages-microsoft-prod.deb
# Update the list of packages after we added packages.microsoft.com
sudo apt-get update
# Install PowerShell
sudo apt-get install -y powershell
# Start PowerShell
pwsh
```

As superuser, register the Microsoft repository once. After registration, you can update PowerShell with `sudo apt-get install powershell`.

Installation via Direct Download

PowerShell 7.2 introduced a universal package that makes installation easier. Download the installer package from the releases page onto the Ubuntu machine. The link to the current version is:

- PowerShell 7.3.5 (universal package) for any supported version of Ubuntu
  - `https://github.com/PowerShell/PowerShell/releases/download/v7.3.5/powershell_7.3.5-1.deb_amd64.deb`
- PowerShell 7.2.12 (universal package) for any supported version of Ubuntu
  - `https://github.com/PowerShell/PowerShell/releases/download/v7.2.12/powershell-lts_7.2.12-1.deb_amd64.deb`

Use the following shell commands to install the package. Change the filename of the package to match the version you downloaded.

sh

```
# Install the downloaded package
sudo dpkg -i powershell-lts_7.3.5-1.deb_amd64.deb

# Resolve missing dependencies and finish the install (if necessary)
sudo apt-get install -f
```

> **Note**
>
> If the `dpkg -i` command fails with unmet dependencies, the next command, `apt-get install -f` resolves these issues then finishes configuring the PowerShell

package.

Uninstallation

```sh
sudo apt-get remove powershell
```

Support for Arm processors

PowerShell 7.2 and newer supports running on Ubuntu using 32-bit Arm processors. Use the binary archive installation method of installing PowerShell that's described in Alternate ways to install PowerShell on Linux.

PowerShell paths

- `$PSHOME` is `/opt/microsoft/powershell/7/`
- User profiles are read from `~/.config/powershell/profile.ps1`
- Default profiles are read from `$PSHOME/profile.ps1`
- User modules are read from `~/.local/share/powershell/Modules`
- Shared modules are read from `/usr/local/share/powershell/Modules`
- Default modules are read from `$PSHOME/Modules`
- PSReadLine history is recorded to `~/.local/share/powershell/PSReadLine/ConsoleHost_history.txt`

The profiles respect PowerShell's per-host configuration, so the default host-specific profiles exists at `Microsoft.PowerShell_profile.ps1` in the same locations.

PowerShell respects the XDG Base Directory Specification on Linux.

Supported versions

The following table is a list of currently supported PowerShell releases and the versions of Ubuntu they're supported on. These versions remain supported until either the version of PowerShell reaches end-of-support or the version of Ubuntu reaches end-of-support.

- The ✅ icon indicates that the version of the OS or PowerShell is still supported

- The 🟡 icon indicates the version of PowerShell is no longer supported on that version of the OS
- The 🚧 icon indicates that we haven't finished testing PowerShell on that OS
- The ❌ icon indicates that the version of the OS or PowerShell isn't supported
- When both the version of the OS and the version of PowerShell have a ✅ icon, that combination is supported

Ubuntu	7.2 (LTS-current)	7.3	7.4 (preview)
✅ 22.04 (LTS)	✅	✅	✅
✅ 20.04 (LTS)	✅	✅	✅
✅ 18.04 (LTS)	✅	✅	✅

Only the LTS releases of Ubuntu are officially supported. Microsoft does not support interim releases or their equivalent. Interim releases are community supported. For more information, see Community supported distributions.

PowerShell is supported on Ubuntu for the following processor architectures.

Ubuntu	7.2 (LTS-current)	7.3	7.4 (preview)
All supported versions	x64, Arm32	x64, Arm32	x64, Arm32

Installation support

Microsoft supports the installation methods in this document. There may be other methods of installation available from other third-party sources. While those tools and methods may work, Microsoft can't support those methods.

Community support for PowerShell on Linux

Article • 06/28/2023

There are many distributions of Linux that aren't officially supported by Microsoft. In some cases, PowerShell may be supported by the community for these releases.

To be supported by Microsoft, the Linux distribution must meet the following criteria:

- The version and architecture of the distribution is supported by .NET Core.
- The version of the distribution is supported for at least one year.
- The version of the distribution isn't an interim release or equivalent.
- The PowerShell team has tested the version of the distribution.

For more information, see the PowerShell Support Lifecycle documentation.

The following distributions are supported by the community. Each distribution has its own community support mechanisms. Consult the distribution's website to find their community resources. You may also get help from these PowerShell Community resources.

Ubuntu interim releases

The documented steps to install PowerShell on Ubuntu may work on Ubuntu interim releases. However, PowerShell is only supported on the LTS releases of Ubuntu. Microsoft doesn't support interim releases of Ubuntu.

Arch Linux

> **Note**
>
> Arch support isn't officially supported by Microsoft and is maintained by the community.

PowerShell is available from the Arch Linux User Repository (AUR).

- It can be compiled with the latest tagged release
- It can be compiled from the latest commit to master
- It can be installed using the latest release binary

Packages in the AUR are maintained by the community. For more information on installing packages from the AUR, see the Arch Linux wiki or Using PowerShell in Docker.

Kali

Kali support isn't officially supported by Microsoft and is maintained by the community.

Installation - Kali

sh

```sh
# Install PowerShell package
apt update && apt -y install powershell

# Start PowerShell
pwsh
```

Uninstallation - Kali

sh

```sh
# Uninstall PowerShell package
apt -y remove powershell
```

Alternate ways to install PowerShell on Linux

Article • 06/28/2023

All packages are available on our GitHub releases page. After the package is installed, run `pwsh` from a terminal. Run `pwsh-preview` if you installed a preview release.

There are three other ways to install PowerShell on a Linux distribution:

- Install using a Snap Package
- Install using the binary archives
- Install as a .NET Global tool

Snap Package

Snaps are application packages that are easy to install, secure, cross-platform and dependency-free. Snaps are discoverable and installable from the Snap Store. Snap packages are supported the same as the distribution you're running the package on.

> **Important**
>
> The Snap Store contains PowerShell snap packages for many Linux distributions that are not officially supported by Microsoft. For support, see the list of available **Community Support** options.

Getting snapd

`snapd` is required to run snaps. Use these instructions to make sure you have `snapd` installed.

Installation via Snap

PowerShell for Linux is published to the Snap store for easy installation and updates.

The preferred method is as follows:

```sh
# Install PowerShell
sudo snap install powershell --classic
```

```
# Start PowerShell
pwsh
```

To install the latest LTS version, use the following method:

```sh
# Install PowerShell
sudo snap install powershell --channel=lts/stable --classic

# Start PowerShell
pwsh
```

To install a preview version, use the following method:

```sh
# Install PowerShell
sudo snap install powershell-preview --classic

# Start PowerShell
pwsh-preview
```

After installation, Snap will automatically upgrade. You can trigger an upgrade using `sudo snap refresh powershell` or `sudo snap refresh powershell-preview`.

Uninstallation

```sh
sudo snap remove powershell
```

or

```sh
sudo snap remove powershell-preview
```

Binary Archives

PowerShell binary `tar.gz` archives are provided for Linux platforms to enable advanced deployment scenarios.

> **Note**
>
> You can use this method to install any version of PowerShell including the latest:
>
> - Stable release: **https://aka.ms/powershell-release?tag=stable**
> - LTS release: **https://aka.ms/powershell-release?tag=lts**
> - Preview release: **https://aka.ms/powershell-release?tag=preview**

Dependencies

PowerShell builds portable binaries for all Linux distributions. But, .NET Core runtime requires different dependencies on different distributions, and PowerShell does too.

It's possible that when you install PowerShell, specific dependencies may not be installed, such as when manually installing from the binary archives. The following list details Linux distributions that are supported by Microsoft and have dependencies you may need to install. Check the distribution page for more information:

- Alpine
- Debian
- RHEL
- SLES
- Ubuntu

To deploy PowerShell binaries on Linux distributions that aren't officially supported, you need to install the necessary dependencies for the target OS in separate steps. For example, our Amazon Linux dockerfile installs dependencies first, and then extracts the Linux `tar.gz` archive.

Installation using a binary archive file

> **Important**
>
> This method can be used to install PowerShell on any version of Linux, including distributions that are not officially supported by Microsoft. Be sure to install any necessary dependencies. For support, see the list of available **Community Support** options.

The following example shows the steps for installing the x64 binary archive. You must choose the correct binary archive that matches the processor type for your platform.

- `powershell-7.3.5-linux-arm32.tar.gz`
- `powershell-7.3.5-linux-arm64.tar.gz`
- `powershell-7.3.5-linux-x64.tar.gz`

Use the following shell commands to download and install PowerShell from the `tar.gz` binary archive. Change the URL to match the version of PowerShell you want to install.

```sh
# Download the powershell '.tar.gz' archive
curl -L -o /tmp/powershell.tar.gz
https://github.com/PowerShell/PowerShell/releases/download/v7.3.5/powershell
-7.3.5-linux-x64.tar.gz

# Create the target folder where powershell will be placed
sudo mkdir -p /opt/microsoft/powershell/7

# Expand powershell to the target folder
sudo tar zxf /tmp/powershell.tar.gz -C /opt/microsoft/powershell/7

# Set execute permissions
sudo chmod +x /opt/microsoft/powershell/7/pwsh

# Create the symbolic link that points to pwsh
sudo ln -s /opt/microsoft/powershell/7/pwsh /usr/bin/pwsh
```

Uninstalling binary archives

```sh
sudo rm -rf /usr/bin/pwsh /opt/microsoft/powershell
```

Install as a .NET Global tool

If you already have the .NET Core SDK installed, it's easy to install PowerShell as a .NET Global tool.

```sh
dotnet tool install --global PowerShell
```

The dotnet tool installer adds `~/.dotnet/tools` to your `PATH` environment variable. However, the currently running shell does not have the updated `PATH`. You should be able to start PowerShell from a new shell by typing `pwsh`.

Installing PowerShell on macOS

Article • 06/28/2023

PowerShell 7.0 or higher require macOS 10.13 and higher. All packages are available on our GitHub releases page. After the package is installed, run `pwsh` from a terminal. Before installing, check the list of Supported versions below.

> **Note**
>
> PowerShell 7.3 is an in-place upgrade that removes previous versions of PowerShell.
>
> If you need to run an older version of PowerShell side-by-side with PowerShell 7.3, install the version you want using the **binary archive** method.

Installation of latest stable release via Homebrew on macOS 10.13 or higher

There are several ways to install PowerShell on macOS. Choose one of the following methods:

- Install using Homebrew. Homebrew is the preferred package manager for macOS.
- Install PowerShell via Direct Download
- Install from binary archives.

If the `brew` command isn't found, you need to install Homebrew following their instructions.

Bash

```
/bin/bash -c "$(curl -fsSL
https://raw.githubusercontent.com/Homebrew/install/HEAD/install.sh)"
```

Now, you can install PowerShell:

sh

```
brew install --cask powershell
```

Finally, verify that your install is working properly:

```sh
pwsh
```

When new versions of PowerShell are released, update Homebrew's formulae and upgrade PowerShell:

```sh
brew update
brew upgrade powershell --cask
```

> **Note**
>
> The commands above can be called from within a PowerShell (pwsh) host, but then the PowerShell shell must be exited and restarted to complete the upgrade and refresh the values shown in `$PSVersionTable`.

Installation of latest preview release via Homebrew on macOS 10.13 or higher

After you've installed Homebrew, you can install PowerShell. First, install the Cask-Versions package that lets you install alternative versions of cask packages:

```sh
brew tap homebrew/cask-versions
```

Now, you can install PowerShell:

```sh
brew install --cask powershell-preview
```

Finally, verify that your install is working properly:

```sh
pwsh-preview
```

When new versions of PowerShell are released, update Homebrew's formulae and upgrade PowerShell:

```sh
brew update
brew upgrade powershell-preview --cask
```

> **Note**
>
> The commands above can be called from within a PowerShell (pwsh) host, but then the PowerShell shell must be exited and restarted to complete the upgrade. and refresh the values shown in `$PSVersionTable`.

Installing PowerShell using the Homebrew tap method is also supported for stable and LTS versions.

```sh
brew install powershell/tap/powershell
```

You can now verify your install

```sh
pwsh
```

When new versions of PowerShell are released, run the following command.

```sh
brew upgrade powershell
```

> **Note**
>
> Whether you use the cask or the tap method, when updating to a newer version of PowerShell, use the same method you used to initially install PowerShell. If you use a different method, opening a new pwsh session will continue to use the older version of PowerShell.
>
> If you do decide to use different methods, there are ways to correct the issue using the **Homebrew link method** .

Installation via Direct Download

Starting with version 7.2, PowerShell supports the Apple M1 processor. Download the install package from the releases page onto your computer. The links to the current versions are:

- PowerShell 7.3.5
  - x64 processors - powershell-7.3.5-osx-x64.pkg
  - M1 processors - powershell-7.3.5-osx-arm64.pkg
- PowerShell 7.2.12
  - x64 processors - powershell-7.2.12-osx-x64.pkg
  - M1 processors - powershell-7.2.12-osx-arm64.pkg

You can double-click the file and follow the prompts, or install it from the terminal using the following commands. Change the name of the file to match the file you downloaded.

```sh
sudo installer -pkg powershell-7.3.5-osx-x64.pkg -target /
```

If you are running on macOS Big Sur 11.5 or higher you may receive the following error message when installing the package:

> "powershell-7.3.5-osx-x64.pkg" cannot be opened because Apple cannot check it for malicious software.

There are two ways to work around this issue:

Using the Finder

1. Find the package in Finder.
2. Control-click (click while pressing the `Ctrl` key) on the package.
3. Select **Open** from the context menu.

From the command line

1. Run `sudo xattr -rd com.apple.quarantine powershell-7.3.5-osx-x64.pkg`. Include the full path to the `.pkg` file.
2. Install the package as you normally would.

> **Note**
>
> This is a known issue related to package notarization that will be addressed in the future.

Install as a .NET Global tool

If you already have the .NET Core SDK installed, it's easy to install PowerShell as a .NET Global tool.

```
dotnet tool install --global PowerShell
```

The dotnet tool installer adds `~/.dotnet/tools` to your `PATH` environment variable. However, the currently running shell doesn't have the updated `PATH`. You should be able to start PowerShell from a new shell by typing `pwsh`.

Binary Archives

PowerShell binary `tar.gz` archives are provided for the macOS platform to enable advanced deployment scenarios. When you install using this method you must also manually install any dependencies.

> **Note**
>
> You can use this method to install any version of PowerShell including the latest:
>
> - Stable release: **https://aka.ms/powershell-release?tag=stable**
> - LTS release: **https://aka.ms/powershell-release?tag=lts**
> - Preview release: **https://aka.ms/powershell-release?tag=preview**

Installing binary archives on macOS

Download the install package from the releases page onto your computer. The links to the current versions are:

- PowerShell 7.3.5
  - x64 processors - powershell-7.3.5-osx-x64.tar.gz

    - M1 processors - powershell-7.3.5-osx-arm64.tar.gz
- PowerShell 7.2.12
    - x64 processors - powershell-7.2.12-osx-x64.tar.gz
    - M1 processors - powershell-7.2.12-osx-arm64.tar.gz

Use the following commands to install PowerShell from the binary archive. Change the download URL to match the version you want to install.

```sh
# Download the powershell '.tar.gz' archive
curl -L -o /tmp/powershell.tar.gz
https://github.com/PowerShell/PowerShell/releases/download/v7.3.5/powershell
-7.3.5-osx-x64.tar.gz

# Create the target folder where powershell is placed
sudo mkdir -p /usr/local/microsoft/powershell/7.3.5

# Expand powershell to the target folder
sudo tar zxf /tmp/powershell.tar.gz -C /usr/local/microsoft/powershell/7.3.5

# Set execute permissions
sudo chmod +x /usr/local/microsoft/powershell/7.3.5/pwsh

# Create the symbolic link that points to pwsh
sudo ln -s /usr/local/microsoft/powershell/7.3.5/pwsh /usr/local/bin/pwsh
```

Uninstalling PowerShell

If you installed PowerShell with Homebrew, use the following command to uninstall:

```sh
brew uninstall --cask powershell
```

If you installed PowerShell via direct download, PowerShell must be removed manually:

```sh
sudo rm -rf /usr/local/bin/pwsh /usr/local/microsoft/powershell
```

To remove the additional PowerShell paths, refer to the paths section in this document and remove the paths using `sudo rm`.

> ⓘ **Note**

This isn't necessary if you installed with Homebrew.

Paths

- `$PSHOME` is `/usr/local/microsoft/powershell/7.3.5/`
- User profiles are read from `~/.config/powershell/profile.ps1`
- Default profiles are read from `$PSHOME/profile.ps1`
- User modules are read from `~/.local/share/powershell/Modules`
- Shared modules are read from `/usr/local/share/powershell/Modules`
- Default modules are read from `$PSHOME/Modules`
- PSReadLine history are recorded to `~/.local/share/powershell/PSReadLine/ConsoleHost_history.txt`

The profiles respect PowerShell's per-host configuration. So the default host-specific profile exists at `Microsoft.PowerShell_profile.ps1` in the same locations.

PowerShell respects the XDG Base Directory Specification on macOS.

Because macOS is a derivation of BSD, the prefix `/usr/local` is used instead of `/opt`. So, `$PSHOME` is `/usr/local/microsoft/powershell/7.3.5/`, and the symbolic link is placed at `/usr/local/bin/pwsh`.

Supported versions

The following table contains a list of PowerShell releases and the status of support for versions of macOS. These versions remain supported until either the version of PowerShell reaches end-of-support or the version of macOS reaches end-of-support.

- The ✅ icon indicates that the version of the OS or PowerShell is still supported
- The 🟡 icon indicates the version of PowerShell is no longer supported on that version of the OS
- The 🚧 icon indicates that we haven't finished testing PowerShell on that OS
- The ❌ icon indicates that the version of the OS or PowerShell isn't supported
- When both the version of the OS and the version of PowerShell have a ✅ icon, that combination is supported

macOS	7.2 (LTS-current)	7.3	7.4 (preview)
✅ Big Sur 11.5	✅	✅	✅

macOS 12 (Monterey) and macOS 13 (Ventura) have not been tested.

Support of macOS is defined by Apple. For more information, see:

- macOS release notes
- Apple Security Updates

PowerShell is supported on macOS for the following processor architectures:

macOS	7.2 (LTS-current)	7.3	7.4 (preview)
macOS Big Sur 11.5	x64, Arm64	x64, Arm64	x64, Arm64

Installation support

Microsoft supports the installation methods in this document. There may be other methods of installation available from other sources. While those tools and methods may work, Microsoft can't support those methods.

Additional Resources

- Homebrew Web
- Homebrew GitHub Repository
- Homebrew-Cask

PowerShell on Arm processors

Article • 01/10/2023

Support for the Arm processor is based on the support policy of the version of .NET that PowerShell uses. While .NET supports many more operating systems and versions, PowerShell support is limited to the versions that have been tested.

It may be possible to use Arm-based versions of PowerShell on other Linux distributions and versions, but we don't officially support it.

PowerShell 7.3

PowerShell 7.3 is based on the .NET 7.0 Supported OS Lifecycle Policy and supports the following platforms:

OS	Architectures	Lifecycle
Windows 11 Client Version 22000+	Arm64	Windows
Windows 10 Client Version 1607+	Arm64	Windows
macOS 10.15+	Arm64	macOS
Raspberry Pi OS (Debian 10)	Arm32	Raspberry Pi OS and Debian
Ubuntu 22.04, 20.04, 18.04	Arm32	Ubuntu

PowerShell 7.2

PowerShell 7.2 is based on the .NET 6.0 Supported OS Lifecycle Policy and supports the following platforms:

OS	Architectures	Lifecycle
Windows 11 Client Version 22000+	Arm64	Windows
Windows 10 Client Version 1607+	Arm64	Windows
macOS 10.14+	Arm64	macOS
Raspberry Pi OS (Debian 10)	Arm32	Raspberry Pi OS and Debian
Ubuntu 22.04, 20.04, 18.04	Arm32	Ubuntu

Installing PowerShell on Arm-based systems

For installation instructions, see the following articles:

Windows

- Windows 10 on Arm
- Windows 10 IoT Enterprise
- Windows 10 IoT Core

Linux - install from the binary archives

- Alternate ways to install PowerShell on Linux

macOS

- Installing PowerShell on macOS

Raspbery Pi

- Raspberry Pi OS

Using PowerShell in Docker

Article • 06/28/2023

We publish Docker images with PowerShell preinstalled. This article shows you how to get started using PowerShell in the Docker container.

Finding available images

The released images require Docker 17.05 or newer. It's also expected that you are able to run Docker without `sudo` or local administrative rights. Please follow Docker's official instructions to install `docker` correctly.

The release containers derive from the official distribution image, then install dependencies, and finally install the PowerShell package.

These containers live at hub.docker.com/r/microsoft/powershell.

For more information about these Docker images, visit the PowerShell-Docker repository on GitHub.

Using PowerShell in a container

The following steps show the Docker commands required to download the image and start an interactive PowerShell session.

Console

```
docker run -it mcr.microsoft.com/powershell
```

Remove the image when no longer needed

The following command is used to delete the Docker image when you no longer need it.

Console

```
docker rmi mcr.microsoft.com/powershell
```

Legal and Licensing

PowerShell is licensed under the MIT license.

Windows Docker File and Image Licenses

By requesting and using the Container OS Image for Windows containers, you acknowledge, understand, and consent to the Supplemental License Terms available on Docker hub:

- Window Server Core
- Nano Server

Telemetry

By default, PowerShell collects limited telemetry without personally identifiable information to help aid development of future versions of PowerShell. To opt-out of sending telemetry, create an environment variable called `POWERSHELL_TELEMETRY_OPTOUT` set to a value of `1` before starting PowerShell from the installed location. The telemetry we collect falls under the Microsoft Privacy Statement.

Microsoft Update for PowerShell FAQ

FAQ

Beginning with PowerShell 7.2, when you install using the MSI package you have the option of enabling Microsoft Update support for PowerShell.

General Information

What is the Microsoft Update feature in PowerShell?

The Microsoft Update feature of PowerShell allows you to get the latest PowerShell 7 updates in your traditional Microsoft Update (MU) management flow, whether that's with Windows Update for Business, WSUS, Microsoft Endpoint Configuration Manager, or the interactive MU dialog in Settings. Microsoft Update and the related services enable you to deploy updates:

- On your schedule
- After testing for your environment
- At scale across your enterprise

How soon after release are updates advertised by Microsoft Update?

When a new version of PowerShell is released, it can take up to two weeks for that version to become available through Microsoft Update. Updates are delivered as optional software updates, even if the update contains a security fix.

If you need to deploy the update before it becomes available in Microsoft Update, download the update from the Releases page on GitHub.

I am on PowerShell 7.2, why have I not been upgraded to 7.3?

The Microsoft Update feature for PowerShell only updates versions in the same release channel. PowerShell 7.2 is the latest long term supported (LTS) version. PowerShell 7.3 is

the latest stable (non-LTS) version. Microsoft Update automatically updates you to the next patch level versions for both 7.2 and 7.3. For example, 7.2.x to 7.2.y and 7.3.x to 7.3.y. For more information about support lifecycles, see PowerShell Support Lifecycle.

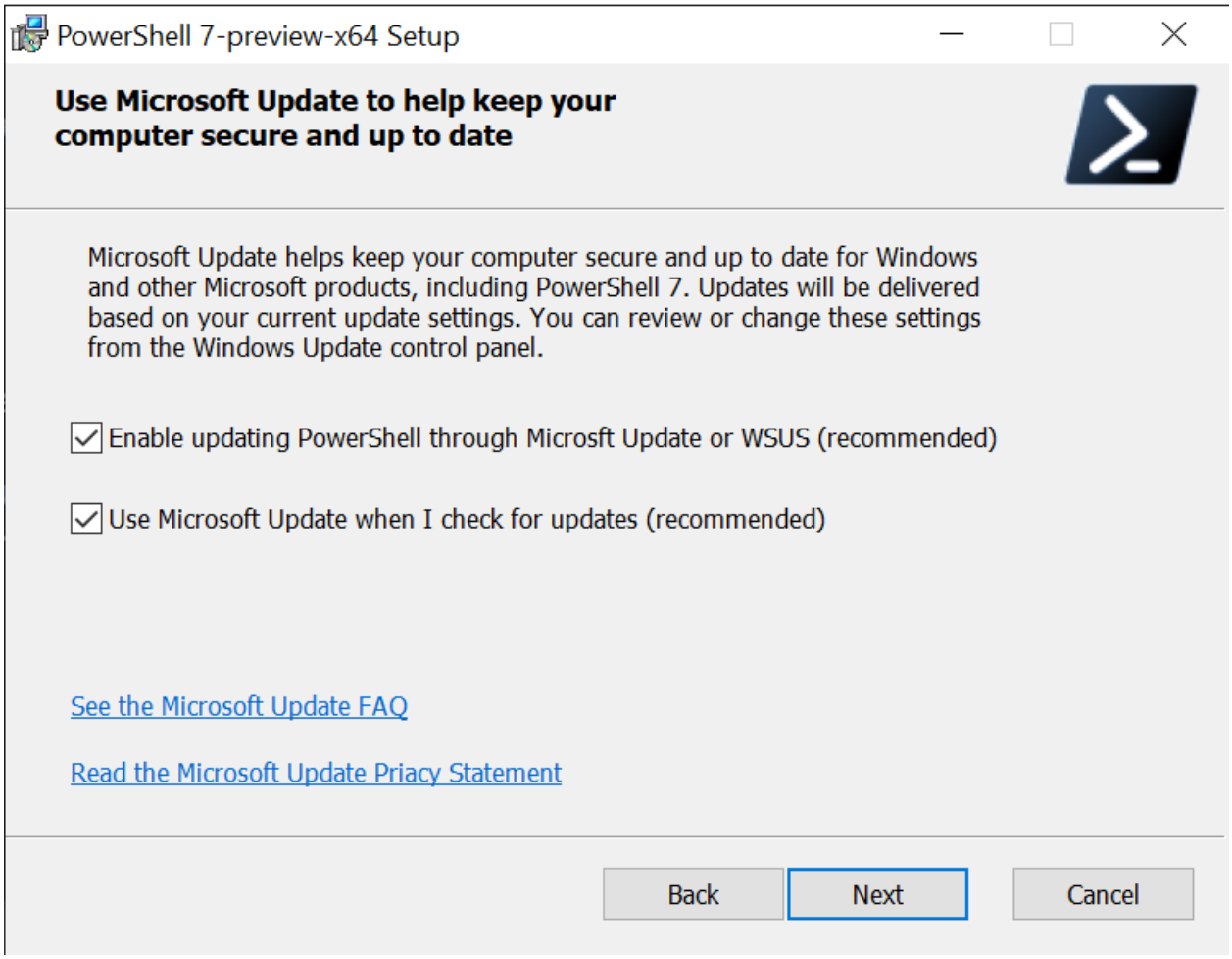
Configuration

What version of Windows is required to support the Microsoft Update feature?

You must have Windows Version 1709 or newer installed on an x64-based system. Version 1709 is the Windows 10 Fall Creators Update or the October update of Windows Server 2016. Versions prior to 1709 do not support Microsoft Update for PowerShell.

Do I need to check both boxes in the setup dialog?

While the two options on the dialog are independent, in most cases, it's best to check both boxes.



What does each checkbox do?

The first checkbox enables updates for PowerShell. These updates can be delivered by Microsoft Update, a WSUS server, or SCCM. If this checkbox is unchecked, you cannot receive updates through any of these channels.

The second checkbox enables Microsoft Update on your system. This allows you to receive updates for any supported Microsoft software, not just Windows. If the box is unchecked, you will not receive the update from Microsoft Update, but you can receive updates from WSUS or SCCM.

What if I want to opt-out later?

If you want to opt-out of updates later, you can run the MSI install package and uncheck the first checkbox. Unchecking the second checkbox has no effect.

Can I enable these update options from the command line or in a script?

Yes. The MSI package includes two new MSI options for enabling the update features:

- `USE_MU` - This property has two possible values:
- `1` (default) - Opts into updating through Microsoft Update, WSUS, or SCCM
- `0` - Do not opt into updating through Microsoft Update, WSUS, or SCCM
- `ENABLE_MU`
  - `1` (default) - Opts into using Microsoft Update for Automatic Updates
  - `0` - Do not opt into using Microsoft Update

> ⓘ **Note**
>
> Setting `ENABLE_MU=0` does not disable Microsoft Update.

Troubleshooting

I haven't received an update for the new release. Why not?

There can be several reasons for not receiving the update:

- We may not have published the update yet. Our goal is to make the update available to Microsoft Update within two weeks of release, but there is no guarantee for that availability.
- There are group policy settings that control Microsoft Update. Your system administrator may have policies set that prevent you from using Microsoft Update. The checkbox in the installer cannot override the Group Policy.
- Make sure you have checked both checkboxes. When doing a repair installation, the installer doesn't show the check box options. To enable MU updates run the following command:

  PowerShell

  ```
  msiexec.exe /fmu .\PowerShell-7.3.6-win-x64.msi USE_MU=1 ENABLE_MU=1
  ```

  For more information about running `msiexec.exe` from the command line, see msiexec.

Introduction

Article • 12/09/2022

This content originally appeared in the book *PowerShell 101* by Mike F Robbins. We thank Mike for granting us permission to reuse his content here. The content has been edited from the original publication. You can still get the original book from Leanpub at PowerShell 101.

Who is this book for?

This is an entry-level book for anyone wanting to learn PowerShell.

This book focuses on PowerShell version 5.1 running on Windows 10 and Windows Server 2016 in a Microsoft Active Directory domain environment. However, the basic concepts apply to all versions of PowerShell running on any supported platform.

About this book

This book is a collection of what I wish someone would have told me when I started learning PowerShell, along with the tips, tricks, and best practices that I've learned while using PowerShell during the past 10 years.

Instead of providing an enormous amount of information, this book attempts to provide a balance of enough information to be successful for someone who is just getting started with PowerShell. Each chapter contains links to specific help topics for those who want more information about the topics covered in that chapter.

About the author

Mike F Robbins is a former Microsoft MVP, co-author of *Windows PowerShell TFM 4th Edition*, and a contributing author in the *PowerShell Deep Dives* book. Mike has been a strong supporter of the PowerShell community and is now the lead writer for Azure PowerShell at Microsoft. He blogs at mikefrobbins.com and can be found on twitter @mikefrobbins.

Lab environment

The examples in this book were designed and tested on Windows 10 Anniversary Edition (build 1607) and Windows Server 2016 using PowerShell version 5.1. If you're using a

different version of PowerShell or operating system, your results may differ from those shown here.

Chapter 1 - Getting Started with PowerShell

Article • 11/17/2022

I often find that presenters at conferences and user group meetings already have PowerShell running when they start entry-level presentations. This book begins by answering the questions I've heard attendees who haven't previously used PowerShell ask in those sessions.

Specifically, this chapter focuses on finding and launching PowerShell, and solving some of the initial pain points that new users experience with PowerShell. Be sure to follow along and walk through the examples shown in this chapter on your Windows 10 lab environment computer.

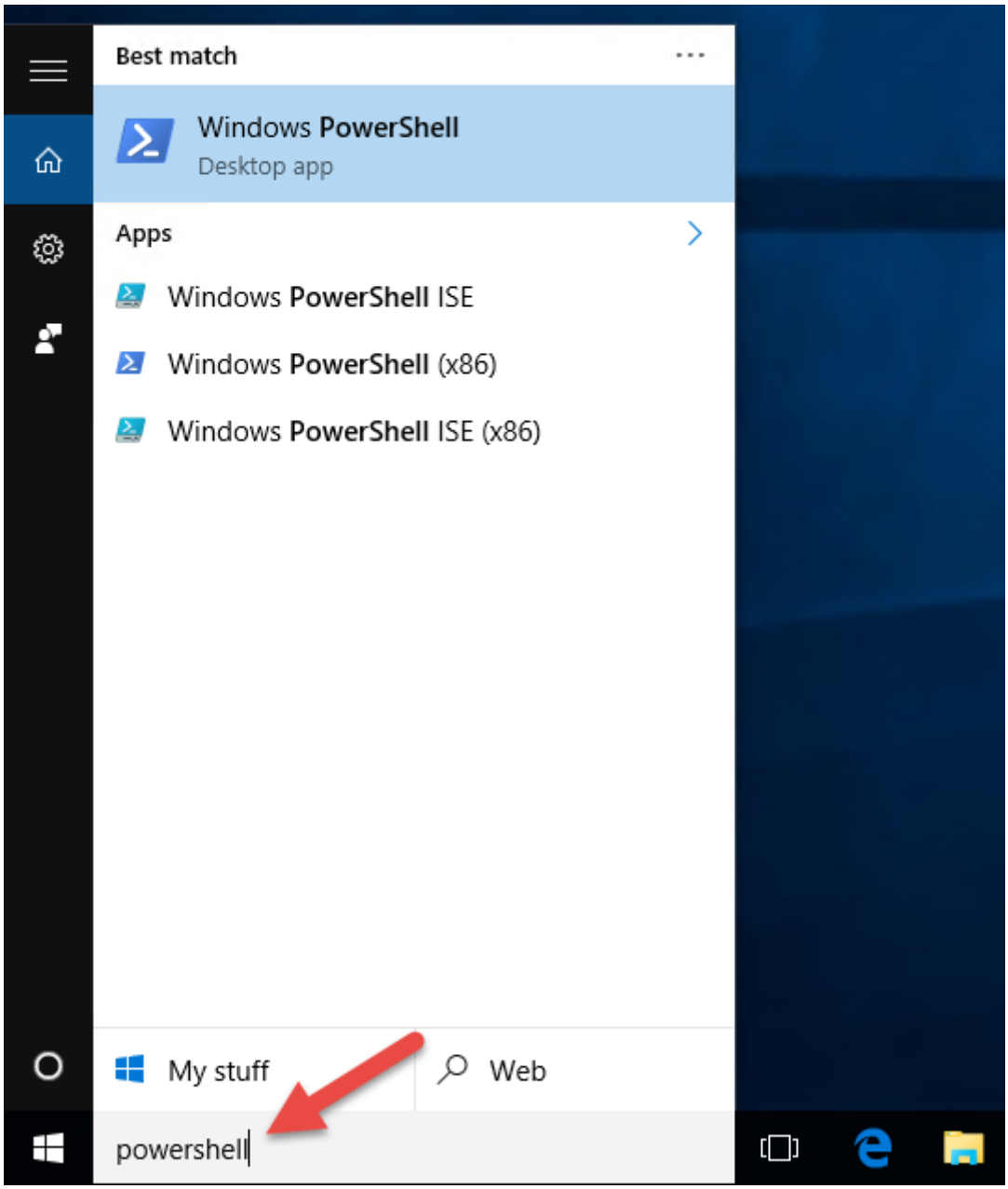
What do I need to get started with PowerShell?

All modern versions of Windows operating systems ship with PowerShell installed. If you're running a version older than 5.1, you should install the latest version.

- To upgrade to Windows PowerShell 5.1, see Upgrading existing Windows PowerShell
- To install the latest version of PowerShell, see Installing PowerShell

Where do I find PowerShell?

The easiest way to find PowerShell on Windows 10 is to type **PowerShell** into the search bar as shown in Figure 1-1.



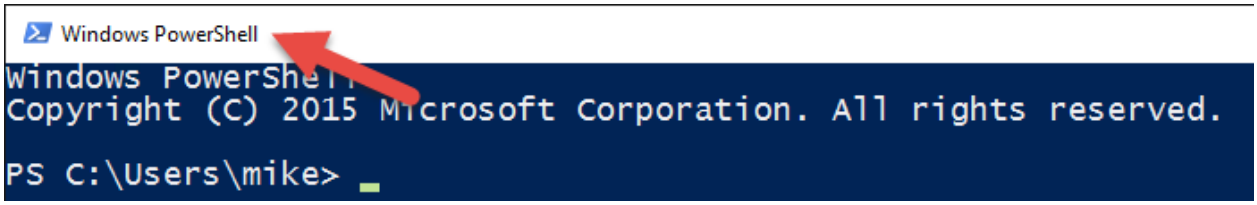
Notice that four different shortcuts for PowerShell are shown in Figure 1-1. The computer used for demonstration purposes in this book is running the 64-bit version of Windows 10 so there's a 64-bit version of the PowerShell console and the PowerShell ISE (Integrated Scripting Environment), and a 32-bit version of each one as denoted by the (x86) suffix on the shortcuts. If you happen to be running a 32-bit version of Windows 10, you'll only have two shortcuts. Those items don't have the (x86) suffix, but are 32-bit versions. If you have a 64-bit operating system, my recommendation is to run the 64-bit version of PowerShell unless you have a specific reason for running the 32-bit version.

For information about starting PowerShell on other versions of Windows, see Starting Windows PowerShell.

How do I launch PowerShell?

In the production enterprise environments that I support, I use three different Active Directory user accounts. I've mirrored those accounts in the lab environment used in this book. I log into the Windows 10 computer as a domain user who is not a domain or local administrator.

I've launched the PowerShell console by clicking on the "Windows PowerShell" shortcut as shown in Figure 1-1.



Notice that the title bar of the PowerShell console says "Windows PowerShell" as shown in Figure 1-4. Some commands run fine, but PowerShell can't participate in User Access Control (UAC). That means it's unable to prompt for elevation for tasks that require the approval of an administrator. The following error message is generated:

PowerShell

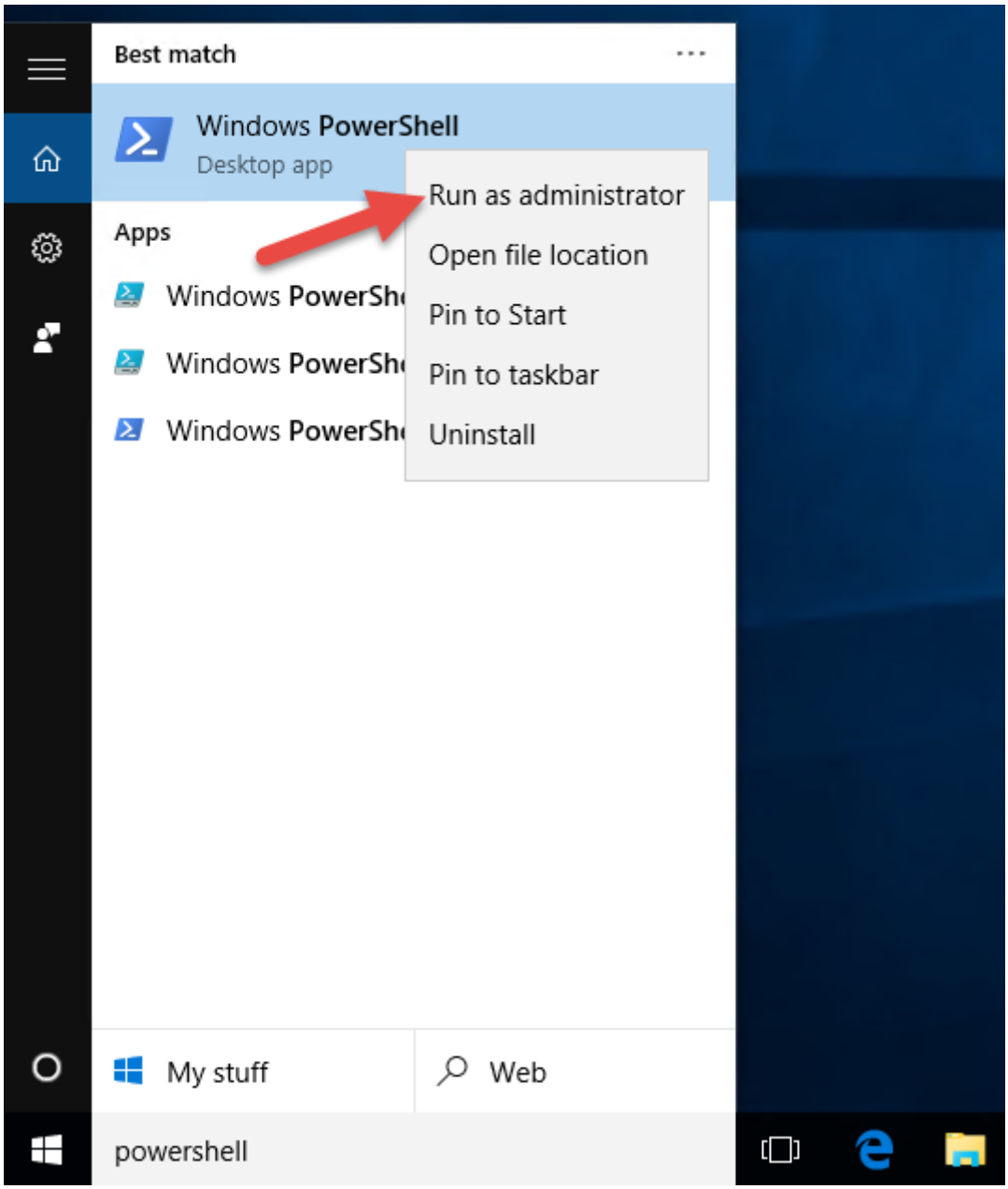
```
Get-Service -Name W32Time | Stop-Service
```

Output

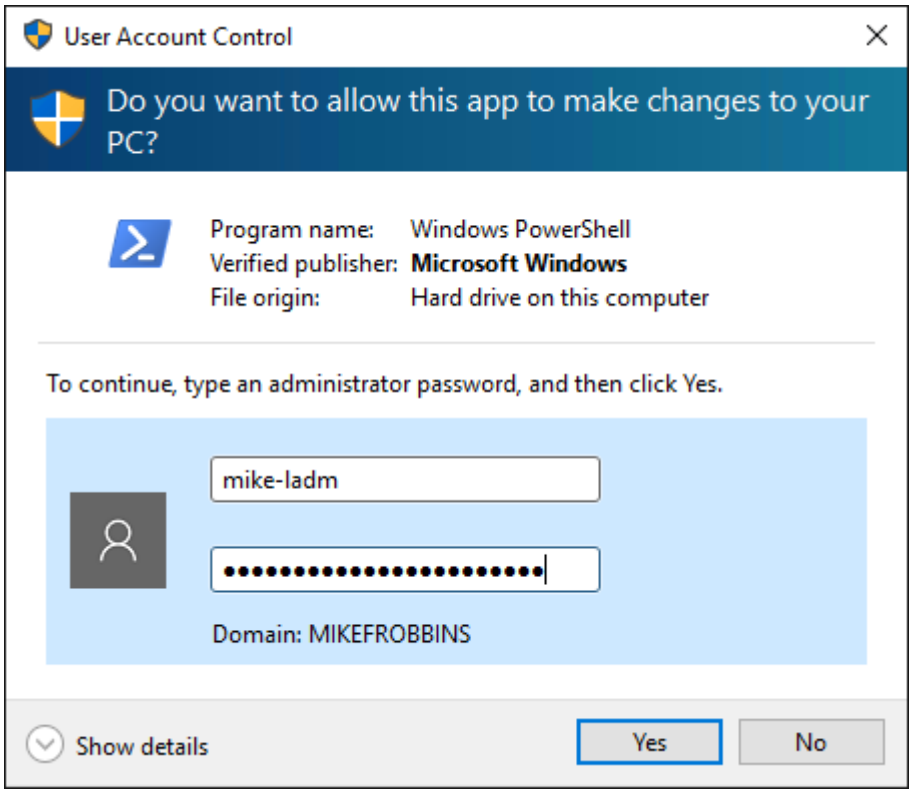
```
Stop-Service : Service 'Windows Time (W32Time)' cannot be stopped due to the
following
error: Cannot open W32Time service on computer '.'.
At line:1 char:29
+ Get-Service -Name W32Time | Stop-Service
+
    + CategoryInfo          : CloseError:
(System.ServiceProcess.ServiceController:ServiceController)
     [Stop-Service], ServiceCommandException
    + FullyQualifiedErrorId :
CouldNotStopService,Microsoft.PowerShell.Commands.StopServiceCommand
```

The solution to this problem is to run PowerShell as a domain user who is a local administrator. This is how my second domain user account is configured. Using the principle of least privilege, this account should NOT be a domain administrator, or have any elevated privileges in the domain.

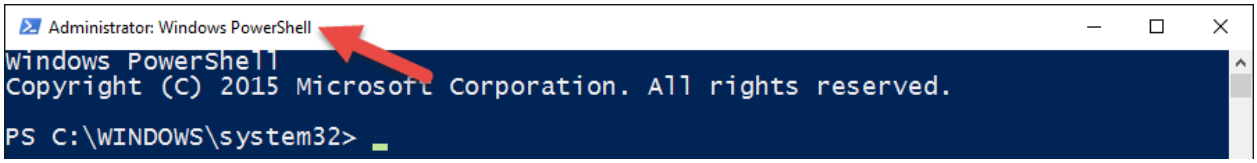
Close PowerShell. Relaunch the PowerShell console, except this time right-click on the **Windows PowerShell** shortcut and select **Run as administrator** as shown in Figure 1-5.



If you're logged into Windows as a normal user, you'll be prompted for credentials. I'll enter the credentials for my user account who is a domain user and local admin as shown in Figure 1-6.



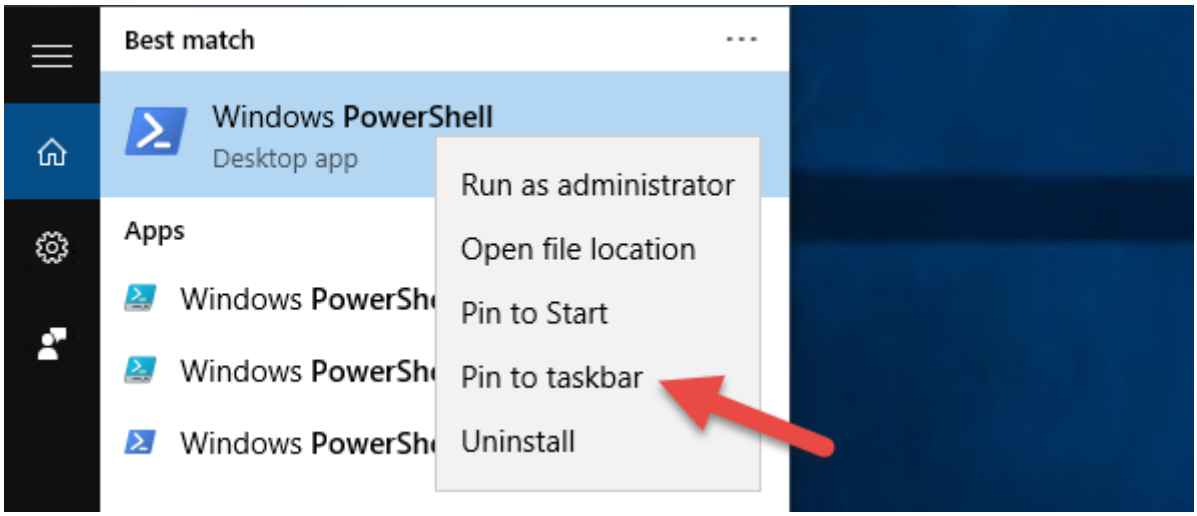
Once PowerShell is relaunched as an administrator, the title bar should say "Administrator: Windows PowerShell" as shown in Figure 1-7.



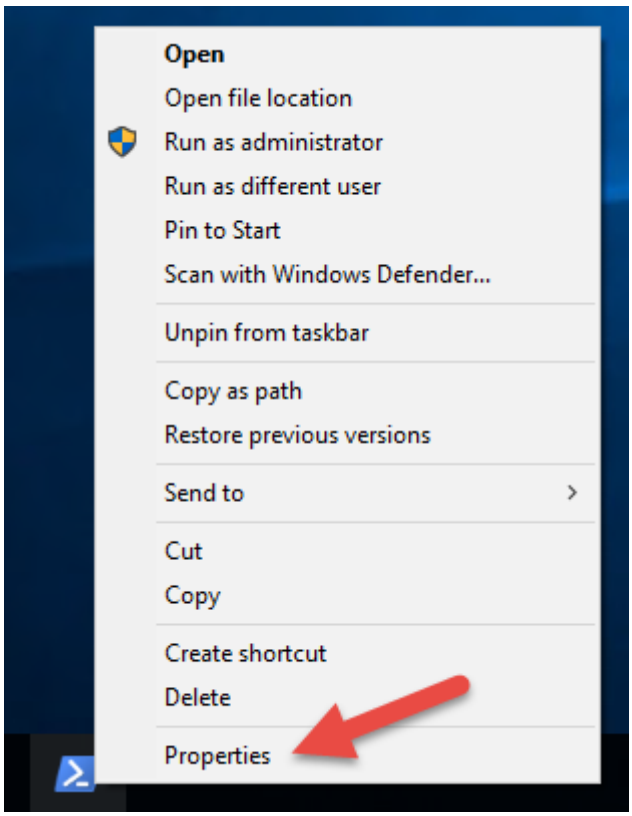
Now that PowerShell is being run elevated as a local administrator, UAC will no longer be a problem when a command is run on the local computer that would normally require a prompt for elevation. Keep in mind though that any command run from this elevated instance of the PowerShell console, also runs elevated.

To simplify finding PowerShell and launching it as an administrator, I recommend pinning it to the taskbar and setting it to automatically launch as an admin each time it's run.

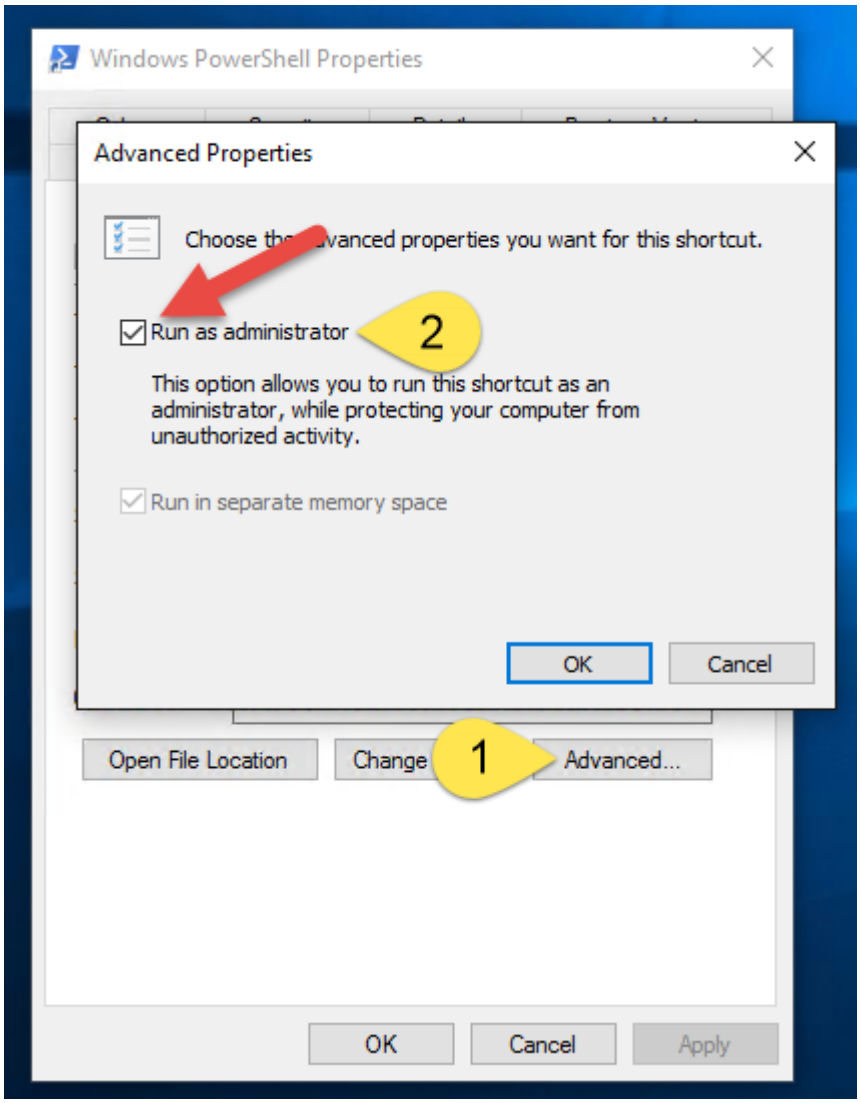
Search for PowerShell again, except this time right-click on it and select "Pin to taskbar" as shown in Figure 1-8.



Right-click on the PowerShell shortcut that's now pinned to the taskbar and select properties as shown in Figure 1-9.



Click on "Advanced" as denoted by #1 in Figure 1-10, then check the "Run as administrator" checkbox as denoted by #2 in Figure 1-10, and then click OK twice to accept the changes and exit out of both dialog boxes.



You'll never have to worry about finding PowerShell or whether or not it's running as an administrator again.

Running PowerShell elevated as an administrator to prevent having problems with UAC only impacts commands that are run against the local computer. It has no effect on commands that target remote computers.

What version of PowerShell am I running?

There are a number of automatic variables in PowerShell that store state information. One of these variables is `$PSVersionTable`, which contains a hashtable that can be used to display the relevant PowerShell version information:

PowerShell

```
$PSVersionTable
```

Output

```
Name                           Value
----                           -----
PSVersion                      5.1.19041.1
PSEdition                      Desktop
PSCompatibleVersions           {1.0, 2.0, 3.0, 4.0...}
BuildVersion                   10.0.19041.1
CLRVersion                     4.0.30319.42000
WSManStackVersion              3.0
PSRemotingProtocolVersion      2.3
SerializationVersion           1.1.0.1
```

Newer versions of Windows PowerShell are distributed as part of the Windows Management Framework (WMF). A specific version of the .NET Framework is required depending on the WMF version. To upgrade to Windows PowerShell 5.1, see Upgrading existing Windows PowerShell.

Execution Policy

Contrary to popular belief, the execution policy in PowerShell is not a security boundary. It's designed to prevent a user from unknowingly running a script. A determined user can easily bypass the execution policy in PowerShell. Table 1-2 shows the default execution policy for current Windows operating systems.

Windows Operating System Version	**Default Execution Policy**
Server 2019	Remote Signed
Server 2016	Remote Signed
Windows 10	Restricted

Regardless of the execution policy setting, any PowerShell command can be run interactively. The execution policy only affects commands running in a script. The `Get-ExecutionPolicy` cmdlet is used to determine what the current execution policy setting is and the `Set-ExecutionPolicy` cmdlet is used to change the execution policy. My recommendation is to use the **RemoteSigned** policy, which requires downloaded scripts to be signed by a trusted publisher in order to be run.

Check the current execution policy:

PowerShell

```
Get-ExecutionPolicy
```

Output

```
Restricted
```

PowerShell scripts can't be run at all when the execution policy is set to **Restricted**. This is the default setting on all Windows client operating systems. To demonstrate the problem, save the following code as a `.ps1` file named `Stop-TimeService.ps1`.

PowerShell

```powershell
Get-Service -Name W32Time | Stop-Service -PassThru
```

That command runs interactively without error as long as PowerShell is run elevated as an administrator. But as soon as it's saved as a script file and you try to execute the script, it generates an error:

PowerShell

```powershell
.\Stop-TimeService.ps1
```

Output

```
.\Stop-TimeService.ps1 : File C:\demo\Stop-TimeService.ps1 cannot be loaded
because
running scripts is disabled on this system. For more information, see
about_Execution_Policies at http://go.microsoft.com/fwlink/?LinkID=135170.
At line:1 char:1
+ .\Stop-TimeService.ps1
+
    + CategoryInfo          : SecurityError: (:) [], PSSecurityException
    + FullyQualifiedErrorId : UnauthorizedAccess
```

Notice that the error shown in the previous set of results tells you exactly what the problem is (running scripts is disabled on this system). When you run a command in PowerShell that generates an error message, be sure to read the error message instead of just rerunning the command and hoping that it runs successfully.

Change the PowerShell execution policy to remote signed.

PowerShell

```powershell
Set-ExecutionPolicy -ExecutionPolicy RemoteSigned
```

Output

```
Execution Policy Change
The execution policy helps protect you from scripts that you do not trust.
Changing the execution
policy might expose you to the security risks described in the
about_Execution_Policies help topic
at http://go.microsoft.com/fwlink/?LinkID=135170. Do you want to change the
execution policy?
[Y] Yes [A] Yes to All [N] No [L] No to All [S] Suspend [?] Help (default is
"N"):y
```

Be sure to read the warning that's displayed when changing the execution policy. I also recommend taking a look at the about_Execution_Policies help topic to make sure you understand the security implications of changing the execution policy.

Now that the execution policy has been set to **RemoteSigned**, the `Stop-TimeService.ps1` script runs error free.

PowerShell

```powershell
.\Stop-TimeService.ps1
```

Output

```
Status   Name               DisplayName
------   ----               -----------
Stopped  W32Time            Windows Time
```

Be sure to start your Windows Time service before continuing otherwise you may run into unforeseen problems.

PowerShell

```powershell
Start-Service -Name w32time
```

Summary

In this chapter, you've learned how to find and launch PowerShell, and how to create a shortcut that launches PowerShell as an administrator. You've also learned about the default execution policy and how to change it.

Review

1. How do you determine what PowerShell version a computer is running?

2. Why is it important to launch PowerShell elevated as an administrator?
3. How do you determine the current PowerShell execution policy?
4. What does the default PowerShell execution policy on Windows client computers prevent from occurring?
5. How do you change the PowerShell execution policy?

Recommended Reading

For those who want to know more information about the topics covered in this chapter, I recommend reading the following PowerShell help topics.

- about_Automatic_Variables
- about_Hash_Tables
- about_Execution_Policies

In the next chapter, you'll learn about the discoverability of commands in PowerShell. One of the things that will be covered is how to update PowerShell so those help topics can be viewed right from within PowerShell instead of having to view them on the internet.

Chapter 2 - The Help System

Article • 12/15/2022

Two groups of IT pros were given a written test without access to a computer to determine their skill level with PowerShell. PowerShell beginners were placed in one group and experts in another. Based on the results of the test, there didn't seem to be much difference in the skill level between the two groups. Both groups were given a second test similar to the first one. This time they were given access to a computer with PowerShell that didn't have access to the internet. The results of the second test showed a huge difference in the skill level between the two groups. Experts don't always know the answers, but they know how to figure out the answers.

What was the difference in the results of the first and second test between these two groups?

The differences observed in these two tests were because experts don't memorize how to use thousands of commands in PowerShell. They learn how to use the help system within PowerShell extremely well. This allows them to find the necessary commands when needed and how to use those commands once they've found them.

I've heard Jeffrey Snover, the inventor of PowerShell, tell a similar story a number of times.

Mastering the help system is the key to being successful with PowerShell.

Discoverability

Compiled commands in PowerShell are called cmdlets. Cmdlet is pronounced "command-let" (not CMD-let). Cmdlets names have the form of singular "Verb-Noun" commands to make them easily discoverable. For example, the cmdlet for determining what processes are running is `Get-Process` and the cmdlet for retrieving a list of services and their statuses is `Get-Service`. There are other types of commands in PowerShell such as aliases and functions that will be covered later in this book. The term PowerShell command is a generic term that's often used to refer to any type of command in PowerShell, regardless of whether or not it's a cmdlet, function, or alias.

The Three Core Cmdlets in PowerShell

- `Get-Command`
- `Get-Help`

- `Get-Member` (covered in chapter 3)

One question I'm often asked is how do you figure out what the commands are in PowerShell? Both `Get-Command` and `Get-Help` can be used to determine the commands.

Get-Help

`Get-Help` is a multipurpose command. `Get-Help` helps you learn how to use commands once you find them. `Get-Help` can also be used to help locate commands, but in a different and more indirect way when compared to `Get-Command`.

When `Get-Help` is used to locate commands, it first searches for wildcard matches of command names based on the provided input. If it doesn't find a match, it searches through the help topics themselves, and if no match is found an error is returned. Contrary to popular belief, `Get-Help` can be used to find commands that don't have help topics.

The first thing you need to know about the help system in PowerShell is how to use the `Get-Help` cmdlet. The following command is used to display the help topic for `Get-Help`.

PowerShell

```
Get-Help -Name Get-Help
```

Output

```
Do you want to run Update-Help?
The Update-Help cmdlet downloads the most current Help files for Windows
PowerShell
modules, and installs them on your computer. For more information about the
Update-Help
cmdlet, see http://go.microsoft.com/fwlink/?LinkId=210614.
[Y] Yes  [N] No  [S] Suspend  [?] Help (default is "Y"):
```

Beginning with PowerShell version 3, PowerShell help doesn't ship with the operating system. The first time `Get-Help` is run for a command, the previous message is displayed. If the `help` function or `man` alias is used instead of the `Get-Help` cmdlet, you don't receive this prompt.

Answering yes by pressing `Y` runs the `Update-Help` cmdlet, which requires internet access by default. `Y` can be specified in either upper or lower case.

Once the help is downloaded and the update is complete, the help topic is returned for the specified command:

```PowerShell
Get-Help -Name Get-Help
```

Take a moment to run that example on your computer, review the output, and take note of how the information is grouped:

- NAME
- SYNOPSIS
- SYNTAX
- DESCRIPTION
- RELATED LINKS
- REMARKS

As you can see, help topics can contain an enormous amount of information and this isn't even the entire help topic.

While not specific to PowerShell, a parameter is a way to provide input to a command. `Get-Help` has many parameters that can be specified in order to return the entire help topic or a subset of it.

The syntax section of the help topic shown in the previous set of results lists all of the parameters for `Get-Help`. At first glance, it appears the same parameters are listed six different times. Each of those different blocks in the syntax section is a parameter set. This means the `Get-Help` cmdlet has six different parameter sets. If you take a closer look, you'll notice that at least one parameter is different in each of the parameter sets.

Parameter sets are mutually exclusive. Once a unique parameter that only exists in one of the parameter sets is used, only parameters contained within that parameter set can be used. For example, both the **Full** and **Detailed** parameters couldn't be specified at the same time because they are in different parameter sets.

Each of the following parameters are in different parameter sets:

- Full
- Detailed
- Examples
- Online
- Parameter
- ShowWindow

All of the cryptic syntax such as square and angle brackets in the syntax section means something but will be covered in Appendix A of this book. While important, learning the cryptic syntax is often difficult to retain for someone who is new to PowerShell and may not use it everyday.

For more information to better understand the cryptic syntax, see Appendix A.

For beginners, there's an easier way to figure out the same information except in plain language.

When the **Full** parameter of `Get-Help` is specified, the entire help topic is returned.

PowerShell

```
Get-Help -Name Get-Help -Full
```

Take a moment to run that example on your computer, review the output, and take note of how the information is grouped:

- NAME
- SYNOPSIS
- SYNTAX
- DESCRIPTION
- PARAMETERS
- INPUTS
- OUTPUTS
- NOTES
- EXAMPLES
- RELATED LINKS

Notice that using the **Full** parameter returned several additional sections, one of which is the PARAMETERS section that provides more information than the cryptic SYNTAX section.

The **Full** parameter is a switch parameter. A parameter that doesn't require a value is called a switch parameter. When a switch parameter is specified, its value is true and when it's not, its value is false.

If you've been working through this chapter in the PowerShell console, you noticed that the previous command to display the full help topic for `Get-Help` flew by on the screen without giving you a chance to read it. There's a better way.

`Help` is a function that pipes `Get-Help` to a function named `more`, which is a wrapper for the `more.com` executable file in Windows. In the PowerShell console, `help` provides one

page of help at a time. In the ISE, it works the same way as `Get-Help`. My recommendation is to use the `help` function instead of the `Get-Help` cmdlet since it provides a better experience and it's less to type.

Less typing isn't always a good thing, however. If you're going to save your commands as a script or share them with someone else, be sure to use full cmdlet and parameter names. The full names are self-documenting, which makes them easier to understand. Think about the next person that has to read and understand your commands. It could be you. Your coworkers and future self will thank you.

Try running the following commands in the PowerShell console on your Windows 10 lab environment computer.

PowerShell

```
Get-Help -Name Get-Help -Full
help -Name Get-Help -Full
help Get-Help -Full
```

Did you notice any differences in the output from the previously listed commands when you ran them on your Windows 10 lab environment computer?

There aren't any differences other than the last two options return the results one page at a time. The `spacebar` is used to display the next page of content when using the `Help` function and `Ctrl`+`C` cancels commands that are running in the PowerShell console.

The first example uses the `Get-Help` cmdlet, the second uses the `Help` function, and the third omits the **Name** parameter when using the `Help` function. **Name** is a positional parameter and it's being used positionally in that example. This means the value can be specified without specifying the parameter name, as long as the value itself is specified in the correct position. How did I know what position to specify the value in? By reading the help as shown in the following example.

PowerShell

```
help Get-Help -Parameter Name
```

Output

```
-Name <String>
    Gets help about the specified command or concept. Enter the name of a
cmdlet, function,
    provider, script, or workflow, such as Get-Member, a conceptual article
name, such as
    about_Objects, or an alias, such as ls. Wildcard characters are
```

```
permitted in cmdlet and
    provider names, but you can't use wildcard characters to find the names
of function help and
    script help articles.

    To get help for a script that isn't located in a path that's listed in
the $env:Path
    environment variable, type the script's path and file name.

    If you enter the exact name of a help article, Get-Help displays the
article contents.

    If you enter a word or word pattern that appears in several help article
titles, Get-Help
    displays a list of the matching titles.

    If you enter a word that doesn't match any help article titles, Get-Help
displays a list of
    articles that include that word in their contents.

    The names of conceptual articles, such as about_Objects, must be entered
in English, even in
    non-English versions of PowerShell.

    Required?                    false
    Position?                    0
    Default value                None
    Accept pipeline input?       True (ByPropertyName)
    Accept wildcard characters?  true
```

Notice that in the previous example, the **Parameter** parameter was used with the Help function to only return information from the help topic for the **Name** parameter. This is much more concise than trying to manually sift through what sometimes seems like a hundred page help topic.

Based on those results, you can see that the **Name** parameter is positional and must be specified in position zero (the first position) when used positionally. The order that parameters are specified in doesn't matter if the parameter name is specified.

One other important piece of information is that the **Name** parameter expects the datatype for its value to be a single string, which is denoted by `<String>`. If it accepted multiple strings, the datatype would be listed as `<String[]>`.

Sometimes you simply don't want to display the entire help topic for a command. There are a number of other parameters besides **Full** that can be specified with `Get-Help` or `Help`. Try running the following commands on your Windows 10 lab environment computer:

```
PowerShell
```

```
Get-Help -Name Get-Command -Full
Get-Help -Name Get-Command -Detailed
Get-Help -Name Get-Command -Examples
Get-Help -Name Get-Command -Online
Get-Help -Name Get-Command -Parameter Noun
Get-Help -Name Get-Command -ShowWindow
```

I typically use `help <command name>` with the **Full** or **Online** parameter. If I'm only interested in the examples, I'll use the **Examples** parameter and if I'm only interested in a specific parameter, I'll use the **Parameter** parameter. The **ShowWindow** parameter opens the help topic in a separate searchable window that can be placed on a different monitor if you have multiple monitors. I've avoided the **ShowWindow** parameter because there's a known bug where it doesn't display the entire help topic.

If you want help in a separate window, my recommendation is to either use the **Online** parameter or use the **Full** parameter and pipe the results to `Out-GridView`, as shown in the following example.

PowerShell

```
help Get-Command -Full | Out-GridView
```

Both the `Out-GridView` cmdlet and the **ShowWindow** parameter of the `Get-Help` cmdlet require an operating system with a GUI (Graphical User Interface). They will generate an error message if you attempt to use either of them on Windows Server that's been installed using the server core (no-GUI) installation option.

To use `Get-Help` to find commands, use the asterisk (`*`) wildcard character with the **Name** parameter. Specify a term that you're searching for commands on as the value for the **Name** parameter as shown in the following example.

PowerShell

```
help *process*
```

Output

```
Name                              Category  Module
Synopsis
----                              --------  ------                    ------
--
Enter-PSHostProcess               Cmdlet    Microsoft.PowerShell.Core
Connects to and ...
Exit-PSHostProcess                Cmdlet    Microsoft.PowerShell.Core Closes
```

```
an intera...
Get-PSHostProcessInfo             Cmdlet    Microsoft.PowerShell.Core
Debug-Process                     Cmdlet    Microsoft.PowerShell.M... Debugs
one or mo...
Get-Process                       Cmdlet    Microsoft.PowerShell.M... Gets
the process...
Start-Process                     Cmdlet    Microsoft.PowerShell.M... Starts
one or mo...
Stop-Process                      Cmdlet    Microsoft.PowerShell.M... Stops
one or mor...
Wait-Process                      Cmdlet    Microsoft.PowerShell.M... Waits
for the pr...
Get-AppvVirtualProcess            Function  AppvClient                ...
Start-AppvVirtualProcess          Function  AppvClient                ...
```

In the previous example, the `*` wildcard characters are not required and omitting them produces the same result. `Get-Help` automatically adds the wildcard characters behind the scenes.

PowerShell

```
help process
```

The previous command produces the same results as specifying the `*` wildcard character on each end of process.

I prefer to add them since that's the option that always works consistently. Otherwise, they are required in certain scenarios and not others. As soon as you add a wildcard character in the middle of the value, they're no longer automatically added behind the scenes to the value you specified.

PowerShell

```
help pr*cess
```

No results are returned by that command unless the `*` wildcard character is added to the beginning, end, or both the beginning and end of `pr*cess`.

If the value you specified begins with a dash, then an error is generated because PowerShell interprets it as a parameter name and no such parameter name exists for the `Get-Help` cmdlet.

PowerShell

```
help -process
```

If what you're attempting to look for are commands that end with `-process`, you only need to add the `*` wildcard character to the beginning of the value.

PowerShell

```
help *-process
```

When searching for PowerShell commands with `Get-Help`, you want to be a little more vague instead of being too specific with what you're searching for.

Searching for `process` earlier found only commands that contained `process` in the name of the command and returned only those results. When `Get-Help` is used to search for `processes`, it doesn't find any matches for command names, so it performs a search of every help topic in PowerShell on your system and returns any matches it finds. This causes it to return an enormous number of results.

PowerShell

```
Get-Help processes
```

Output

```
Name                              Category  Module
Synopsis
----                              --------  ------                    ------
--
Disconnect-PSSession              Cmdlet    Microsoft.PowerShell.Core
Disconnects from...
Enter-PSHostProcess               Cmdlet    Microsoft.PowerShell.Core
Connects to and ...
ForEach-Object                    Cmdlet    Microsoft.PowerShell.Core
Performs an oper...
Get-PSSessionConfiguration        Cmdlet    Microsoft.PowerShell.Core Gets
the registe...
New-PSTransportOption             Cmdlet    Microsoft.PowerShell.Core
Creates an objec...
Out-Host                          Cmdlet    Microsoft.PowerShell.Core Sends
output to ...
Where-Object                      Cmdlet    Microsoft.PowerShell.Core
Selects objects ...
Clear-Variable                    Cmdlet    Microsoft.PowerShell.U...
Deletes the valu...
Compare-Object                    Cmdlet    Microsoft.PowerShell.U...
Compares two set...
Convert-String                    Cmdlet    Microsoft.PowerShell.U...
Formats a string...
ConvertFrom-Csv                   Cmdlet    Microsoft.PowerShell.U...
Converts object ...
```

```
ConvertTo-Html                  Cmdlet    Microsoft.PowerShell.U...
Converts Microso...
ConvertTo-Xml                   Cmdlet    Microsoft.PowerShell.U...
Creates an XML-b...
Debug-Runspace                  Cmdlet    Microsoft.PowerShell.U... Starts
an intera...
Export-Csv                      Cmdlet    Microsoft.PowerShell.U...
Converts objects...
Export-FormatData               Cmdlet    Microsoft.PowerShell.U... Saves
formatting...
Format-List                     Cmdlet    Microsoft.PowerShell.U...
Formats the outp...
Format-Table                    Cmdlet    Microsoft.PowerShell.U...
Formats the outp...
Get-Random                      Cmdlet    Microsoft.PowerShell.U... Gets a
random nu...
Get-Unique                      Cmdlet    Microsoft.PowerShell.U...
Returns unique i...
Group-Object                    Cmdlet    Microsoft.PowerShell.U... Groups
objects t...
Import-Clixml                   Cmdlet    Microsoft.PowerShell.U...
Imports a CLIXML...
Import-Csv                      Cmdlet    Microsoft.PowerShell.U...
Creates table-li...
Measure-Object                  Cmdlet    Microsoft.PowerShell.U...
Calculates the n...
Out-File                        Cmdlet    Microsoft.PowerShell.U... Sends
output to ...
Out-GridView                    Cmdlet    Microsoft.PowerShell.U... Sends
output to ...
Select-Object                   Cmdlet    Microsoft.PowerShell.U...
Selects objects ...
Set-Variable                    Cmdlet    Microsoft.PowerShell.U... Sets
the value o...
Sort-Object                     Cmdlet    Microsoft.PowerShell.U... Sorts
objects by...
Tee-Object                      Cmdlet    Microsoft.PowerShell.U... Saves
command ou...
Trace-Command                   Cmdlet    Microsoft.PowerShell.U...
Configures and s...
Write-Output                    Cmdlet    Microsoft.PowerShell.U... Sends
the specif...
Debug-Process                   Cmdlet    Microsoft.PowerShell.M... Debugs
one or mo...
Get-Process                     Cmdlet    Microsoft.PowerShell.M... Gets
the process...
Get-WmiObject                   Cmdlet    Microsoft.PowerShell.M... Gets
instances o...
Start-Process                   Cmdlet    Microsoft.PowerShell.M... Starts
one or mo...
Stop-Process                    Cmdlet    Microsoft.PowerShell.M... Stops
one or mor...
Wait-Process                    Cmdlet    Microsoft.PowerShell.M... Waits
for the pr...
Get-Counter                     Cmdlet    Microsoft.PowerShell.D... Gets
```

```
performance...
Invoke-WSManAction                Cmdlet    Microsoft.WSMan.Manage...
Invokes an actio...
Remove-WSManInstance              Cmdlet    Microsoft.WSMan.Manage...
Deletes a manage...
Get-WSManInstance                 Cmdlet    Microsoft.WSMan.Manage...
Displays managem...
New-WSManInstance                 Cmdlet    Microsoft.WSMan.Manage...
Creates a new in...
Set-WSManInstance                 Cmdlet    Microsoft.WSMan.Manage...
Modifies the man...
about_Arithmetic_Operators        HelpFile
Describes the op...
about_Arrays                      HelpFile
Describes arrays...
about_Debuggers                   HelpFile
Describes the Wi...
about_Execution_Policies          HelpFile
Describes the Wi...
about_ForEach-Parallel            HelpFile
Describes the Fo...
about_Foreach                     HelpFile
Describes a lang...
about_Functions                   HelpFile
Describes how to...
about_Language_Keywords           HelpFile
Describes the ke...
about_Methods                     HelpFile
Describes how to...
about_Objects                     HelpFile
Provides essenti...
about_Parallel                    HelpFile
Describes the Pa...
about_Pipelines                   HelpFile
Combining comman...
about_Preference_Variables        HelpFile
Variables that c...
about_Remote                      HelpFile
Describes how to...
about_Remote_Output               HelpFile
Describes how to...
about_Sequence                    HelpFile
Describes the Se...
about_Session_Configuration_Files HelpFile
Describes sessio...
about_Variables                   HelpFile
Describes how va...
about_Windows_PowerShell_5.0      HelpFile
Describes new fe...
about_WQL                         HelpFile
Describes WMI Qu...
about_WS-Management_Cmdlets       HelpFile
Provides an over...
about_ForEach-Parallel            HelpFile
Describes the Fo...
```

```
about_Parallel                    HelpFile
Describes the Pa...
about_Sequence                    HelpFile
Describes the Se...
```

Using `Help` to search for `process` returned 10 results and using it to search for `processes` returned 68 results. If only one result is found, the help topic itself will be displayed instead of a list of commands.

PowerShell

```
get-help *hotfix*
```

Output

```
NAME
    Get-HotFix

SYNOPSIS
    Gets the hotfixes that have been applied to the local and remote
computers.


SYNTAX
    Get-HotFix [-ComputerName <String[]>] [-Credential <PSCredential>] [-
Description
    <String[]>] [<CommonParameters>]

    Get-HotFix [[-Id] <String[]>] [-ComputerName <String[]>] [-Credential
    <PSCredential>] [<CommonParameters>]


DESCRIPTION
    The Get-Hotfix cmdlet gets hotfixes (also called updates) that have been
installed
    on either the local computer (or on specified remote computers) by
Windows Update,
    Microsoft Update, or Windows Server Update Services; the cmdlet also
gets hotfixes
    or updates that have been installed manually by users.


RELATED LINKS
    Online Version: http://go.microsoft.com/fwlink/?LinkId=821586
    Win32_QuickFixEngineering http://go.microsoft.com/fwlink/?LinkID=145071
    Get-ComputerRestorePoint
    Add-Content

REMARKS
    To see the examples, type: "get-help Get-HotFix -examples".
    For more information, type: "get-help Get-HotFix -detailed".
```

```
    For technical information, type: "get-help Get-HotFix -full".
    For online help, type: "get-help Get-HotFix -online"
```

Now to debunk the myth that `Help` in PowerShell can only find commands that have help topics.

PowerShell

```
help *more*
```

Output

```
NAME
    more

SYNTAX
    more [[-paths] <string[]>]


ALIASES
    None


REMARKS
    None
```

Notice in the previous example that `more` doesn't have a help topic, yet the `Help` system in PowerShell was able to find it. It only found one match and returned the basic syntax information that you'll see when a command doesn't have a help topic.

PowerShell contains numerous conceptual (About) help topics. The following command can be used to return a list of all **About** help topics on your system.

PowerShell

```
help About_*
```

Limiting the results to one single About help topic displays the actual help topic instead of returning a list.

PowerShell

```
help about_Updatable_Help
```

The help system in PowerShell has to be updated in order for the **About** help topics to be present. If for some reason the initial update of the help system failed on your computer, the files will not be available until the `Update-Help` cmdlet has been run successfully.

Get-Command

`Get-Command` is designed to help you locate commands. Running `Get-Command` without any parameters returns a list of all the commands on your system. The following example demonstrates using the `Get-Command` cmdlet to determine what commands exist for working with processes:

PowerShell

```
Get-Command -Noun Process
```

Output

```
CommandType     Name                                               Version
Source
-----------     ----                                               -------
------
Cmdlet          Debug-Process                                      3.1.0.0
Microsof...
Cmdlet          Get-Process                                        3.1.0.0
Microsof...
Cmdlet          Start-Process                                      3.1.0.0
Microsof...
Cmdlet          Stop-Process                                       3.1.0.0
Microsof...
Cmdlet          Wait-Process                                       3.1.0.0
Microsof...
```

Notice in the previous example where `Get-Command` was run, the **Noun** parameter is used and `Process` is specified as the value for the **Noun** parameter. What if you didn't know how to use the `Get-Command` cmdlet? You could use `Get-Help` to display the help topic for `Get-Command`.

The **Name**, **Noun**, and **Verb** parameters accept wildcards. The following example shows wildcards being used with the **Name** parameter:

PowerShell

```
Get-Command -Name *service*
```

Output

```
CommandType     Name                                               Version
Source
-----------     ----                                               -------
------
Function        Get-NetFirewallServiceFilter                       2.0.0.0
NetSecurity
Function        Set-NetFirewallServiceFilter                       2.0.0.0
NetSecurity
Cmdlet          Get-Service                                        3.1.0.0
Microsof...
Cmdlet          New-Service                                        3.1.0.0
Microsof...
Cmdlet          New-WebServiceProxy                                3.1.0.0
Microsof...
Cmdlet          Restart-Service                                    3.1.0.0
Microsof...
Cmdlet          Resume-Service                                     3.1.0.0
Microsof...
Cmdlet          Set-Service                                        3.1.0.0
Microsof...
Cmdlet          Start-Service                                      3.1.0.0
Microsof...
Cmdlet          Stop-Service                                       3.1.0.0
Microsof...
Cmdlet          Suspend-Service                                    3.1.0.0
Microsof...
Application     AgentService.exe
10.0.14... C:\Windo...
Application     SensorDataService.exe
10.0.14... C:\Windo...
Application     services.exe
10.0.14... C:\Windo...
Application     services.msc                                       0.0.0.0
C:\Windo...
Application     TieringEngineService.exe
10.0.14... C:\Windo...
```

I'm not a fan of using wildcards with the **Name** parameter of `Get-Command` since it also returns executable files that are not native PowerShell commands.

If you are going to use wildcard characters with the **Name** parameter, I recommend limiting the results with the **CommandType** parameter.

PowerShell

```powershell
Get-Command -Name *service* -CommandType Cmdlet, Function, Alias
```

A better option is to use either the **Verb** or **Noun** parameter or both of them since only PowerShell commands have both verbs and nouns.

Found something wrong with a help topic? The good news is the help topics for PowerShell have been open-sourced and available in the PowerShell-Docs repository on GitHub. Pay it forward by not only fixing the incorrect information for yourself, but everyone else as well. Simply fork the PowerShell documentation repository on GitHub, update the help topic, and submit a pull request. Once the pull request is accepted, the corrected documentation is available for everyone.

Updating Help

The local copy of the PowerShell help topics was previously updated the first-time help on a command was requested. It's recommended to periodically update the help system because there can be updates to the help content from time to time. The `Update-Help` cmdlet is used to update the help topics. It requires internet access by default and for you to be running PowerShell elevated as an administrator.

PowerShell

```
Update-Help
```

Output

```
Update-Help : Failed to update Help for the module(s) 'BitsTransfer' with UI
culture(s)
{en-US} : Unable to retrieve the HelpInfo XML file for UI culture en-US.
Make sure the HelpInfoUri
property in the module manifest is valid or check your network connection
and then try the command again.
At line:1 char:1
+ Update-Help
+
    + CategoryInfo          : InvalidOperation: (:) [Update-Help], Exception
    + FullyQualifiedErrorId :
InvalidHelpInfoUri,Microsoft.PowerShell.Commands.UpdateHel
   pCommand

Update-Help : Failed to update Help for the module(s)
'NetworkControllerDiagnostics,
StorageReplica' with UI culture(s) {en-US} : Unable to retrieve the HelpInfo
XML file
for UI culture en-US. Make sure the HelpInfoUri property in the module
manifest is valid
or check your network connection and then try the command again.
At line:1 char:1
+ Update-Help
```

```
+
    + CategoryInfo          : ResourceUnavailable: (:) [Update-Help],
Exception
    + FullyQualifiedErrorId :
UnableToRetrieveHelpInfoXml,Microsoft.PowerShell.Commands.
   UpdateHelpCommand
```

A couple of the modules returned errors, which is not uncommon. If the machine didn't have internet access, you could use the `Save-Help` cmdlet on another machine that does have internet access to first save the updated help information to a file share on your network and then use the **SourcePath** parameter of `Update-Help` to specify this network location for the help topics.

Consider setting up a scheduled task or adding some logic to your profile script in PowerShell to periodically update the help content on your computer. Profile scripts will be discussed in an upcoming chapter.

Summary

In this chapter you've learned how to find commands with both `Get-Help` and `Get-Command`. You've learned how to use the help system to figure out how to use commands once you find them. You've also learned how to update the content of the help topics when updates are available.

My challenge to you is to learn a PowerShell command a day.

PowerShell

```powershell
Get-Command | Get-Random | Get-Help -Full
```

Review

1. Is the **DisplayName** parameter of `Get-Service` positional?
2. How many parameter sets does the `Get-Process` cmdlet have?
3. What PowerShell commands exist for working with event logs?
4. What is the PowerShell command for returning a list of PowerShell processes running on your computer?
5. How do you update the PowerShell help content that's stored on your computer?

Recommended Reading

If you want to know more information about the topics covered in this chapter, I recommend reading the following PowerShell help topics.

- Get-Help
- Get-Command
- Update-Help
- Save-Help
- about_Updatable_Help
- about_Command_Syntax

In the next chapter, you'll learn about the `Get-Member` cmdlet as well as objects, properties, and methods.

Chapter 3 - Discovering objects, properties, and methods

Article • 12/09/2022

My first introduction to computers was a Commodore 64, but my first modern computer was a 286 12-Mhz IBM clone with 1 megabyte of memory, a 40-megabyte hard drive, and one 5-1/4 inch floppy disk drive with a CGA monitor running Microsoft DOS 3.3.

Many IT Pros, like myself, are no stranger to the command line, but when the subject of objects, properties, and methods comes up, they get the deer in the headlights look and say, "I'm not a developer." Guess what? You don't have to be a developer to be successful with PowerShell. Don't get bogged down in the terminology. Not everything may make sense initially, but after a little hands-on experience you'll start to have those "light bulb" moments. "Aha! So that's what the book was talking about."

Be sure to try the examples on your computer to gain some of that hands-on experience.

Requirements

The Active Directory PowerShell module is required by some of the examples shown in this chapter. The module is part of the Remote Server Administration Tools (RSAT) for Windows. For the 1809 (or higher) build of Windows, the RSAT tools are installed as a Windows feature. Support for Active Directory is not available on Windows Home.

- For information about installing the RSAT tools, see Windows Management modules.
- For older versions of Windows, see RSAT for Windows.

Get-Member

`Get-Member` helps you discover what objects, properties, and methods are available for commands. Any command that produces object-based output can be piped to `Get-Member`. A property is a characteristic about an item. Your drivers license has a property called eye color and the most common values for that property are blue and brown. A method is an action that can be taken on an item. In staying with the drivers license example, one of the methods is "Revoke" because the department of motor vehicles can revoke your drivers license.

Properties

In the following example, I'll retrieve information about the Windows Time service running on my computer.

PowerShell

```
Get-Service -Name w32time
```

Output

```
Status   Name               DisplayName
------   ----               -----------
Running  w32time            Windows Time
```

Status, **Name**, and **DisplayName** are examples of properties as shown in the previous set of results. The value for the **Status** property is `Running`, the value for the **Name** property is `w32time`, and the value for **DisplayName** is `Windows Time`.

Now I'll pipe that same command to `Get-Member`:

PowerShell

```
Get-Service -Name w32time | Get-Member
```

Output

```
   TypeName: System.ServiceProcess.ServiceController

Name                      MemberType    Definition
----                      ----------    ----------
Name                      AliasProperty Name = ServiceName
RequiredServices          AliasProperty RequiredServices =
ServicesDependedOn
Disposed                  Event         System.EventHandler
Disposed(System.Object, Sy...
Close                     Method        void Close()
Continue                  Method        void Continue()
CreateObjRef              Method        System.Runtime.Remoting.ObjRef
CreateObjRef(ty...
Dispose                   Method        void Dispose(), void
IDisposable.Dispose()
Equals                    Method        bool Equals(System.Object obj)
ExecuteCommand            Method        void ExecuteCommand(int command)
GetHashCode               Method        int GetHashCode()
GetLifetimeService        Method        System.Object GetLifetimeService()
GetType                   Method        type GetType()
InitializeLifetimeService Method        System.Object
```

```
InitializeLifetimeService()
Pause                     Method        void Pause()
Refresh                   Method        void Refresh()
Start                     Method        void Start(), void Start(string[]
args)
Stop                      Method        void Stop()
WaitForStatus             Method        void
WaitForStatus(System.ServiceProcess.Servi...
CanPauseAndContinue       Property      bool CanPauseAndContinue {get;}
CanShutdown               Property      bool CanShutdown {get;}
CanStop                   Property      bool CanStop {get;}
Container                 Property      System.ComponentModel.IContainer
Container {get;}
DependentServices         Property
System.ServiceProcess.ServiceController[] Depe...
DisplayName               Property      string DisplayName {get;set;}
MachineName               Property      string MachineName {get;set;}
ServiceHandle             Property
System.Runtime.InteropServices.SafeHandle Serv...
ServiceName               Property      string ServiceName {get;set;}
ServicesDependedOn        Property
System.ServiceProcess.ServiceController[] Serv...
ServiceType               Property      System.ServiceProcess.ServiceType
ServiceType ...
Site                      Property      System.ComponentModel.ISite Site
{get;set;}
StartType                 Property
System.ServiceProcess.ServiceStartMode StartTy...
Status                    Property
System.ServiceProcess.ServiceControllerStatus ...
ToString                  ScriptMethod  System.Object ToString();
```

The first line of the results in the previous example contains one piece of very important information. **TypeName** tells you what type of object was returned. In this example, a **System.ServiceProcess.ServiceController** object was returned. This is often abbreviated as the portion of the **TypeName** just after the last period; **ServiceController** in this example.

Once you know what type of object a command produces, you can use this information to find commands that accept that type of object as input.

PowerShell

```
Get-Command -ParameterType ServiceController
```

Output

```
CommandType     Name                                               Version
Source
-----------     ----                                               -------
```

```
------
Cmdlet          Get-Service                                        3.1.0.0
Microsof...
Cmdlet          Restart-Service                                    3.1.0.0
Microsof...
Cmdlet          Resume-Service                                     3.1.0.0
Microsof...
Cmdlet          Set-Service                                        3.1.0.0
Microsof...
Cmdlet          Start-Service                                      3.1.0.0
Microsof...
Cmdlet          Stop-Service                                       3.1.0.0
Microsof...
Cmdlet          Suspend-Service                                    3.1.0.0
Microsof...
```

All of those commands have a parameter that accepts a **ServiceController** object type by pipeline, parameter input, or both.

Notice that there are more properties than are displayed by default. Although these additional properties aren't displayed by default, they can be selected from the pipeline by piping the command to the `Select-Object` cmdlet and using the **Property** parameter. The following example selects all of the properties by piping the results of `Get-Service` to `Select-Object` and specifying the `*` wildcard character as the value for the **Property** parameter.

PowerShell

```powershell
Get-Service -Name w32time | Select-Object -Property *
```

Output

```
Name                  : w32time
RequiredServices      : {}
CanPauseAndContinue   : False
CanShutdown           : True
CanStop               : True
DisplayName           : Windows Time
DependentServices     : {}
MachineName           : .
ServiceName           : w32time
ServicesDependedOn    : {}
ServiceHandle         : SafeServiceHandle
Status                : Running
ServiceType           : Win32ShareProcess
StartType             : Manual
Site                  :
Container             :
```

Specific properties can also be selected using a comma-separated list for the value of the **Property** parameter.

PowerShell

```
Get-Service -Name w32time | Select-Object -Property Status, Name,
DisplayName, ServiceType
```

Output

```
 Status Name    DisplayName        ServiceType
 ------ ----    -----------        -----------
Running w32time Windows Time Win32ShareProcess
```

By default, four properties are returned in a table and five or more are returned in a list. Some commands use custom formatting to override how many properties are displayed by default in a table. There are several `Format-*` cmdlets that can be used to manually override these defaults. The most common ones are `Format-Table` and `Format-List`, both of which will be covered in an upcoming chapter.

Wildcard characters can be used when specifying the property names with `Select-Object`.

PowerShell

```
Get-Service -Name w32time | Select-Object -Property Status, DisplayName,
Can*
```

Output

```
Status              : Running
DisplayName         : Windows Time
CanPauseAndContinue : False
CanShutdown         : True
CanStop             : True
```

In the previous example, `Can*` was used as one of the values for the **Property** parameter to return all the properties that start with `Can`. These include **CanPauseAndContinue**, **CanShutdown**, and **CanStop**.

Methods

Methods are an action that can be taken. Use the **MemberType** parameter to narrow down the results of `Get-Member` to only show the methods for `Get-Service`.

PowerShell

```
Get-Service -Name w32time | Get-Member -MemberType Method
```

Output

```
   TypeName: System.ServiceProcess.ServiceController

Name                      MemberType Definition
----                      ---------- ----------
Close                     Method     void Close()
Continue                  Method     void Continue()
CreateObjRef              Method     System.Runtime.Remoting.ObjRef
CreateObjRef(type ...
Dispose                   Method     void Dispose(), void
IDisposable.Dispose()
Equals                    Method     bool Equals(System.Object obj)
ExecuteCommand            Method     void ExecuteCommand(int command)
GetHashCode               Method     int GetHashCode()
GetLifetimeService        Method     System.Object GetLifetimeService()
GetType                   Method     type GetType()
InitializeLifetimeService Method     System.Object
InitializeLifetimeService()
Pause                     Method     void Pause()
Refresh                   Method     void Refresh()
Start                     Method     void Start(), void Start(string[] args)
Stop                      Method     void Stop()
WaitForStatus             Method     void
WaitForStatus(System.ServiceProcess.ServiceC...
```

As you can see, there are many methods. The **Stop** method can be used to stop a Windows service.

PowerShell

```
(Get-Service -Name w32time).Stop()
```

Now to verify the Windows time service has indeed been stopped.

PowerShell

```
Get-Service -Name w32time
```

Output

```
Status   Name               DisplayName
------   ----               -----------
Stopped  w32time            Windows Time
```

I rarely find myself using methods, but they're something you need to be aware of. There are times that you'll come across a `Get-*` command without a corresponding command to modify that item. Often, a method can be used to perform an action that modifies it. The `Get-SqlAgentJob` cmdlet in the SqlServer PowerShell module is a good example of this. The module installs as part of SQL Server Management Studio (SMSS). No corresponding `Set-*` cmdlet exists, but a method can be used to complete the same task.

Another reason to be aware of methods is that many beginners assume destructive changes can't be made with `Get-*` commands. But they indeed can cause serious problems if used inappropriately.

A better option is to use a cmdlet to perform the action if one exists. Go ahead and start the Windows Time service, except this time use the cmdlet for starting services.

PowerShell

```powershell
Get-Service -Name w32time | Start-Service -PassThru
```

Output

```
Status   Name               DisplayName
------   ----               -----------
Running  w32time            Windows Time
```

By default, `Start-Service` doesn't return any results just like the start method of `Get-Service`. But one of the benefits of using a cmdlet is that many times the cmdlet offers additional functionality that isn't available with a method. In the previous example, the **PassThru** parameter was used. This causes a cmdlet that doesn't normally produce output, to produce output.

Be careful with assumptions about the output of a cmdlet. We all know what happens when you assume things. I'll retrieve information about the PowerShell process running on my Windows 10 lab environment computer.

PowerShell

```powershell
Get-Process -Name PowerShell
```

Output

```
Handles  NPM(K)    PM(K)      WS(K)     CPU(s)      Id  SI ProcessName
-------  ------    -----      -----     ------      --  -- -----------
    922      48   107984     140552       2.84   9020   1 powershell
```

Now I'll pipe that same command to Get-Member:

PowerShell

```powershell
Get-Process -Name PowerShell | Get-Member
```

Output

```
   TypeName: System.Diagnostics.Process

Name                       MemberType     Definition
----                       ----------     ----------
Handles                    AliasProperty  Handles = Handlecount
Name                       AliasProperty  Name = ProcessName
NPM                        AliasProperty  NPM = NonpagedSystemMemorySize64
PM                         AliasProperty  PM = PagedMemorySize64
SI                         AliasProperty  SI = SessionId
VM                         AliasProperty  VM = VirtualMemorySize64
WS                         AliasProperty  WS = WorkingSet64
Disposed                   Event          System.EventHandler
Disposed(System.Object, ...
ErrorDataReceived          Event
System.Diagnostics.DataReceivedEventHandler ...
Exited                     Event          System.EventHandler
Exited(System.Object, Sy...
OutputDataReceived         Event
System.Diagnostics.DataReceivedEventHandler ...
BeginErrorReadLine         Method         void BeginErrorReadLine()
BeginOutputReadLine        Method         void BeginOutputReadLine()
CancelErrorRead            Method         void CancelErrorRead()
CancelOutputRead           Method         void CancelOutputRead()
Close                      Method         void Close()
CloseMainWindow            Method         bool CloseMainWindow()
CreateObjRef               Method         System.Runtime.Remoting.ObjRef
CreateObjRef(...
Dispose                    Method         void Dispose(), void
IDisposable.Dispose()
Equals                     Method         bool Equals(System.Object obj)
GetHashCode                Method         int GetHashCode()
GetLifetimeService         Method         System.Object GetLifetimeService()
GetType                    Method         type GetType()
InitializeLifetimeService  Method         System.Object
InitializeLifetimeService()
Kill                       Method         void Kill()
```

```
Refresh                    Method         void Refresh()
Start                      Method         bool Start()
ToString                   Method         string ToString()
WaitForExit                Method         bool WaitForExit(int
milliseconds), void Wai...
WaitForInputIdle           Method         bool WaitForInputIdle(int
milliseconds), boo...
__NounName                 NoteProperty   string __NounName=Process
BasePriority               Property       int BasePriority {get;}
Container                  Property       System.ComponentModel.IContainer
Container {...
EnableRaisingEvents        Property       bool EnableRaisingEvents
{get;set;}
ExitCode                   Property       int ExitCode {get;}
ExitTime                   Property       datetime ExitTime {get;}
Handle                     Property       System.IntPtr Handle {get;}
HandleCount                Property       int HandleCount {get;}
HasExited                  Property       bool HasExited {get;}
Id                         Property       int Id {get;}
MachineName                Property       string MachineName {get;}
MainModule                 Property       System.Diagnostics.ProcessModule
MainModule ...
MainWindowHandle           Property       System.IntPtr MainWindowHandle
{get;}
MainWindowTitle            Property       string MainWindowTitle {get;}
MaxWorkingSet              Property       System.IntPtr MaxWorkingSet
{get;set;}
MinWorkingSet              Property       System.IntPtr MinWorkingSet
{get;set;}
Modules                    Property
System.Diagnostics.ProcessModuleCollection M...
NonpagedSystemMemorySize   Property       int NonpagedSystemMemorySize
{get;}
NonpagedSystemMemorySize64 Property       long NonpagedSystemMemorySize64
{get;}
PagedMemorySize            Property       int PagedMemorySize {get;}
PagedMemorySize64          Property       long PagedMemorySize64 {get;}
PagedSystemMemorySize      Property       int PagedSystemMemorySize {get;}
PagedSystemMemorySize64    Property       long PagedSystemMemorySize64
{get;}
PeakPagedMemorySize        Property       int PeakPagedMemorySize {get;}
PeakPagedMemorySize64      Property       long PeakPagedMemorySize64 {get;}
PeakVirtualMemorySize      Property       int PeakVirtualMemorySize {get;}
PeakVirtualMemorySize64    Property       long PeakVirtualMemorySize64
{get;}
PeakWorkingSet             Property       int PeakWorkingSet {get;}
PeakWorkingSet64           Property       long PeakWorkingSet64 {get;}
PriorityBoostEnabled       Property       bool PriorityBoostEnabled
{get;set;}
PriorityClass              Property
System.Diagnostics.ProcessPriorityClass Prio...
PrivateMemorySize          Property       int PrivateMemorySize {get;}
PrivateMemorySize64        Property       long PrivateMemorySize64 {get;}
PrivilegedProcessorTime    Property       timespan PrivilegedProcessorTime
{get;}
```

```
ProcessName                Property       string ProcessName {get;}
ProcessorAffinity          Property       System.IntPtr ProcessorAffinity
{get;set;}
Responding                 Property       bool Responding {get;}
SafeHandle                 Property
Microsoft.Win32.SafeHandles.SafeProcessHandl...
SessionId                  Property       int SessionId {get;}
Site                       Property       System.ComponentModel.ISite Site
{get;set;}
StandardError              Property       System.IO.StreamReader
StandardError {get;}
StandardInput              Property       System.IO.StreamWriter
StandardInput {get;}
StandardOutput             Property       System.IO.StreamReader
StandardOutput {get;}
StartInfo                  Property
System.Diagnostics.ProcessStartInfo StartInf...
StartTime                  Property       datetime StartTime {get;}
SynchronizingObject        Property
System.ComponentModel.ISynchronizeInvoke Syn...
Threads                    Property
System.Diagnostics.ProcessThreadCollection T...
TotalProcessorTime         Property       timespan TotalProcessorTime {get;}
UserProcessorTime          Property       timespan UserProcessorTime {get;}
VirtualMemorySize          Property       int VirtualMemorySize {get;}
VirtualMemorySize64        Property       long VirtualMemorySize64 {get;}
WorkingSet                 Property       int WorkingSet {get;}
WorkingSet64               Property       long WorkingSet64 {get;}
PSConfiguration            PropertySet    PSConfiguration {Name, Id,
PriorityClass, Fi...
PSResources                PropertySet    PSResources {Name, Id,
Handlecount, WorkingS...
Company                    ScriptProperty System.Object Company
{get=$this.Mainmodule....
CPU                        ScriptProperty System.Object CPU
{get=$this.TotalProcessorT...
Description                ScriptProperty System.Object Description
{get=$this.Mainmod...
FileVersion                ScriptProperty System.Object FileVersion
{get=$this.Mainmod...
Path                       ScriptProperty System.Object Path
{get=$this.Mainmodule.Fil...
Product                    ScriptProperty System.Object Product
{get=$this.Mainmodule....
ProductVersion             ScriptProperty System.Object ProductVersion
{get=$this.Main...
```

Notice that there are more properties listed than are displayed by default. A number of the default properties displayed don't show up as properties when viewing the results of `Get-Member`. This is because many of the displayed values, such as `NPM(K)`, `PM(K)`, `WS(K)`, and `CPU(s)`, are calculated properties. To determine the actual property names, the command must be piped to `Get-Member`.

If a command does not produce output, it can't be piped to `Get-Member`. Since `Start-Service` doesn't produce any output by default, it generates an error when you try to pipe it to `Get-Member`.

PowerShell

```
Start-Service -Name w32time | Get-Member
```

Output

```
Get-Member : You must specify an object for the Get-Member cmdlet.
At line:1 char:31
+ Start-Service -Name w32time | Get-Member
+
    + CategoryInfo          : CloseError: (:) [Get-Member],
InvalidOperationException
    + FullyQualifiedErrorId :
NoObjectInGetMember,Microsoft.PowerShell.Commands.GetMembe
   rCommand
```

The **PassThru** parameter can be specified with the `Start-Service` cmdlet make it produce output, which is then piped to `Get-Member` without error.

PowerShell

```
Start-Service -Name w32time -PassThru | Get-Member
```

Output

```
   TypeName: System.ServiceProcess.ServiceController

Name                      MemberType    Definition
----                      ----------    ----------
Name                      AliasProperty Name = ServiceName
RequiredServices          AliasProperty RequiredServices =
ServicesDependedOn
Disposed                  Event         System.EventHandler
Disposed(System.Object, Sy...
Close                     Method        void Close()
Continue                  Method        void Continue()
CreateObjRef              Method        System.Runtime.Remoting.ObjRef
CreateObjRef(ty...
Dispose                   Method        void Dispose(), void
IDisposable.Dispose()
Equals                    Method        bool Equals(System.Object obj)
ExecuteCommand            Method        void ExecuteCommand(int command)
GetHashCode               Method        int GetHashCode()
GetLifetimeService        Method        System.Object GetLifetimeService()
```

```
GetType                    Method        type GetType()
InitializeLifetimeService Method        System.Object
InitializeLifetimeService()
Pause                      Method        void Pause()
Refresh                    Method        void Refresh()
Start                      Method        void Start(), void Start(string[]
args)
Stop                       Method        void Stop()
WaitForStatus              Method        void
WaitForStatus(System.ServiceProcess.Servi...
CanPauseAndContinue        Property      bool CanPauseAndContinue {get;}
CanShutdown                Property      bool CanShutdown {get;}
CanStop                    Property      bool CanStop {get;}
Container                  Property      System.ComponentModel.IContainer
Container {get;}
DependentServices          Property
System.ServiceProcess.ServiceController[] Depe...
DisplayName                Property      string DisplayName {get;set;}
MachineName                Property      string MachineName {get;set;}
ServiceHandle              Property
System.Runtime.InteropServices.SafeHandle Serv...
ServiceName                Property      string ServiceName {get;set;}
ServicesDependedOn         Property
System.ServiceProcess.ServiceController[] Serv...
ServiceType                Property      System.ServiceProcess.ServiceType
ServiceType ...
Site                       Property      System.ComponentModel.ISite Site
{get;set;}
StartType                  Property
System.ServiceProcess.ServiceStartMode StartTy...
Status                     Property
System.ServiceProcess.ServiceControllerStatus ...
ToString                   ScriptMethod  System.Object ToString();
```

To be piped to `Get-Member`, a command must produce object-based output.

PowerShell

```powershell
Get-Service -Name w32time | Out-Host | Get-Member
```

Output

```
Status   Name               DisplayName
------   ----               -----------
Running  w32time            Windows Time

Get-Member : You must specify an object for the Get-Member cmdlet.
At line:1 char:40
+ Get-Service -Name w32time | Out-Host | Get-Member
+
    + CategoryInfo          : CloseError: (:) [Get-Member],
InvalidOperationException
```

```
    + FullyQualifiedErrorId :
NoObjectInGetMember,Microsoft.PowerShell.Commands.GetMemberCommand
```

`Out-Host` writes directly to the PowerShell host, but it doesn't produce object-based output for the pipeline. So it can't be piped to `Get-Member`.

Active Directory

> ⓘ Note
>
> The Remote Server Administration Tools listed in the requirements section of this chapter are required to complete this section. Also, as mentioned in the introduction to this book, your Windows 10 lab environment computer must be a member of the lab environment domain.

Use `Get-Command` with the **Module** parameter to determine what commands were added as part of the ActiveDirectory PowerShell module when the remote server administration tools were installed.

PowerShell

```
Get-Command -Module ActiveDirectory
```

Output

```
CommandType     Name                                               Version
Source
-----------     ----                                               -------
------
Cmdlet          Add-ADCentralAccessPolicyMember                    1.0.0.0
ActiveDi...
Cmdlet          Add-ADComputerServiceAccount                       1.0.0.0
ActiveDi...
Cmdlet          Add-ADDomainControllerPasswordReplicationPolicy    1.0.0.0
ActiveDi...
Cmdlet          Add-ADFineGrainedPasswordPolicySubject             1.0.0.0
ActiveDi...
Cmdlet          Add-ADGroupMember                                  1.0.0.0
ActiveDi...
Cmdlet          Add-ADPrincipalGroupMembership                     1.0.0.0
ActiveDi...
Cmdlet          Add-ADResourcePropertyListMember                   1.0.0.0
ActiveDi...
Cmdlet          Clear-ADAccountExpiration                          1.0.0.0
ActiveDi...
```

```
Cmdlet          Clear-ADClaimTransformLink                         1.0.0.0
ActiveDi...
Cmdlet          Disable-ADAccount                                  1.0.0.0
ActiveDi...
...
```

A total of 147 commands were added as part of the ActiveDirectory PowerShell module. Some commands of these commands only return a portion of the available properties by default.

Did you notice anything different about the names of the commands in this module? The noun portion of the commands has an AD prefix. This is common to see on the commands of most modules. The prefix is designed to help prevent naming conflicts.

PowerShell

```powershell
Get-ADUser -Identity mike | Get-Member
```

Output

```
   TypeName: Microsoft.ActiveDirectory.Management.ADUser

Name              MemberType            Definition
----              ----------            ----------
Contains          Method                bool Contains(string propertyName)
Equals            Method                bool Equals(System.Object obj)
GetEnumerator     Method
System.Collections.IDictionaryEnumerator GetEn...
GetHashCode       Method                int GetHashCode()
GetType           Method                type GetType()
ToString          Method                string ToString()
Item              ParameterizedProperty
Microsoft.ActiveDirectory.Management.ADPropert...
DistinguishedName Property              System.String DistinguishedName
{get;set;}
Enabled           Property              System.Boolean Enabled {get;set;}
GivenName         Property              System.String GivenName {get;set;}
Name              Property              System.String Name {get;}
ObjectClass       Property              System.String ObjectClass {get;set;}
ObjectGUID        Property              System.Nullable`1[[System.Guid,
mscorlib, Vers...
SamAccountName    Property              System.String SamAccountName
{get;set;}
SID               Property
System.Security.Principal.SecurityIdentifier S...
Surname           Property              System.String Surname {get;set;}
UserPrincipalName Property              System.String UserPrincipalName
{get;set;}
```

Even if you're only vaguely familiar with Active Directory, you're probably aware that a user account has more properties than are shown in this example.

The `Get-ADUser` cmdlet has a **Properties** parameter that is used to specify the additional (non-default) properties you want to return. Specifying the `*` wildcard character returns all of them.

PowerShell

```
Get-ADUser -Identity mike -Properties * | Get-Member
```

Output

```
   TypeName: Microsoft.ActiveDirectory.Management.ADUser

Name                                  MemberType            Definition
----                                  ----------            ----------
Contains                              Method                bool
Contains(string proper...
Equals                                Method                bool
Equals(System.Object obj)
GetEnumerator                         Method
System.Collections.IDiction...
GetHashCode                           Method                int GetHashCode()
GetType                               Method                type GetType()
ToString                              Method                string ToString()
Item                                  ParameterizedProperty
Microsoft.ActiveDirectory.M...
AccountExpirationDate                 Property              System.DateTime
AccountExpi...
accountExpires                        Property              System.Int64
accountExpires...
AccountLockoutTime                    Property              System.DateTime
AccountLock...
AccountNotDelegated                   Property              System.Boolean
AccountNotDe...
AllowReversiblePasswordEncryption     Property              System.Boolean
AllowReversi...
AuthenticationPolicy                  Property
Microsoft.ActiveDirectory.M...
AuthenticationPolicySilo              Property
Microsoft.ActiveDirectory.M...
BadLogonCount                         Property              System.Int32
BadLogonCount ...
badPasswordTime                       Property              System.Int64
badPasswordTim...
badPwdCount                           Property              System.Int32
badPwdCount {g...
CannotChangePassword                  Property              System.Boolean
CannotChange...
CanonicalName                         Property              System.String
```

```
CanonicalName...
Certificates                        Property
Microsoft.ActiveDirectory.M...
City                                Property            System.String
City {get;set;}
CN                                  Property            System.String CN
{get;}
codePage                            Property            System.Int32
codePage {get;...
Company                             Property            System.String
Company {get;...
CompoundIdentitySupported           Property
Microsoft.ActiveDirectory.M...
Country                             Property            System.String
Country {get;...
countryCode                         Property            System.Int32
countryCode {g...
Created                             Property            System.DateTime
Created {get;}
createTimeStamp                     Property            System.DateTime
createTimeS...
Deleted                             Property            System.Boolean
Deleted {get;}
Department                          Property            System.String
Department {g...
Description                         Property            System.String
Description {...
DisplayName                         Property            System.String
DisplayName {...
DistinguishedName                   Property            System.String
Distinguished...
Division                            Property            System.String
Division {get...
DoesNotRequirePreAuth               Property            System.Boolean
DoesNotRequi...
dSCorePropagationData               Property
Microsoft.ActiveDirectory.M...
EmailAddress                        Property            System.String
EmailAddress ...
EmployeeID                          Property            System.String
EmployeeID {g...
EmployeeNumber                      Property            System.String
EmployeeNumbe...
Enabled                             Property            System.Boolean
Enabled {get...
Fax                                 Property            System.String Fax
{get;set;}
GivenName                           Property            System.String
GivenName {ge...
HomeDirectory                       Property            System.String
HomeDirectory...
HomedirRequired                     Property            System.Boolean
HomedirRequi...
HomeDrive                           Property            System.String
HomeDrive {ge...
```

```
HomePage                                Property             System.String
HomePage {get...
HomePhone                               Property             System.String
HomePhone {ge...
Initials                                Property             System.String
Initials {get...
instanceType                            Property             System.Int32
instanceType {...
isDeleted                               Property             System.Boolean
isDeleted {g...
KerberosEncryptionType                  Property
Microsoft.ActiveDirectory.M...
LastBadPasswordAttempt                  Property             System.DateTime
LastBadPass...
LastKnownParent                         Property             System.String
LastKnownPare...
lastLogoff                              Property             System.Int64
lastLogoff {ge...
lastLogon                               Property             System.Int64
lastLogon {get...
LastLogonDate                           Property             System.DateTime
LastLogonDa...
lastLogonTimestamp                      Property             System.Int64
lastLogonTimes...
LockedOut                               Property             System.Boolean
LockedOut {g...
logonCount                              Property             System.Int32
logonCount {ge...
LogonWorkstations                       Property             System.String
LogonWorkstat...
Manager                                 Property             System.String
Manager {get;...
MemberOf                                Property
Microsoft.ActiveDirectory.M...
MNSLogonAccount                         Property             System.Boolean
MNSLogonAcco...
MobilePhone                             Property             System.String
MobilePhone {...
Modified                                Property             System.DateTime
Modified {g...
modifyTimeStamp                         Property             System.DateTime
modifyTimeS...
msDS-User-Account-Control-Computed      Property             System.Int32
msDS-User-Acco...
Name                                    Property             System.String
Name {get;}
nTSecurityDescriptor                    Property
System.DirectoryServices.Ac...
ObjectCategory                          Property             System.String
ObjectCategor...
ObjectClass                             Property             System.String
ObjectClass {...
ObjectGUID                              Property
System.Nullable`1[[System.G...
objectSid                               Property
```

```
System.Security.Principal.S...
Office                                Property             System.String
Office {get;s...
OfficePhone                           Property             System.String
OfficePhone {...
Organization                          Property             System.String
Organization ...
OtherName                             Property             System.String
OtherName {ge...
PasswordExpired                       Property             System.Boolean
PasswordExpi...
PasswordLastSet                       Property             System.DateTime
PasswordLas...
PasswordNeverExpires                  Property             System.Boolean
PasswordNeve...
PasswordNotRequired                   Property             System.Boolean
PasswordNotR...
POBox                                 Property             System.String
POBox {get;set;}
PostalCode                            Property             System.String
PostalCode {g...
PrimaryGroup                          Property             System.String
PrimaryGroup ...
primaryGroupID                        Property             System.Int32
primaryGroupID...
PrincipalsAllowedToDelegateToAccount Property
Microsoft.ActiveDirectory.M...
ProfilePath                           Property             System.String
ProfilePath {...
ProtectedFromAccidentalDeletion       Property             System.Boolean
ProtectedFro...
pwdAnswer                             Property             System.String
pwdAnswer {ge...
pwdLastSet                            Property             System.Int64
pwdLastSet {ge...
pwdQuestion                           Property             System.String
pwdQuestion {...
SamAccountName                        Property             System.String
SamAccountNam...
sAMAccountType                        Property             System.Int32
sAMAccountType...
ScriptPath                            Property             System.String
ScriptPath {g...
sDRightsEffective                     Property             System.Int32
sDRightsEffect...
ServicePrincipalNames                 Property
Microsoft.ActiveDirectory.M...
SID                                   Property
System.Security.Principal.S...
SIDHistory                            Property
Microsoft.ActiveDirectory.M...
SmartcardLogonRequired                Property             System.Boolean
SmartcardLog...
sn                                    Property             System.String sn
{get;set;}
```

```
State                                 Property              System.String
State {get;set;}
StreetAddress                         Property              System.String
StreetAddress...
Surname                               Property              System.String
Surname {get;...
Title                                 Property              System.String
Title {get;set;}
TrustedForDelegation                  Property              System.Boolean
TrustedForDe...
TrustedToAuthForDelegation            Property              System.Boolean
TrustedToAut...
UseDESKeyOnly                         Property              System.Boolean
UseDESKeyOnl...
userAccountControl                    Property              System.Int32
userAccountCon...
userCertificate                       Property
Microsoft.ActiveDirectory.M...
UserPrincipalName                     Property              System.String
UserPrincipal...
uSNChanged                            Property              System.Int64
uSNChanged {get;}
uSNCreated                            Property              System.Int64
uSNCreated {get;}
whenChanged                           Property              System.DateTime
whenChanged...
whenCreated                           Property              System.DateTime
whenCreated...
```

Now that looks more like it.

Can you think of a reason why the properties of an Active Directory user account would be so limited by default? Imagine if you returned every property for every user account in your production Active Directory environment. Think of the performance degradation that you could cause, not only to the domain controllers themselves, but also to your network. It's doubtful that you'll actually need every property anyway. Returning all of the properties for a single user account is perfectly acceptable when you're trying to determine what properties exist.

It's not uncommon to run a command many times when prototyping it. If you're going to perform some huge query, query it once and store the results in a variable. Then work with the contents of the variable instead of repeatedly using some expensive query.

PowerShell

```powershell
$Users = Get-ADUser -Identity mike -Properties *
```

Use the contents of the `$Users` variable instead of running the previous command numerous times. Keep in mind that the contents of the variable aren't updated when changes are made to that user in Active Directory.

You could pipe the `$Users` variable to `Get-Member` to discover the available properties.

PowerShell

```
$Users | Get-Member
```

Then select the individual properties by piping `$Users` to `Select-Object`, all without ever having to query Active Directory more than one time.

PowerShell

```
$Users | Select-Object -Property Name, LastLogonDate, LastBadPasswordAttempt
```

If you are going to query Active Directory more than once, use the **Properties** parameter to specify any non-default properties you want.

PowerShell

```
Get-ADUser -Identity mike -Properties LastLogonDate, LastBadPasswordAttempt
```

Output

```
DistinguishedName      : CN=Mike F. Robbins,OU=Sales,DC=mikefrobbins,DC=com
Enabled                : True
GivenName              : Mike
LastBadPasswordAttempt : 2/4/2017 10:46:15 AM
LastLogonDate          : 2/18/2017 12:45:14 AM
Name                   : Mike F. Robbins
ObjectClass            : user
ObjectGUID             : a82a8c58-1332-4a57-a6e2-68e0c750ea56
SamAccountName         : mike
SID                    : S-1-5-21-2989741381-570885089-3319121794-1108
Surname                : Robbins
UserPrincipalName      : miker@mikefrobbins.com
```

Summary

In this chapter, you've learned how to determine what type of object a command produces, how to determine what properties and methods are available for a command, and how to work with commands that limit the properties that are returned by default.

Review

1. What type of object does the `Get-Process` cmdlet produce?
2. How do you determine what the available properties are for a command?
3. If a command exists for getting something but not for setting the same thing, what should you check for?
4. How can certain commands that don't produce output by default be made to produce output?
5. If you're going to be working with the results of a command that produces an enormous amount of output, what should you consider doing?

Recommended Reading

- Get-Member
- Viewing Object Structure (Get-Member)
- about_Objects
- about_Properties
- about_Methods
- No PowerShell Cmdlet to Start or Stop Something? Don't Forget to Check for Methods on the Get Cmdlets

Chapter 4 - One-liners and the pipeline

Article • 12/09/2022

When I first started learning PowerShell, if I couldn't accomplish a task with a PowerShell one-liner, I went back to the GUI. Over time, I built my skills up to writing scripts, functions, and modules. Don't allow yourself to become overwhelmed by some of the more advanced examples you may see on the internet. No one is a natural expert with PowerShell. We were all beginners at one time.

I have a bit of advice to offer those of you who are still using the GUI for administration: install the management tools on your admin workstation and manage your servers remotely. This way it won't matter if the server is running a GUI or Server Core installation of the operating system. It's going to help prepare you for managing servers remotely with PowerShell.

As with previous chapters, be sure to follow along on your Windows 10 lab environment computer.

One-Liners

A PowerShell one-liner is one continuous pipeline and not necessarily a command that's on one physical line. Not all commands that are on one physical line are one-liners.

Even though the following command is on multiple physical lines, it's a PowerShell one-liner because it's one continuous pipeline. It could be written on one physical line, but I've chosen to line break at the pipe symbol. The pipe symbol is one of the characters where a natural line break is allowed in PowerShell.

PowerShell

```
Get-Service |
  Where-Object CanPauseAndContinue -eq $true |
    Select-Object -Property *
```

Output

```
Name                  : LanmanWorkstation
RequiredServices      : {NSI, MRxSmb20, Bowser}
CanPauseAndContinue   : True
CanShutdown           : False
CanStop               : True
DisplayName           : Workstation
DependentServices     : {SessionEnv, Netlogon, Browser}
```

```
MachineName         : .
ServiceName         : LanmanWorkstation
ServicesDependedOn  : {NSI, MRxSmb20, Bowser}
ServiceHandle       : SafeServiceHandle
Status              : Running
ServiceType         : Win32ShareProcess
StartType           : Automatic
Site                :
Container           :

Name                : Netlogon
RequiredServices    : {LanmanWorkstation}
CanPauseAndContinue : True
CanShutdown         : False
CanStop             : True
DisplayName         : Netlogon
DependentServices   : {}
MachineName         : .
ServiceName         : Netlogon
ServicesDependedOn  : {LanmanWorkstation}
ServiceHandle       : SafeServiceHandle
Status              : Running
ServiceType         : Win32ShareProcess
StartType           : Automatic
Site                :
Container           :

Name                : vmicheartbeat
RequiredServices    : {}
CanPauseAndContinue : True
CanShutdown         : False
CanStop             : True
DisplayName         : Hyper-V Heartbeat Service
DependentServices   : {}
MachineName         : .
ServiceName         : vmicheartbeat
ServicesDependedOn  : {}
ServiceHandle       : SafeServiceHandle
Status              : Running
ServiceType         : Win32ShareProcess
StartType           : Manual
Site                :
Container           :

Name                : vmickvpexchange
RequiredServices    : {}
CanPauseAndContinue : True
CanShutdown         : False
CanStop             : True
DisplayName         : Hyper-V Data Exchange Service
DependentServices   : {}
MachineName         : .
ServiceName         : vmickvpexchange
ServicesDependedOn  : {}
ServiceHandle       : SafeServiceHandle
```

```
Status              : Running
ServiceType         : Win32ShareProcess
StartType           : Manual
Site                :
Container           :

Name                : vmicrdv
RequiredServices    : {}
CanPauseAndContinue : True
CanShutdown         : False
CanStop             : True
DisplayName         : Hyper-V Remote Desktop Virtualization Service
DependentServices   : {}
MachineName         : .
ServiceName         : vmicrdv
ServicesDependedOn  : {}
ServiceHandle       : SafeServiceHandle
Status              : Running
ServiceType         : Win32ShareProcess
StartType           : Manual
Site                :
Container           :

Name                : vmicshutdown
RequiredServices    : {}
CanPauseAndContinue : True
CanShutdown         : False
CanStop             : True
DisplayName         : Hyper-V Guest Shutdown Service
DependentServices   : {}
MachineName         : .
ServiceName         : vmicshutdown
ServicesDependedOn  : {}
ServiceHandle       : SafeServiceHandle
Status              : Running
ServiceType         : Win32ShareProcess
StartType           : Manual
Site                :
Container           :

Name                : vmictimesync
RequiredServices    : {VmGid}
CanPauseAndContinue : True
CanShutdown         : False
CanStop             : True
DisplayName         : Hyper-V Time Synchronization Service
DependentServices   : {}
MachineName         : .
ServiceName         : vmictimesync
ServicesDependedOn  : {VmGid}
ServiceHandle       : SafeServiceHandle
Status              : Running
ServiceType         : Win32ShareProcess
StartType           : Manual
Site                :
```

```
Container           :

Name                : vmicvss
RequiredServices    : {}
CanPauseAndContinue : True
CanShutdown         : False
CanStop             : True
DisplayName         : Hyper-V Volume Shadow Copy Requestor
DependentServices   : {}
MachineName         : .
ServiceName         : vmicvss
ServicesDependedOn  : {}
ServiceHandle       : SafeServiceHandle
Status              : Running
ServiceType         : Win32ShareProcess
StartType           : Manual
Site                :
Container           :

Name                : Winmgmt
RequiredServices    : {RPCSS}
CanPauseAndContinue : True
CanShutdown         : True
CanStop             : True
DisplayName         : Windows Management Instrumentation
DependentServices   : {wscsvc, NcaSvc, iphlpsvc}
MachineName         : .
ServiceName         : Winmgmt
ServicesDependedOn  : {RPCSS}
ServiceHandle       : SafeServiceHandle
Status              : Running
ServiceType         : Win32ShareProcess
StartType           : Automatic
Site                :
Container           :
```

Natural line breaks can occur at commonly used characters including comma (`,`) and opening brackets (`[`), braces (`{`), and parenthesis (`(`). Others that aren't so common include the semicolon (`;`), equals sign (`=`), and both opening single and double quotes (`'`,`"`).

Using the backtick (`` ` ``) or grave accent character as a line continuation character is a controversial topic. My recommendation is to try to avoid it if at all possible. I often see PowerShell commands written using a backtick immediately after a natural line break character. There's no reason for it to be there.

PowerShell

```powershell
Get-Service -Name w32time |
>> Select-Object -Property *
```

Output

```
Name                : w32time
RequiredServices    : {}
CanPauseAndContinue : False
CanShutdown         : True
CanStop             : True
DisplayName         : Windows Time
DependentServices   : {}
MachineName         : .
ServiceName         : w32time
ServicesDependedOn  : {}
ServiceHandle       : SafeServiceHandle
Status              : Running
ServiceType         : Win32ShareProcess
StartType           : Manual
Site                :
Container           :
```

The commands shown in the previous two examples work fine in the PowerShell console. But if you try to run them in the console pane of the PowerShell ISE, they'll generate an error. The console pane of the PowerShell ISE doesn't wait for the rest of the command to be entered on the next line like the PowerShell console does. To avoid this problem in the console pane of the PowerShell ISE, use `Shift`+`Enter` instead of just pressing `Enter` when continuing a command on another line.

This next example isn't a PowerShell one-liner because it's not one continuous pipeline. It's two separate commands on one line, separated by a semicolon.

PowerShell

```
$Service = 'w32time'; Get-Service -Name $Service
```

Output

```
Status   Name               DisplayName
------   ----               -----------
Running  w32time            Windows Time
```

Many programming and scripting languages require a semicolon at the end of each line. While they can be used that way in PowerShell, it's not recommended because they're not needed.

Filtering Left

The results of the commands shown in this chapter have been filtered down to a subset. For example, `Get-Service` was used with the **Name** parameter to filter the list of services that were returned to only the Windows Time service.

In the pipeline, you always want to filter the results down to what you're looking for as early as possible. This is accomplished using parameters on the first command or, the one to the far left. This is sometimes called *filtering left*.

The following example uses the **Name** parameter of `Get-Service` to immediately filter the results to the Windows Time service only.

PowerShell

```
Get-Service -Name w32time
```

Output

```
Status   Name               DisplayName
------   ----               -----------
Running  w32time            Windows Time
```

It's not uncommon to see examples where the command is piped to `Where-Object` to perform the filtering.

PowerShell

```
Get-Service | Where-Object Name -eq w32time
```

Output

```
Status   Name               DisplayName
------   ----               -----------
Running  W32Time            Windows Time
```

The first example filters at the source and only returns the results for the Windows Time service. The second example returns all the services then pipes them to another command to perform the filtering. While this may not seem like a big deal in this example, imagine if you were querying a list of Active Directory users. Do you really want to return the information for many thousands of user accounts from Active Directory only to pipe them to another command that filters them down to a tiny subset? My recommendation is to always filter left even when it doesn't seem to matter. You'll be so use to it that you'll automatically filter left when it really does matter.

I once had someone tell me that the order you specify the commands in doesn't matter. That couldn't be further from the truth. The order that the commands are specified in does indeed matter when performing filtering. For example, consider the scenario where you are using `Select-Object` to select only a few properties and `Where-Object` to filter on properties that won't be in the selection. In that scenario, the filtering must occur first, otherwise the property won't exist in the pipeline when try to perform the filtering.

PowerShell

```
Get-Service |
Select-Object -Property DisplayName, Running, Status |
Where-Object CanPauseAndContinue
```

The command in the previous example doesn't return any results because the **CanStopAndContinue** property doesn't exist when the results of `Select-Object` are piped to `Where-Object`. That particular property wasn't "selected". In essence, it was filtered out. Reversing the order of `Select-Object` and `Where-Object` produces the desired results.

PowerShell

```
Get-Service |
Where-Object CanPauseAndContinue |
Select-Object -Property DisplayName, Status
```

Output

```
DisplayName                                   Status
-----------                                   ------
Workstation                                   Running
Netlogon                                      Running
Hyper-V Heartbeat Service                     Running
Hyper-V Data Exchange Service                 Running
Hyper-V Remote Desktop Virtualization Service Running
Hyper-V Guest Shutdown Service                Running
Hyper-V Time Synchronization Service          Running
Hyper-V Volume Shadow Copy Requestor          Running
Windows Management Instrumentation            Running
```

The Pipeline

As you've seen in many of the examples shown so far throughout this book, many times the output of one command can be used as input for another command. In Chapter 3, `Get-Member` was used to determine what type of object a command produces. Chapter 3

also showed using the **ParameterType** parameter of `Get-Command` to determine what commands accepted that type of input, although not necessarily by pipeline input.

Depending on how thorough a commands help is, it may include an **INPUTS** and **OUTPUTS** section.

PowerShell

```
help Stop-Service -Full
```

Output

```
...
INPUTS
    System.ServiceProcess.ServiceController, System.String
        You can pipe a service object or a string that contains the name of
a service
        to this cmdlet.

OUTPUTS
    None, System.ServiceProcess.ServiceController
        This cmdlet generates a System.ServiceProcess.ServiceController
object that
        represents the service, if you use the PassThru parameter.
Otherwise, this
        cmdlet does not generate any output.
...
```

Only the relevant section of the help is shown in the previous results. As you can see, the **INPUTS** section states that a **ServiceController** or a **String** object can be piped to the `Stop-Service` cmdlet. It doesn't tell you which parameters accept that type of input. One of the easiest ways to determine that information is to look through the different parameters in the full version of the help for the `Stop-Service` cmdlet.

PowerShell

```
help Stop-Service -Full
```

Output

```
...
-DisplayName <String[]>
    Specifies the display names of the services to stop. Wildcard characters
are
    permitted.

    Required?                    true
```

```
    Position?                   named
    Default value               None
    Accept pipeline input?      False
    Accept wildcard characters?  false

-InputObject <ServiceController[]>
    Specifies ServiceController objects that represent the services to stop.
Enter a
    variable that contains the objects, or type a command or expression that
gets the
    objects.

    Required?                   true
    Position?                   0
    Default value               None
    Accept pipeline input?      True (ByValue)
    Accept wildcard characters?  false

-Name <String[]>
    Specifies the service names of the services to stop. Wildcard characters
are
    permitted.

    Required?                   true
    Position?                   0
    Default value               None
    Accept pipeline input?      True (ByPropertyName, ByValue)
    Accept wildcard characters?  false
...
```

Once again, I've only shown the relevant portion of the help in the previous set of results. Notice that the **DisplayName** parameter doesn't accept pipeline input, the **InputObject** parameter accepts pipeline input **by value** for **ServiceController** objects, and the **Name** parameter accepts pipeline input **by value** for **string** objects. It also accepts pipeline input **by property name**.

When a parameter accepts pipeline input by both property name and by value, it always tries **by value** first. If **by value** fails, then it tries **by property name**. **By value** is a little misleading. I prefer to call it **by type**. This means if you pipe the results of a command that produces a **ServiceController** object type to `Stop-Service`, it binds that input to the **InputObject** parameter. But if you pipe the results of a command that produces **String** output to `Stop-Service`, it binds it to the **Name** parameter. If you pipe the results of a command that doesn't produce a **ServiceController** or **String** object to `Stop-Service`, but it does produce output containing a property called **Name**, then it binds the **Name** property from the output to the **Name** parameter of `Stop-Service`.

Determine what type of output the `Get-Service` command produces.

```
```

PowerShell

```
Get-Service -Name w32time | Get-Member
```

Output

```
   TypeName: System.ServiceProcess.ServiceController
```

`Get-Service` produces a ServiceController object type.

As you previously saw in the help, the **InputObject** parameter of `Stop-Service` accepts **ServiceController** objects via the pipeline **by value** (by type). This means that when the results of the `Get-Service` cmdlet are piped to `Stop-Service`, they bind to the **InputObject** parameter of `Stop-Service`.

PowerShell

```
Get-Service -Name w32time | Stop-Service
```

Now to try string input. Pipe `w32time` to `Get-Member` just to confirm that it's a string.

PowerShell

```
'w32time' | Get-Member
```

Output

```
   TypeName: System.String
```

As previously shown in the help, piping a string to `Stop-Service` binds it **by value** to the **Name** parameter of `Stop-Service`. Test this by piping `w32time` to `Stop-Service`.

PowerShell

```
'w32time' | Stop-Service
```

Notice that in the previous example, I used single quotes around the string `w32time`. In PowerShell, you should always use single quotes instead of double quotes unless the contents of the quoted string contains a variable that needs to be expanded to its actual value. By using single quotes, PowerShell doesn't have to parse the contents contained within the quotes so your code runs a little faster.

Create a custom object to test pipeline input by property name for the **Name** parameter of `Stop-Service`.

PowerShell

```
$CustomObject = [pscustomobject]@{
 Name = 'w32time'
 }
```

The contents of the **CustomObject** variable is a **PSCustomObject** object type and it contains a property named **Name**.

PowerShell

```
$CustomObject | Get-Member
```

Output

```
   TypeName: System.Management.Automation.PSCustomObject

Name        MemberType   Definition
----        ----------   ----------
Equals      Method       bool Equals(System.Object obj)
GetHashCode Method       int GetHashCode()
GetType     Method       type GetType()
ToString    Method       string ToString()
Name        NoteProperty string Name=w32time
```

If you were to surround the `$CustomObject` variable with quotes, you want to use double quotes. Otherwise, using single quotes, the literal string `$CustomObject` is piped to `Get-Member` instead of the value contained by the variable.

Although piping the contents of `$CustomObject` to `Stop-Service` cmdlet binds to the **Name** parameter, this time it binds **by property name** instead of **by value** because the contents of `$CustomObject` is an object that has a property named **Name**.

In this example, I create another custom object using a different property name, such as **Service**.

PowerShell

```
$CustomObject = [pscustomobject]@{
  Service = 'w32time'
}
```

An error is generated when trying to pipe `$CustomObject` to `Stop-Service` because it doesn't produce a **ServiceController** or **String** object, and it doesn't have a property named **Name**.

PowerShell

```
$CustomObject | Stop-Service
```

Output

```
Stop-Service : Cannot find any service with service name
'@{Service=w32time}'.
At line:1 char:17
+ $CustomObject | Stop-Service
+
    + CategoryInfo          : ObjectNotFound: (@{Service=w32time}:String)
[Stop-Service]
   , ServiceCommandException
    + FullyQualifiedErrorId :
NoServiceFoundForGivenName,Microsoft.PowerShell.Commands.S
   topServiceCommand
```

If the output of one command doesn't line up with the pipeline input options for another command, `Select-Object` can be used to rename the property so that the properties lineup correctly.

PowerShell

```
$CustomObject |
  Select-Object -Property @{name='Name';expression={$_.Service}} |
    Stop-Service
```

In this example, `Select-Object` was used to rename the **Service** property to a property named **Name**.

The syntax this example may seem a little complicated at first. What I have learned is that you'll never learn the syntax by copy and pasting code. Take the time to type the code in. After a few times, it becomes second nature. Having multiple monitors is a huge benefit because you can display the example code on one screen and type it in on another one.

Occasionally, you may want to use a parameter that doesn't accept pipeline input. The following example demonstrates using the output of one command as input for another. First save the display name for a couple of Windows services into a text file.

PowerShell

```
'Background Intelligent Transfer Service', 'Windows Time' |
Out-File -FilePath $env:TEMP\services.txt
```

You can run the command that provides the needed output within parentheses as the value for the parameter of the command requiring the input.

PowerShell

```
Stop-Service -DisplayName (Get-Content -Path $env:TEMP\services.txt)
```

This is just like order of operations in Algebra for those of you who remember how it works. The command within parentheses always runs prior to the outer portion of the command.

PowerShellGet

PowerShellGet is a PowerShell module that contains commands for discovering, installing, publishing, and updating PowerShell modules (and other artifacts) to or from a NuGet repository. PowerShellGet ships with PowerShell version 5.0 and higher. It is available as a separate download for PowerShell version 3.0 and higher.

Microsoft hosts an online NuGet repository called the PowerShell Gallery. Although this repository is hosted by Microsoft, the majority of the modules contained within the repository aren't written by Microsoft. Any code obtain from the PowerShell Gallery should be thoroughly reviewed in an isolated test environment before being considered suitable for use in a production environment.

Most companies will want to host their own internal private NuGet repository where they can post their internal use only modules as well as modules that they've downloaded from other sources once they've validated them as being non-malicious.

Use the `Find-Module` cmdlet that's part of the PowerShellGet module to find a module in the PowerShell Gallery that I wrote named MrToolkit.

PowerShell

```
Find-Module -Name MrToolkit
```

Output

```
NuGet provider is required to continue
PowerShellGet requires NuGet provider version '2.8.5.201' or newer to
interact with
NuGet-based repositories. The NuGet provider must be available in
'C:\Program
Files\PackageManagement\ProviderAssemblies' or
'C:\Users\MrAdmin\AppData\Local\PackageManagement\ProviderAssemblies'. You
can also
install the NuGet provider by running 'Install-PackageProvider -Name NuGet
-MinimumVersion 2.8.5.201 -Force'. Do you want PowerShellGet to install and
import the
NuGet provider now?
[Y] Yes  [N] No  [S] Suspend  [?] Help (default is "Y"):

Version    Name                                Repository
Description
-------    ----                                ----------           --------
---
1.1        MrToolkit                           PSGallery            Misc
PowerShell Tools
```

The first time you use one of the commands from the PowerShellGet module, you'll be prompted to install the NuGet provider.

To install the MrToolkit module, pipe the previous command to `Install-Module`.

PowerShell

```
Find-Module -Name MrToolkit | Install-Module
```

Output

```
Untrusted repository
You are installing the modules from an untrusted repository. If you trust
this
repository, change its InstallationPolicy value by running the Set-
PSRepository cmdlet.
Are you sure you want to install the modules from
'https://www.powershellgallery.com/api/v2/'?
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
(default is "N"): y
```

Since the PowerShell Gallery is an untrusted repository, it prompts you to approve the installation of the module.

Finding pipeline input the easy way

The MrToolkit module contains a function named `Get-MrPipelineInput`. This cmdlet can be used to easily determine which parameters of a command accept pipeline input, what type of object they accept, and if they accept pipeline input **by value** or **by property name**.

PowerShell

```
Get-MrPipelineInput -Name Stop-Service
```

Output

```
ParameterName ParameterType                                ValueFromPipeline
ValueFromPipelineByPropertyName
------------- -------------                                ----------------- --
-------------
InputObject   System.ServiceProcess.ServiceController[]             True
False
Name          System.String[]                                       True
True
```

As you can see, the same information we previously determined by sifting through the help can easily be determined with this function.

Summary

In this chapter, you've learned about PowerShell one-liners. You've learned that the number of physical lines that a command is on has nothing to do with whether or not it's a PowerShell one-liner. You've also learned about filtering left, the pipeline, and PowerShellGet.

Review

1. What is a PowerShell one-liner?
2. What are some of the characters where natural line breaks can occur in PowerShell?
3. Why should you filter left?
4. What are the two ways that a PowerShell command can accept pipeline input?
5. Why shouldn't you trust commands found in the PowerShell Gallery?

Recommended Reading

- about_Pipelines

- about_Command_Syntax
- about_Parameters
- PowerShellGet: The BIG EASY way to discover, install, and update PowerShell modules

Chapter 5 - Formatting, aliases, providers, comparison

Article • 11/17/2022

Requirements

The SQL Server PowerShell module is required by some of the examples shown in this chapter. The module installs as part of SQL Server Management Studio (SSMS). It's also used in subsequent chapters. Download and install it on your Windows 10 lab environment computer.

Format Right

In Chapter 4, you learned to filter as far to the left as possible. The rule for manually formatting a command's output is similar to that rule except it needs to occur as far to the right as possible.

The most common format commands are `Format-Table` and `Format-List`. `Format-Wide` and `Format-Custom` can also be used, but are less common.

As mentioned in Chapter 3, a command that returns more than four properties defaults to a list unless custom formatting is used.

PowerShell

```
Get-Service -Name w32time | Select-Object -Property Status, DisplayName,
Can*
```

Output

```
Status              : Running
DisplayName         : Windows Time
CanPauseAndContinue : False
CanShutdown         : True
CanStop             : True
```

Use the `Format-Table` cmdlet to manually override the formatting and show the output in a table instead of a list.

PowerShell

```
Get-Service -Name w32time | Select-Object -Property Status, DisplayName,
Can* |
Format-Table
```

Output

```
 Status DisplayName  CanPauseAndContinue CanShutdown CanStop
 ------ -----------  ------------------- ----------- -------
Running Windows Time               False        True    True
```

The default output for `Get-Service` is three properties in a table.

PowerShell

```
Get-Service -Name w32time
```

Output

```
Status   Name               DisplayName
------   ----               -----------
Running  w32time            Windows Time
```

Use the `Format-List` cmdlet to override the default formatting and return the results in a list.

PowerShell

```
Get-Service -Name w32time | Format-List
```

Output

```
Name                : w32time
DisplayName         : Windows Time
Status              : Running
DependentServices   : {}
ServicesDependedOn  : {}
CanPauseAndContinue : False
CanShutdown         : True
CanStop             : True
ServiceType         : Win32ShareProcess
```

Notice that simply piping `Get-Service` to `Format-List` made it return additional properties. This doesn't occur with every command because of the way the formatting for that particular command is set up behind the scenes.

The number one thing to be aware of with the format cmdlets is they produce format objects that are different than normal objects in PowerShell.

PowerShell

```
Get-Service -Name w32time | Format-List | Get-Member
```

Output

```
   TypeName: Microsoft.PowerShell.Commands.Internal.Format.FormatStartData

Name                                    MemberType Definition
----                                    ---------- ----------
Equals                                  Method     bool Equals(System.Object
obj)
GetHashCode                             Method     int GetHashCode()
GetType                                 Method     type GetType()
ToString                                Method     string ToString()
autosizeInfo                            Property
Microsoft.PowerShell.Commands.Inter...
ClassId2e4f51ef21dd47e99d3c952918aff9cd Property   string
ClassId2e4f51ef21dd47e99d3c9...
groupingEntry                           Property
Microsoft.PowerShell.Commands.Inter...
pageFooterEntry                         Property
Microsoft.PowerShell.Commands.Inter...
pageHeaderEntry                         Property
Microsoft.PowerShell.Commands.Inter...
shapeInfo                               Property
Microsoft.PowerShell.Commands.Inter...

   TypeName: Microsoft.PowerShell.Commands.Internal.Format.GroupStartData

Name                                    MemberType Definition
----                                    ---------- ----------
Equals                                  Method     bool Equals(System.Object
obj)
GetHashCode                             Method     int GetHashCode()
GetType                                 Method     type GetType()
ToString                                Method     string ToString()
ClassId2e4f51ef21dd47e99d3c952918aff9cd Property   string
ClassId2e4f51ef21dd47e99d3c9...
groupingEntry                           Property
Microsoft.PowerShell.Commands.Inter...
shapeInfo                               Property
Microsoft.PowerShell.Commands.Inter...

   TypeName: Microsoft.PowerShell.Commands.Internal.Format.FormatEntryData

Name                                    MemberType Definition
----                                    ---------- ----------
Equals                                  Method     bool Equals(System.Object
```

```
obj)
GetHashCode                             Method     int GetHashCode()
GetType                                 Method     type GetType()
ToString                                Method     string ToString()
ClassId2e4f51ef21dd47e99d3c952918aff9cd Property   string
ClassId2e4f51ef21dd47e99d3c9...
formatEntryInfo                         Property
Microsoft.PowerShell.Commands.Inter...
outOfBand                               Property   bool outOfBand {get;set;}
writeStream                             Property
Microsoft.PowerShell.Commands.Inter...

   TypeName: Microsoft.PowerShell.Commands.Internal.Format.GroupEndData

Name                                    MemberType Definition
----                                    ---------- ----------
Equals                                  Method     bool Equals(System.Object
obj)
GetHashCode                             Method     int GetHashCode()
GetType                                 Method     type GetType()
ToString                                Method     string ToString()
ClassId2e4f51ef21dd47e99d3c952918aff9cd Property   string
ClassId2e4f51ef21dd47e99d3c9...
groupingEntry                           Property
Microsoft.PowerShell.Commands.Inter...

   TypeName: Microsoft.PowerShell.Commands.Internal.Format.FormatEndData

Name                                    MemberType Definition
----                                    ---------- ----------
Equals                                  Method     bool Equals(System.Object
obj)
GetHashCode                             Method     int GetHashCode()
GetType                                 Method     type GetType()
ToString                                Method     string ToString()
ClassId2e4f51ef21dd47e99d3c952918aff9cd Property   string
ClassId2e4f51ef21dd47e99d3c9...
groupingEntry                           Property
Microsoft.PowerShell.Commands.Inter...
```

What this means is format commands can't be piped to most other commands. They can be piped to some of the `Out-*` commands, but that's about it. This is why you want to perform any formatting at the very end of the line (format right).

Aliases

An alias in PowerShell is a shorter name for a command. PowerShell includes a set of built-in aliases and you can also define your own aliases.

The `Get-Alias` cmdlet is used to find aliases. If you already know the alias for a command, the **Name** parameter is used to determine what command the alias is associated with.

PowerShell

```
Get-Alias -Name gcm
```

Output

```
CommandType     Name                                               Version
Source
-----------     ----                                               -------
------
Alias           gcm -> Get-Command
```

Multiple aliases can be specified for the value of the **Name** parameter.

PowerShell

```
Get-Alias -Name gcm, gm
```

Output

```
CommandType     Name                                               Version
Source
-----------     ----                                               -------
------
Alias           gcm -> Get-Command
Alias           gm -> Get-Member
```

You'll often see the **Name** parameter omitted since it's a positional parameter.

PowerShell

```
Get-Alias gm
```

Output

```
CommandType     Name                                               Version
Source
-----------     ----                                               -------
------
Alias           gm -> Get-Member
```

If you want to find aliases for a command, you'll need to use the **Definition** parameter.

PowerShell

```
Get-Alias -Definition Get-Command, Get-Member
```

Output

```
CommandType     Name                                               Version
Source
-----------     ----                                               -------
------
Alias           gcm -> Get-Command
Alias           gm -> Get-Member
```

The **Definition** parameter can't be used positionally so it must be specified.

Aliases can save you a few keystrokes and they're fine when you're typing commands into the console. They shouldn't be used in scripts or any code that you're saving or sharing with others. As mentioned earlier in this book, using full cmdlet and parameter names is self-documenting and easier to understand.

Use caution when creating your own aliases because they'll only exist in your current PowerShell session on your computer.

Providers

A provider in PowerShell is an interface that allows file system like access to a datastore. There are a number of built-in providers in PowerShell.

PowerShell

```
Get-PSProvider
```

Output

```
Name                 Capabilities                       Drives
----                 ------------                       ------
Registry             ShouldProcess, Transactions        {HKLM, HKCU}
Alias                ShouldProcess                      {Alias}
Environment          ShouldProcess                      {Env}
FileSystem           Filter, ShouldProcess, Credentials {C, A, D}
Function             ShouldProcess                      {Function}
Variable             ShouldProcess                      {Variable}
Certificate          ShouldProcess                      {Cert}
WSMan                Credentials                        {WSMan}
```

As you can see in the previous results, there are built-in providers for the registry, aliases, environment variables, the file system, functions, variables, certificates, and WSMan.

The actual drives that these providers use to expose their datastore can be determined with the `Get-PSDrive` cmdlet. The `Get-PSDrive` cmdlet not only displays drives exposed by providers, but it also displays Windows logical drives including drives mapped to network shares.

PowerShell

```
Get-PSDrive
```

Output

```
Name           Used (GB)     Free (GB) Provider      Root
----           ---------     --------- --------      ----
A                                      FileSystem    A:\
Alias                                  Alias
C                  14.41        112.10 FileSystem    C:\
Cert                                   Certificate   \
D                                      FileSystem    D:\
Env                                    Environment
Function                               Function
HKCU                                   Registry      HKEY_CURRENT_USER
HKLM                                   Registry      HKEY_LOCAL_MACHINE
Variable                               Variable
WSMan                                  WSMan
```

Third-party modules such as the Active Directory PowerShell module and the SQLServer PowerShell module both add their own PowerShell provider and PSDrive.

Import the Active Directory and SQL Server PowerShell modules.

PowerShell

```
Import-Module -Name ActiveDirectory, SQLServer
```

Check to see if any additional PowerShell providers were added.

PowerShell

```
Get-PSProvider
```

Output

```
Name                Capabilities                        Drives
----                ------------                        ------
Registry            ShouldProcess, Transactions         {HKLM, HKCU}
Alias               ShouldProcess                       {Alias}
Environment         ShouldProcess                       {Env}
FileSystem          Filter, ShouldProcess, Credentials {C, A, D}
Function            ShouldProcess                       {Function}
Variable            ShouldProcess                       {Variable}
ActiveDirectory     Include, Exclude, Filter, Shoul... {AD}
SqlServer           Credentials                         {SQLSERVER}
```

Notice that in the previous set of results, two new PowerShell providers now exist, one for Active Directory and another one for SQL Server.

A PSDrive for each of those modules was also added.

PowerShell

```
Get-PSDrive
```

Output

```
Name           Used (GB)     Free (GB) Provider      Root
----           ---------     --------- --------      ----
A                                      FileSystem    A:\
AD                                     ActiveDire... //RootDSE/
Alias                                  Alias
C                  19.38        107.13 FileSystem    C:\
Cert                                   Certificate   \
D                                      FileSystem    D:\
Env                                    Environment
Function                               Function
HKCU                                   Registry      HKEY_CURRENT_USER
HKLM                                   Registry      HKEY_LOCAL_MACHINE
SQLSERVER                              SqlServer     SQLSERVER:\
Variable                               Variable
WSMan                                  WSMan
```

PSDrives can be accessed just like a traditional file system.

PowerShell

```
Get-ChildItem -Path Cert:\LocalMachine\CA
```

Output

```
   PSParentPath: Microsoft.PowerShell.Security\Certificate::LocalMachine\CA

Thumbprint                                Subject
----------                                -------
FEE449EE0E3965A5246F000E87FDE2A065FD89D4  CN=Root Agency
D559A586669B08F46A30A133F8A9ED3D038E2EA8  OU=www.verisign.com/CPS
Incorporated LIABI...
109F1CAED645BB78B3EA2B94C0697C740733031C  CN=Microsoft Windows Hardware
Compatibility,...
```

Comparison Operators

PowerShell contains a number of comparison operators that are used to compare values or find values that match certain patterns. Table 5-1 contains a list of comparison operators in PowerShell.

Operator	Definition
`-eq`	Equal to
`-ne`	Not equal to
`-gt`	Greater than
`-ge`	Greater than or equal to
`-lt`	Less than
`-le`	Less than or equal to
`-Like`	Match using the `*` wildcard character
`-NotLike`	Does not match using the `*` wildcard character
`-Match`	Matches the specified regular expression
`-NotMatch`	Does not match the specified regular expression
`-Contains`	Determines if a collection contains a specified value
`-NotContains`	Determines if a collection does not contain a specific value
`-In`	Determines if a specified value is in a collection
`-NotIn`	Determines if a specified value is not in a collection
`-Replace`	Replaces the specified value

All of the operators listed in Table 5-1 are case-insensitive. Place a `c` in front of the operator listed in Table 5-1 to make it case-sensitive. For example, `-ceq` is the case-sensitive version of the `-eq` comparison operator.

Proper case "PowerShell" is equal to lower case "powershell" using the equals comparison operator.

PowerShell

```
'PowerShell' -eq 'powershell'
```

Output

```
True
```

It's not equal using the case-sensitive version of the equals comparison operator.

PowerShell

```
'PowerShell' -ceq 'powershell'
```

Output

```
False
```

The not equal comparison operator reverses the condition.

PowerShell

```
'PowerShell' -ne 'powershell'
```

Output

```
False
```

Greater than, greater than or equal to, less than, and less than or equal all work with string or numeric values.

PowerShell

```
5 -gt 5
```

Output

```
False
```

Using greater than or equal to instead of greater than with the previous example returns the **Boolean** true since five is equal to five.

PowerShell

```
5 -ge 5
```

Output

```
True
```

Based on the results from the previous two examples, you can probably guess how both less than and less than or equal to work.

PowerShell

```
5 -lt 10
```

Output

```
True
```

The `-Like` and `-Match` operators can be confusing, even for experienced PowerShell users. `-Like` is used with wildcard the characters `*` and `?` to perform "like" matches.

PowerShell

```
'PowerShell' -like '*shell'
```

Output

```
True
```

`-Match` uses a regular expression to perform the matching.

PowerShell

```
'PowerShell' -match '^*.shell$'
```

Output

```
True
```

Use the range operator to store the numbers 1 through 10 in a variable.

PowerShell

```
$Numbers = 1..10
```

Output

```

```

Determine if the `$Numbers` variable includes 15.

PowerShell

```
$Numbers -contains 15
```

Output

```
False
```

Determine if it includes the number 10.

PowerShell

```
$Numbers -contains 10
```

Output

```
True
```

`-NotContains` reverses the logic to see if the `$Numbers` variable doesn't contain a value.

PowerShell

```
$Numbers -notcontains 15
```

Output

```
True
```

The previous example returns the **Boolean** true because it's true that the `$Numbers` variable doesn't contain 15. It does however contain the number 10 so it's false when it's tested.

PowerShell

```
$Numbers -notcontains 10
```

Output

```
False
```

The "in" comparison operator was first introduced in PowerShell version 3.0. It's used to determine if a value is "in" an array. The `$Numbers` variable is an array since it contains multiple values.

PowerShell

```
15 -in $Numbers
```

Output

```
False
```

In other words, `-in` performs the same test as the contains comparison operator except from the opposite direction.

PowerShell

```
10 -in $Numbers
```

Output

```
True
```

15 isn't in the `$Numbers` array so false is returned in the following example.

PowerShell

```
15 -in $Numbers
```

Output

```
False
```

Just like the `-contains` operator, `not` reverses the logic for the `-in` operator.

PowerShell

```
10 -notin $Numbers
```

Output

```
False
```

The previous example returns false because the `$Numbers` array does include 10 and the condition was testing to determine if it didn't contain 10.

15 is "not in" the `$Numbers` array so it returns the **Boolean** true.

PowerShell

```
15 -notin $Numbers
```

Output

```
True
```

The `-replace` operator does just want you would think. It's used to replace something. Specifying one value replaces that value with nothing. In the following example, I replace "Shell" with nothing.

PowerShell

```
'PowerShell' -replace 'Shell'
```

Output

```
Power
```

If you want to replace a value with a different value, specify the new value after the pattern you want to replace. SQL Saturday in Baton Rouge is an event that I try to speak

at every year. In the following example, I replace the word "Saturday" with the abbreviation "Sat".

PowerShell

```
'SQL Saturday - Baton Rouge' -Replace 'saturday','Sat'
```

Output

```
SQL Sat - Baton Rouge
```

There are also methods like **Replace()** that can be used to replace things similar to the way the replace operator works. However, the `-Replace` operator is case-insensitive by default, and the **Replace()** method is case-sensitive.

PowerShell

```
'SQL Saturday - Baton Rouge'.Replace('saturday','Sat')
```

Output

```
SQL Saturday - Baton Rouge
```

Notice that the word "Saturday" wasn't replaced in the previous example. This is because it was specified in a different case than the original. When the word "Saturday" is specified in the same case as the original, the **Replace()** method does replace it as expected.

PowerShell

```
'SQL Saturday - Baton Rouge'.Replace('Saturday','Sat')
```

Output

```
SQL Sat - Baton Rouge
```

Be careful when using methods to transform data because you can run into unforeseen problems, such as failing the *Turkey Test*. For an example, see the blog article titled Using Pester to Test PowerShell Code with Other Cultures. My recommendation is to use an operator instead of a method whenever possible to avoid these types of problems.

While the comparison operators can be used as shown in the previous examples, I normally find myself using them with the `Where-Object` cmdlet to perform some type of filtering.

Summary

In this chapter, you've learned a number of different topics to include Formatting Right, Aliases, Providers, and Comparison Operators.

Review

1. Why is it necessary to perform Formatting as far to the right as possible?
2. How do you determine what the actual cmdlet is for the `%` alias?
3. Why shouldn't you use aliases in scripts you save or code you share with others?
4. Perform a directory listing on the drives that are associated with one of the registry providers.
5. What's one of the main benefits of using the replace operator instead of the replace method?

Recommended Reading

- Format-Table
- Format-List
- Format-Wide
- about_Aliases
- about_Providers
- about_Comparison_Operators
- about_Arrays

Chapter 6 - Flow control

Article • 12/09/2022

Scripting

When you move from writing PowerShell one-liners to writing scripts, it sounds a lot more complicated than it really is. A script is nothing more than the same or similar commands that you would run interactively in the PowerShell console, except they're saved as a `.PS1` file. There are some scripting constructs that you may use such as a `foreach` loop instead of the `ForEach-Object` cmdlet. To beginners, the differences can be confusing especially when you consider that `foreach` is both a scripting construct and an alias for the `ForEach-Object` cmdlet.

Looping

One of the great things about PowerShell is, once you figure out how to do something for one item, it's almost as easy to do the same task for hundreds of items. Simply loop through the items using one of the many different types of loops in PowerShell.

ForEach-Object

`ForEach-Object` is a cmdlet for iterating through items in a pipeline such as with PowerShell one-liners. `ForEach-Object` streams the objects through the pipeline.

Although the **Module** parameter of `Get-Command` accepts multiple values that are strings, it only accepts them via pipeline input by property name or via parameter input. In the following scenario, if I want to pipe two strings by value to `Get-Command` for use with the **Module** parameter, I would need to use the `ForEach-Object` cmdlet.

PowerShell

```
'ActiveDirectory', 'SQLServer' |
   ForEach-Object {Get-Command -Module $_} |
     Group-Object -Property ModuleName -NoElement |
         Sort-Object -Property Count -Descending
```

Output

```
Count Name
----- ----
```

```
  147 ActiveDirectory
   82 SqlServer
```

In the previous example, `$_` is the current object. Beginning with PowerShell version 3.0, `$PSItem` can be used instead of `$_`. But I find that most experienced PowerShell users still prefer using `$_` since it's backward compatible and less to type.

When using the `foreach` keyword, you must store all of the items in memory before iterating through them, which could be difficult if you don't know how many items you're working with.

PowerShell

```powershell
$ComputerName = 'DC01', 'WEB01'
foreach ($Computer in $ComputerName) {
  Get-ADComputer -Identity $Computer
}
```

Output

```
DistinguishedName : CN=DC01,OU=Domain Controllers,DC=mikefrobbins,DC=com
DNSHostName       : dc01.mikefrobbins.com
Enabled           : True
Name              : DC01
ObjectClass       : computer
ObjectGUID        : c38da20c-a484-469d-ba4c-bab3fb71ae8e
SamAccountName    : DC01$
SID               : S-1-5-21-2989741381-570885089-3319121794-1001
UserPrincipalName :

DistinguishedName : CN=WEB01,CN=Computers,DC=mikefrobbins,DC=com
DNSHostName       : web01.mikefrobbins.com
Enabled           : True
Name              : WEB01
ObjectClass       : computer
ObjectGUID        : 33aa530e-1e31-40d8-8c78-76a18b673c33
SamAccountName    : WEB01$
SID               : S-1-5-21-2989741381-570885089-3319121794-1107
UserPrincipalName :
```

Many times a loop such as `foreach` or `ForEach-Object` is necessary. Otherwise you'll receive an error message.

PowerShell

```powershell
Get-ADComputer -Identity 'DC01', 'WEB01'
```

Output

```
Get-ADComputer : Cannot convert 'System.Object[]' to the type
'Microsoft.ActiveDirectory.Management.ADComputer' required by parameter
'Identity'.
Specified method is not supported.
At line:1 char:26
+ Get-ADComputer -Identity 'DC01', 'WEB01'
+                          ~~~~~~~~~~~~~~~
    + CategoryInfo          : InvalidArgument: (:) [Get-ADComputer],
ParameterBindingExc
   eption
    + FullyQualifiedErrorId :
CannotConvertArgument,Microsoft.ActiveDirectory.Management
   .Commands.GetADComputer
```

Other times, you can get the same results while eliminating the loop altogether. Consult the cmdlet help to understand your options.

PowerShell

```powershell
'DC01', 'WEB01' | Get-ADComputer
```

Output

```
DistinguishedName : CN=DC01,OU=Domain Controllers,DC=mikefrobbins,DC=com
DNSHostName       : dc01.mikefrobbins.com
Enabled           : True
Name              : DC01
ObjectClass       : computer
ObjectGUID        : c38da20c-a484-469d-ba4c-bab3fb71ae8e
SamAccountName    : DC01$
SID               : S-1-5-21-2989741381-570885089-3319121794-1001
UserPrincipalName :

DistinguishedName : CN=WEB01,CN=Computers,DC=mikefrobbins,DC=com
DNSHostName       : web01.mikefrobbins.com
Enabled           : True
Name              : WEB01
ObjectClass       : computer
ObjectGUID        : 33aa530e-1e31-40d8-8c78-76a18b673c33
SamAccountName    : WEB01$
SID               : S-1-5-21-2989741381-570885089-3319121794-1107
UserPrincipalName :
```

As you can see in the previous examples, the **Identity** parameter for `Get-ADComputer` only accepts a single value when provided via parameter input, but it allows for multiple items when the input is provided via pipeline input.

For

A `for` loop iterates while a specified condition is true. The `for` loop is not something that I use often, but it does have its uses.

PowerShell

```
for ($i = 1; $i -lt 5; $i++) {
  Write-Output "Sleeping for $i seconds"
  Start-Sleep -Seconds $i
}
```

Output

```
Sleeping for 1 seconds
Sleeping for 2 seconds
Sleeping for 3 seconds
Sleeping for 4 seconds
```

In the previous example, the loop will iterate four times by starting off with the number one and continue as long as the counter variable `$i` is less than 5. It will sleep for a total of 10 seconds.

Do

There are two different `do` loops in PowerShell. `Do Until` runs while the specified condition is false.

PowerShell

```
$number = Get-Random -Minimum 1 -Maximum 10
do {
  $guess = Read-Host -Prompt "What's your guess?"
  if ($guess -lt $number) {
    Write-Output 'Too low!'
  }
  elseif ($guess -gt $number) {
    Write-Output 'Too high!'
  }
}
until ($guess -eq $number)
```

Output

```
What's your guess?: 1
Too low!
```

```
What's your guess?: 2
Too low!
What's your guess?: 3
```

The previous example is a numbers game that continues until the value you guess equals the same number that the `Get-Random` cmdlet generated.

`Do While` is just the opposite. It runs as long as the specified condition evaluates to true.

PowerShell

```powershell
$number = Get-Random -Minimum 1 -Maximum 10
do {
  $guess = Read-Host -Prompt "What's your guess?"
  if ($guess -lt $number) {
    Write-Output 'Too low!'
  } elseif ($guess -gt $number) {
    Write-Output 'Too high!'
  }
}
while ($guess -ne $number)
```

Output

```
What's your guess?: 1
Too low!
What's your guess?: 2
Too low!
What's your guess?: 3
Too low!
What's your guess?: 4
```

The same results are achieved with a `Do While` loop by reversing the test condition to not equals.

`Do` loops always run at least once because the condition is evaluated at the end of the loop.

While

Similar to the `Do While` loop, a `While` loop runs as long as the specified condition is true. The difference however, is that a `While` loop evaluates the condition at the top of the loop before any code is run. So it doesn't run if the condition evaluates to false.

PowerShell

```powershell
$date = Get-Date -Date 'November 22'
while ($date.DayOfWeek -ne 'Thursday') {
  $date = $date.AddDays(1)
}
Write-Output $date
```

Output

```
Thursday, November 23, 2017 12:00:00 AM
```

The previous example calculates what day Thanksgiving Day is on in the United States. It's always on the fourth Thursday of November. So the loop starts with the 22nd day of November and adds a day while the day of the week isn't equal to Thursday. If the 22nd is a Thursday, the loop doesn't run at all.

Break, Continue, and Return

`Break` is designed to break out of a loop. It's also commonly used with the `switch` statement.

PowerShell

```powershell
for ($i = 1; $i -lt 5; $i++) {
  Write-Output "Sleeping for $i seconds"
  Start-Sleep -Seconds $i
  break
}
```

Output

```
Sleeping for 1 seconds
```

The `break` statement shown in the previous example causes the loop to exit on the first iteration.

Continue is designed to skip to the next iteration of a loop.

PowerShell

```powershell
while ($i -lt 5) {
  $i += 1
  if ($i -eq 3) {
    continue
  }
```

```
  Write-Output $i
}
```

Output

```
1
2
4
5
```

The previous example will output the numbers 1, 2, 4, and 5. It skips number 3 and continues with the next iteration of the loop. Similar to `break`, `continue` breaks out of the loop except only for the current iteration. Execution continues with the next iteration instead of breaking out of the loop and stopping.

Return is designed to exit out of the existing scope.

PowerShell

```
$number = 1..10
foreach ($n in $number) {
  if ($n -ge 4) {
    Return $n
  }
}
```

Output

```
4
```

Notice that in the previous example, return outputs the first result and then exits out of the loop. A more thorough explanation of the result statement can be found in one of my blog articles: "The PowerShell return keyword".

Summary

In this chapter, you've learned about the different types of loops that exist in PowerShell.

Review

1. What is the difference in the `ForEach-Object` cmdlet and the foreach scripting construct?

2. What is the primary advantage of using a While loop instead of a Do While or Do Until loop.
3. How do the break and continue statements differ?

Recommended Reading

- ForEach-Object
- about_ForEach
- about_For
- about_Do
- about_While
- about_Break
- about_Continue
- about_Return

Chapter 7 - Working with WMI

Article • 12/09/2022

WMI and CIM

PowerShell ships by default with cmdlets for working with other technologies such as Windows Management Instrumentation (WMI). There are several native WMI cmdlets that exist in PowerShell without having to install any additional software or modules.

PowerShell has had cmdlets for working with WMI since the beginning. `Get-Command` can be used to determine what WMI cmdlets exist in PowerShell. The following results are from my Windows 10 lab environment computer that is running PowerShell version 5.1. Your results may differ depending on what PowerShell version you're running.

PowerShell

```powershell
Get-Command -Noun WMI*
```

Output

```
CommandType     Name                                               Version
Source
-----------     ----                                               -------
------
Cmdlet          Get-WmiObject                                      3.1.0.0
Microsof...
Cmdlet          Invoke-WmiMethod                                   3.1.0.0
Microsof...
Cmdlet          Register-WmiEvent                                  3.1.0.0
Microsof...
Cmdlet          Remove-WmiObject                                   3.1.0.0
Microsof...
Cmdlet          Set-WmiInstance                                    3.1.0.0
Microsof...
```

Common Information Model (CIM) cmdlets were introduced in PowerShell version 3.0. The CIM cmdlets are designed so they can be used on both Windows and non-Windows machines. The WMI cmdlets are deprecated so my recommendation is to use the CIM cmdlets instead of the older WMI ones.

The CIM cmdlets are all contained within a module. To obtain a list of the CIM cmdlets, use `Get-Command` with the **Module** parameter as shown in the following example.

PowerShell

```powershell
Get-Command -Module CimCmdlets
```

Output

```
CommandType     Name                                               Version
Source
-----------     ----                                               -------
------
Cmdlet          Export-BinaryMiLog                                 1.0.0.0
CimCmdlets
Cmdlet          Get-CimAssociatedInstance                          1.0.0.0
CimCmdlets
Cmdlet          Get-CimClass                                       1.0.0.0
CimCmdlets
Cmdlet          Get-CimInstance                                    1.0.0.0
CimCmdlets
Cmdlet          Get-CimSession                                     1.0.0.0
CimCmdlets
Cmdlet          Import-BinaryMiLog                                 1.0.0.0
CimCmdlets
Cmdlet          Invoke-CimMethod                                   1.0.0.0
CimCmdlets
Cmdlet          New-CimInstance                                    1.0.0.0
CimCmdlets
Cmdlet          New-CimSession                                     1.0.0.0
CimCmdlets
Cmdlet          New-CimSessionOption                               1.0.0.0
CimCmdlets
Cmdlet          Register-CimIndicationEvent                        1.0.0.0
CimCmdlets
Cmdlet          Remove-CimInstance                                 1.0.0.0
CimCmdlets
Cmdlet          Remove-CimSession                                  1.0.0.0
CimCmdlets
Cmdlet          Set-CimInstance                                    1.0.0.0
CimCmdlets
```

The CIM cmdlets still allow you to work with WMI so don't be confused when someone makes the statement "When I query WMI with the PowerShell CIM cmdlets..."

As I previously mentioned, WMI is a separate technology from PowerShell and you're just using the CIM cmdlets for accessing WMI. You may find an old VBScript that uses WMI Query Language (WQL) to query WMI such as in the following example.

VB

```vb
strComputer = "."
Set objWMIService = GetObject("winmgmts:" _
```

```
    & "{impersonationLevel=impersonate}!\\" & strComputer & "\root\cimv2")

Set colBIOS = objWMIService.ExecQuery _
    ("Select * from Win32_BIOS")

For each objBIOS in colBIOS
    Wscript.Echo "Manufacturer: " & objBIOS.Manufacturer
    Wscript.Echo "Name: " & objBIOS.Name
    Wscript.Echo "Serial Number: " & objBIOS.SerialNumber
    Wscript.Echo "SMBIOS Version: " & objBIOS.SMBIOSBIOSVersion
    Wscript.Echo "Version: " & objBIOS.Version
Next
```

You can take the WQL query from that VBScript and use it with the `Get-CimInstance` cmdlet without any modifications.

PowerShell

```
Get-CimInstance -Query 'Select * from Win32_BIOS'
```

Output

```
SMBIOSBIOSVersion : 090006
Manufacturer      : American Megatrends Inc.
Name              : Intel(R) Xeon(R) CPU E3-1505M v5 @ 2.80GHz
SerialNumber      : 3810-1995-1654-4615-2295-2755-89
Version           : VRTUAL - 4001628
```

That's not how I typically query WMI with PowerShell. But it does work and allows you to easily migrate existing VBScripts to PowerShell. When I start out writing a one-liner to query WMI, I use the following syntax.

PowerShell

```
Get-CimInstance -ClassName Win32_BIOS
```

Output

```
SMBIOSBIOSVersion : 090006
Manufacturer      : American Megatrends Inc.
Name              : Intel(R) Xeon(R) CPU E3-1505M v5 @ 2.80GHz
SerialNumber      : 3810-1995-1654-4615-2295-2755-89
Version           : VRTUAL - 4001628
```

If I only want the serial number, I can pipe the output to `Select-Object` and specify only the **SerialNumber** property.

PowerShell

```
Get-CimInstance -ClassName Win32_BIOS | Select-Object -Property SerialNumber
```

Output

```
SerialNumber
------------
3810-1995-1654-4615-2295-2755-89
```

By default, there are several properties that are retrieved behind the scenes that are never used. It may not matter much when querying WMI on the local computer. But once you start querying remote computers, it's not only additional processing time to return that information, but also additional unnecessary information to have to pull across the network. `Get-CimInstance` has a **Property** parameter that limits the information that's retrieved. This makes the query to WMI more efficient.

PowerShell

```
Get-CimInstance -ClassName Win32_BIOS -Property SerialNumber |
Select-Object -Property SerialNumber
```

Output

```
SerialNumber
------------
3810-1995-1654-4615-2295-2755-89
```

The previous results returned an object. To return a simple string, use the **ExpandProperty** parameter.

PowerShell

```
Get-CimInstance -ClassName Win32_BIOS -Property SerialNumber |
Select-Object -ExpandProperty SerialNumber
```

Output

```
3810-1995-1654-4615-2295-2755-89
```

You could also use the dotted style of syntax to return a simple string. This eliminates the need to pipe to `Select-Object`.

PowerShell

```powershell
(Get-CimInstance -ClassName Win32_BIOS -Property SerialNumber).SerialNumber
```

Output

```
3810-1995-1654-4615-2295-2755-89
```

Query Remote Computers with the CIM cmdlets

I'm still running PowerShell as a local admin who is a domain user. When I try to query information from a remote computer using the `Get-CimInstance` cmdlet, I receive an access denied error message.

PowerShell

```powershell
Get-CimInstance -ComputerName dc01 -ClassName Win32_BIOS
```

Output

```
Get-CimInstance : Access is denied.
At line:1 char:1
+ Get-CimInstance -ComputerName dc01 -ClassName Win32_BIOS
+ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
    + CategoryInfo          : PermissionDenied:
(root\cimv2:Win32_BIOS:String) [Get-CimI
   nstance], CimException
    + FullyQualifiedErrorId : HRESULT
0x80070005,Microsoft.Management.Infrastructure.Cim
   Cmdlets.GetCimInstanceCommand
    + PSComputerName        : dc01
```

Many people have security concerns when it comes to PowerShell, but the truth is you have exactly the same permissions in PowerShell as you do in the GUI. No more and no less. The problem in the previous example is that the user running PowerShell doesn't have rights to query WMI information from the DC01 server. I could relaunch PowerShell as a domain administrator since `Get-CimInstance` doesn't have a **Credential** parameter. But, trust me, that isn't a good idea because then anything that I run from PowerShell would be running as a domain admin. That could be dangerous from a security standpoint depending on the situation.

Using the principle of least privilege, I elevate to my domain admin account on a per command basis using the **Credential** parameter, if a command has one. `Get-CimInstance` doesn't have a **Credential** parameter so the solution in this scenario is to create a **CimSession** first. Then I use the **CimSession** instead of a computer name to query WMI on the remote computer.

PowerShell

```
$CimSession = New-CimSession -ComputerName dc01 -Credential (Get-Credential)
```

Output

```
cmdlet Get-Credential at command pipeline position 1
Supply values for the following parameters:
Credential
```

The CIM session was stored in a variable named `$CimSession`. Notice that I also specified the `Get-Credential` cmdlet in parentheses so that it executes first, prompting me for alternate credentials, before creating the new session. I'll show you another more efficient way to specify alternate credentials later in this chapter, but it's important to understand this basic concept before making it more complicated.

The CIM session created in the previous example can now be used with the `Get-CimInstance` cmdlet to query the BIOS information from WMI on the remote computer.

PowerShell

```
Get-CimInstance -CimSession $CimSession -ClassName Win32_BIOS
```

Output

```
SMBIOSBIOSVersion : 090006
Manufacturer      : American Megatrends Inc.
Name              : Intel(R) Xeon(R) CPU E3-1505M v5 @ 2.80GHz
SerialNumber      : 0986-6980-3916-0512-6608-8243-13
Version           : VRTUAL - 4001628
PSComputerName    : dc01
```

There are several additional benefits to using CIM sessions instead of just specifying a computer name. When running multiple queries to the same computer, using a CIM session is more efficient than using the computer name for each query. Creating a CIM session only sets up the connection once. Then, multiple queries use that same session

to retrieve information. Using the computer name requires the cmdlets to set up and tear down the connection with each individual query.

The `Get-CimInstance` cmdlet uses the WSMan protocol by default, which means the remote computer needs PowerShell version 3.0 or higher to connect. It's actually not the PowerShell version that matters, it's the stack version. The stack version can be determined using the `Test-WSMan` cmdlet. It needs to be version 3.0. That's the version you'll find with PowerShell version 3.0 and higher.

PowerShell

```
Test-WSMan -ComputerName dc01
```

Output

```
wsmid           :
http://schemas.dmtf.org/wbem/wsman/identity/1/wsmanidentity.xsd
ProtocolVersion : http://schemas.dmtf.org/wbem/wsman/1/wsman.xsd
ProductVendor   : Microsoft Corporation
ProductVersion  : OS: 0.0.0 SP: 0.0 Stack: 3.0
```

The older WMI cmdlets use the DCOM protocol, which is compatible with older versions of Windows. But DCOM is typically blocked by the firewall on newer versions of Windows. The `New-CimSessionOption` cmdlet allows you to create a DCOM protocol connection for use with `New-CimSession`. This allows the `Get-CimInstance` cmdlet to be used to communicate with versions of Windows as old as Windows Server 2000. This also means that PowerShell is not required on the remote computer when using the `Get-CimInstance` cmdlet with a CimSession that's configured to use the DCOM protocol.

Create the DCOM protocol option using the `New-CimSessionOption` cmdlet and store it in a variable.

PowerShell

```
$DCOM = New-CimSessionOption -Protocol Dcom
```

For efficiency, you can store your domain administrator or elevated credentials in a variable so you don't have to constantly enter them for each command.

PowerShell

```
$Cred = Get-Credential
```

Output

```
cmdlet Get-Credential at command pipeline position 1
Supply values for the following parameters:
Credential
```

I have a server named SQL03 that runs Windows Server 2008 (non-R2). It's the newest Windows Server operating system that doesn't have PowerShell installed by default.

Create a **CimSession** to SQL03 using the DCOM protocol.

PowerShell

```
$CimSession = New-CimSession -ComputerName sql03 -SessionOption $DCOM -
Credential $Cred
```

Notice in the previous command, this time I specified the variable named `$Cred` as the value for the **Credential** parameter instead of having to enter them manually again.

The output of the query is the same regardless of the underlying protocol being used.

PowerShell

```
Get-CimInstance -CimSession $CimSession -ClassName Win32_BIOS
```

Output

```
SMBIOSBIOSVersion : 090006
Manufacturer      : American Megatrends Inc.
Name              : Intel(R) Xeon(R) CPU E3-1505M v5 @ 2.80GHz
SerialNumber      : 7237-7483-8873-8926-7271-5004-86
Version           : VRTUAL - 4001628
PSComputerName    : sql03
```

The `Get-CimSession` cmdlet is used to see what **CimSessions** are currently connected and what protocols they're using.

PowerShell

```
Get-CimSession
```

Output

```
Id           : 1
Name         : CimSession1
```

```
InstanceId   : 80742787-e38e-41b1-a7d7-fa1369cf1402
ComputerName : dc01
Protocol     : WSMAN

Id           : 2
Name         : CimSession2
InstanceId   : 8fcabd81-43cf-4682-bd53-ccce1e24aecb
ComputerName : sql03
Protocol     : DCOM
```

Retrieve and store both of the previously created **CimSessions** in a variable named `$CimSession`.

PowerShell

```
$CimSession = Get-CimSession
```

Query both of the computers with one command, one using the WSMan protocol and the other one with DCOM.

PowerShell

```
Get-CimInstance -CimSession $CimSession -ClassName Win32_BIOS
```

Output

```
SMBIOSBIOSVersion : 090006
Manufacturer      : American Megatrends Inc.
Name              : Intel(R) Xeon(R) CPU E3-1505M v5 @ 2.80GHz
SerialNumber      : 0986-6980-3916-0512-6608-8243-13
Version           : VRTUAL - 4001628
PSComputerName    : dc01

SMBIOSBIOSVersion : 090006
Manufacturer      : American Megatrends Inc.
Name              : Intel(R) Xeon(R) CPU E3-1505M v5 @ 2.80GHz
SerialNumber      : 7237-7483-8873-8926-7271-5004-86
Version           : VRTUAL - 4001628
PSComputerName    : sql03
```

I've written numerous blog articles about the WMI and CIM cmdlets. One of the most useful ones is about a function that I created to automatically determine if WSMan or DCOM should be used and set up the CIM session automatically without having to figure out which one manually. That blog article is titled PowerShell Function to Create CimSessions to Remote Computers with Fallback to Dcom.

When you're finished with the CIM sessions, you should remove them with the `Remove-CimSession` cmdlet. To remove all CIM sessions, simply pipe `Get-CimSession` to `Remove-CimSession`.

```PowerShell
Get-CimSession | Remove-CimSession
```

Summary

In this chapter, you've learned about using PowerShell to work with WMI on both local and remote computers. You've also learned how to use the CIM cmdlets to work with remote computers with both the WSMan or DCOM protocol.

Review

1. What is the difference in the WMI and CIM cmdlets?
2. By default, what protocol does the `Get-CimInstance` cmdlet use?
3. What are some of the benefits of using a CIM session instead of specifying a computer name with `Get-CimInstance`?
4. How do you specify an alternate protocol other than the default one for use with `Get-CimInstance`?
5. How do you close or remove CIM sessions?

Recommended Reading

- about_WMI
- about_WMI_Cmdlets
- about_WQL
- CimCmdlets Module
- Video: Using CIM Cmdlets and CIM Sessions

Chapter 8 - PowerShell remoting

Article • 12/09/2022

PowerShell has many different ways to run commands against remote computers. In the last chapter, you saw how to remotely query WMI using the CIM cmdlets. PowerShell also includes several cmdlets that have a built-in **ComputerName** parameter.

As shown in the following example, `Get-Command` can be used with the **ParameterName** parameter to determine what commands have a **ComputerName** parameter.

PowerShell

```
Get-Command -ParameterName ComputerName
```

Output

```
CommandType     Name                                Version    Source
-----------     ----                                -------    ------
Cmdlet          Add-Computer                        3.1.0.0
Microsoft.PowerShell.Management
Cmdlet          Clear-EventLog                      3.1.0.0
Microsoft.PowerShell.Management
Cmdlet          Connect-PSSession                   3.0.0.0
Microsoft.PowerShell.Core
Cmdlet          Enter-PSSession                     3.0.0.0
Microsoft.PowerShell.Core
Cmdlet          Get-EventLog                        3.1.0.0
Microsoft.PowerShell.Management
Cmdlet          Get-HotFix                          3.1.0.0
Microsoft.PowerShell.Management
Cmdlet          Get-Process                         3.1.0.0
Microsoft.PowerShell.Management
Cmdlet          Get-PSSession                       3.0.0.0
Microsoft.PowerShell.Core
Cmdlet          Get-Service                         3.1.0.0
Microsoft.PowerShell.Management
Cmdlet          Get-WmiObject                       3.1.0.0
Microsoft.PowerShell.Management
Cmdlet          Invoke-Command                      3.0.0.0
Microsoft.PowerShell.Core
Cmdlet          Invoke-WmiMethod                    3.1.0.0
Microsoft.PowerShell.Management
Cmdlet          Limit-EventLog                      3.1.0.0
Microsoft.PowerShell.Management
Cmdlet          New-EventLog                        3.1.0.0
Microsoft.PowerShell.Management
Cmdlet          New-PSSession                       3.0.0.0
Microsoft.PowerShell.Core
Cmdlet          Receive-Job                         3.0.0.0
```

```
Microsoft.PowerShell.Core
Cmdlet          Receive-PSSession               3.0.0.0
Microsoft.PowerShell.Core
Cmdlet          Register-WmiEvent               3.1.0.0
Microsoft.PowerShell.Management
Cmdlet          Remove-Computer                 3.1.0.0
Microsoft.PowerShell.Management
Cmdlet          Remove-EventLog                 3.1.0.0
Microsoft.PowerShell.Management
Cmdlet          Remove-PSSession                3.0.0.0
Microsoft.PowerShell.Core
Cmdlet          Remove-WmiObject                3.1.0.0
Microsoft.PowerShell.Management
Cmdlet          Rename-Computer                 3.1.0.0
Microsoft.PowerShell.Management
Cmdlet          Restart-Computer                3.1.0.0
Microsoft.PowerShell.Management
Cmdlet          Send-MailMessage                3.1.0.0
Microsoft.PowerShell.Utility
Cmdlet          Set-Service                     3.1.0.0
Microsoft.PowerShell.Management
Cmdlet          Set-WmiInstance                 3.1.0.0
Microsoft.PowerShell.Management
Cmdlet          Show-EventLog                   3.1.0.0
Microsoft.PowerShell.Management
Cmdlet          Stop-Computer                   3.1.0.0
Microsoft.PowerShell.Management
Cmdlet          Test-Connection                 3.1.0.0
Microsoft.PowerShell.Management
Cmdlet          Write-EventLog                  3.1.0.0
Microsoft.PowerShell.Management
```

Commands such as `Get-Process` and `Get-Hotfix` have a **ComputerName** parameter. This isn't the long-term direction that Microsoft is heading for running commands against remote computers. Even if you find a command that has a **ComputerName** parameter, chances are that you'll need to specify alternate credentials and it won't have a **Credential** parameter. And if you decided to run PowerShell from an elevated account, a firewall between you and the remote computer can block the request.

To use the PowerShell remoting commands that are demonstrated in this chapter, PowerShell remoting must be enabled on the remote computer. Use the `Enable-PSRemoting` cmdlet to enable PowerShell remoting.

PowerShell

```
Enable-PSRemoting
```

Output

```
WinRM has been updated to receive requests.
WinRM service type changed successfully.
WinRM service started.

WinRM has been updated for remote management.
WinRM firewall exception enabled.
```

One-To-One Remoting

If you want your remote session to be interactive, then one-to-one remoting is what you want. This type of remoting is provided via the `Enter-PSSession` cmdlet.

In the last chapter, I stored my domain admin credentials in a variable named `$Cred`. If you haven't already done so, go ahead and store your domain admin credentials in the `$Cred` variable.

This allows you to enter the credentials once and use them on a per command basis as long as your current PowerShell session is active.

PowerShell

```powershell
$Cred = Get-Credential
```

Create a one-to-one PowerShell remoting session to the domain controller named dc01.

PowerShell

```powershell
Enter-PSSession -ComputerName dc01 -Credential $Cred
```

Output

```
[dc01]: PS C:\Users\Administrator\Documents>
```

Notice that in the previous example that the PowerShell prompt is preceded by `[dc01]`. This means you're in an interactive PowerShell session to the remote computer named dc01. Any commands you execute run on dc01, not on your local computer. Also, keep in mind that you only have access to the PowerShell commands that exist on the remote computer and not the ones on your local computer. In other words, if you've installed additional modules on your computer, they aren't accessible on the remote computer.

When you're connected to a remote computer via a one-to-one interactive PowerShell remoting session, you're effectively sitting at the remote computer. The objects are

normal objects just like the ones you've been working with throughout this entire book.

PowerShell

```
[dc01]:  Get-Process | Get-Member
```

Output

```
   TypeName: System.Diagnostics.Process

Name                       MemberType     Definition
----                       ----------     ----------
Handles                    AliasProperty  Handles = Handlecount
Name                       AliasProperty  Name = ProcessName
NPM                        AliasProperty  NPM = NonpagedSystemMemorySize64
PM                         AliasProperty  PM = PagedMemorySize64
SI                         AliasProperty  SI = SessionId
VM                         AliasProperty  VM = VirtualMemorySize64
WS                         AliasProperty  WS = WorkingSet64
Disposed                   Event          System.EventHandler
Disposed(System.Object, ...
ErrorDataReceived          Event
System.Diagnostics.DataReceivedEventHandler ...
Exited                     Event          System.EventHandler
Exited(System.Object, Sy...
OutputDataReceived         Event
System.Diagnostics.DataReceivedEventHandler ...
BeginErrorReadLine         Method         void BeginErrorReadLine()
BeginOutputReadLine        Method         void BeginOutputReadLine()
CancelErrorRead            Method         void CancelErrorRead()
CancelOutputRead           Method         void CancelOutputRead()
Close                      Method         void Close()
CloseMainWindow            Method         bool CloseMainWindow()
CreateObjRef               Method         System.Runtime.Remoting.ObjRef
CreateObjRef(...
Dispose                    Method         void Dispose(), void
IDisposable.Dispose()
Equals                     Method         bool Equals(System.Object obj)
GetHashCode                Method         int GetHashCode()
GetLifetimeService         Method         System.Object GetLifetimeService()
GetType                    Method         type GetType()
InitializeLifetimeService  Method         System.Object
InitializeLifetimeService()
Kill                       Method         void Kill()
Refresh                    Method         void Refresh()
Start                      Method         bool Start()
ToString                   Method         string ToString()
WaitForExit                Method         bool WaitForExit(int
milliseconds), void Wai...
WaitForInputIdle           Method         bool WaitForInputIdle(int
milliseconds), boo...
__NounName                 NoteProperty   string __NounName=Process
BasePriority               Property       int BasePriority {get;}
```

```
Container                   Property       System.ComponentModel.IContainer
Container {...
EnableRaisingEvents         Property       bool EnableRaisingEvents
{get;set;}
ExitCode                    Property       int ExitCode {get;}
ExitTime                    Property       datetime ExitTime {get;}
Handle                      Property       System.IntPtr Handle {get;}
HandleCount                 Property       int HandleCount {get;}
HasExited                   Property       bool HasExited {get;}
Id                          Property       int Id {get;}
MachineName                 Property       string MachineName {get;}
MainModule                  Property       System.Diagnostics.ProcessModule
MainModule ...
MainWindowHandle            Property       System.IntPtr MainWindowHandle
{get;}
MainWindowTitle             Property       string MainWindowTitle {get;}
MaxWorkingSet               Property       System.IntPtr MaxWorkingSet
{get;set;}
MinWorkingSet               Property       System.IntPtr MinWorkingSet
{get;set;}
Modules                     Property
System.Diagnostics.ProcessModuleCollection M...
NonpagedSystemMemorySize    Property       int NonpagedSystemMemorySize
{get;}
NonpagedSystemMemorySize64 Property        long NonpagedSystemMemorySize64
{get;}
PagedMemorySize             Property       int PagedMemorySize {get;}
PagedMemorySize64           Property       long PagedMemorySize64 {get;}
PagedSystemMemorySize       Property       int PagedSystemMemorySize {get;}
PagedSystemMemorySize64     Property       long PagedSystemMemorySize64
{get;}
PeakPagedMemorySize         Property       int PeakPagedMemorySize {get;}
PeakPagedMemorySize64       Property       long PeakPagedMemorySize64 {get;}
PeakVirtualMemorySize       Property       int PeakVirtualMemorySize {get;}
PeakVirtualMemorySize64     Property       long PeakVirtualMemorySize64
{get;}
PeakWorkingSet              Property       int PeakWorkingSet {get;}
PeakWorkingSet64            Property       long PeakWorkingSet64 {get;}
PriorityBoostEnabled        Property       bool PriorityBoostEnabled
{get;set;}
PriorityClass               Property
System.Diagnostics.ProcessPriorityClass Prio...
PrivateMemorySize           Property       int PrivateMemorySize {get;}
PrivateMemorySize64         Property       long PrivateMemorySize64 {get;}
PrivilegedProcessorTime     Property       timespan PrivilegedProcessorTime
{get;}
ProcessName                 Property       string ProcessName {get;}
ProcessorAffinity           Property       System.IntPtr ProcessorAffinity
{get;set;}
Responding                  Property       bool Responding {get;}
SafeHandle                  Property
Microsoft.Win32.SafeHandles.SafeProcessHandl...
SessionId                   Property       int SessionId {get;}
Site                        Property       System.ComponentModel.ISite Site
{get;set;}
```

```
StandardError               Property       System.IO.StreamReader
StandardError {get;}
StandardInput               Property       System.IO.StreamWriter
StandardInput {get;}
StandardOutput              Property       System.IO.StreamReader
StandardOutput {get;}
StartInfo                   Property
System.Diagnostics.ProcessStartInfo StartInf...
StartTime                   Property       datetime StartTime {get;}
SynchronizingObject         Property
System.ComponentModel.ISynchronizeInvoke Syn...
Threads                     Property
System.Diagnostics.ProcessThreadCollection T...
TotalProcessorTime          Property       timespan TotalProcessorTime {get;}
UserProcessorTime           Property       timespan UserProcessorTime {get;}
VirtualMemorySize           Property       int VirtualMemorySize {get;}
VirtualMemorySize64         Property       long VirtualMemorySize64 {get;}
WorkingSet                  Property       int WorkingSet {get;}
WorkingSet64                Property       long WorkingSet64 {get;}
PSConfiguration             PropertySet    PSConfiguration {Name, Id,
PriorityClass, Fi...
PSResources                 PropertySet    PSResources {Name, Id,
Handlecount, WorkingS...
Company                     ScriptProperty System.Object Company
{get=$this.Mainmodule....
CPU                         ScriptProperty System.Object CPU
{get=$this.TotalProcessorT...
Description                 ScriptProperty System.Object Description
{get=$this.Mainmod...
FileVersion                 ScriptProperty System.Object FileVersion
{get=$this.Mainmod...
Path                        ScriptProperty System.Object Path
{get=$this.Mainmodule.Fil...
Product                     ScriptProperty System.Object Product
{get=$this.Mainmodule....
ProductVersion              ScriptProperty System.Object ProductVersion
{get=$this.Main...
[dc01]:
```

When you're done working with the remote computer, exit the one-to-one remoting session by using the `Exit-PSSession` cmdlet.

PowerShell

```
[dc01]:  Exit-PSSession
```

One-To-Many Remoting

Sometimes you may need to perform a task interactively on a remote computer. But remoting is much more powerful when performing a task on multiple remote computers

at the same time. Use the `Invoke-Command` cmdlet to run a command against one or more remote computers at the same time.

PowerShell

```
Invoke-Command -ComputerName dc01, sql02, web01 {Get-Service -Name W32time}
-Credential $Cred
```

Output

```
Status   Name        DisplayName       PSComputerName
------   ----        -----------       --------------
Running  W32time     Windows Time      web01
Start... W32time     Windows Time      dc01
Running  W32time     Windows Time      sql02
```

In the previous example, three servers were queried for the status of the Windows Time service. The `Get-Service` cmdlet was placed inside the script block of `Invoke-Command`. `Get-Service` actually runs on the remote computer and the results are returned to your local computer as deserialized objects.

Piping the previous command to `Get-Member` shows that the results are indeed deserialized objects.

PowerShell

```
Invoke-Command -ComputerName dc01, sql02, web01 {Get-Service -Name W32time}
-Credential $Cred | Get-Member
```

Output

```
   TypeName: Deserialized.System.ServiceProcess.ServiceController

Name                MemberType   Definition
----                ----------   ----------
GetType             Method       type GetType()
ToString            Method       string ToString(), string ToString(string
format, Sys...
Name                NoteProperty string Name=W32time
PSComputerName      NoteProperty string PSComputerName=sql02
PSShowComputerName  NoteProperty bool PSShowComputerName=True
RequiredServices    NoteProperty
Deserialized.System.ServiceProcess.ServiceController[...
RunspaceId          NoteProperty guid RunspaceId=570313c4-ac84-4109-bf67-
c6b33236af0a
CanPauseAndContinue Property     System.Boolean {get;set;}
CanShutdown         Property     System.Boolean {get;set;}
```

```
CanStop             Property     System.Boolean {get;set;}
Container           Property      {get;set;}
DependentServices   Property
Deserialized.System.ServiceProcess.ServiceController[...
DisplayName         Property     System.String {get;set;}
MachineName         Property     System.String {get;set;}
ServiceHandle       Property     System.String {get;set;}
ServiceName         Property     System.String {get;set;}
ServicesDependedOn  Property
Deserialized.System.ServiceProcess.ServiceController[...
ServiceType         Property     System.String {get;set;}
Site                Property      {get;set;}
StartType           Property     System.String {get;set;}
Status              Property     System.String {get;set;}
```

Notice that the majority of the methods are missing on deserialized objects. This means they're not live objects; they're inert. You can't start or stop a service using a deserialized object because it's a snapshot of the state of that object the point when the command ran on the remote computer.

That doesn't mean you can't start or stop a service using a method with `Invoke-Command` though. It just means that the method has to be called in the remote session.

I'll stop the Windows Time service on all three of those remote servers using the **Stop()** method to prove this point.

PowerShell

```
Invoke-Command -ComputerName dc01, sql02, web01 {(Get-Service -Name
W32time).Stop()} -Credential $Cred
Invoke-Command -ComputerName dc01, sql02, web01 {Get-Service -Name W32time}
-Credential $Cred
```

Output

```
Status   Name        DisplayName       PSComputerName
------   ----        -----------       --------------
Stopped  W32time     Windows Time      web01
Stopped  W32time     Windows Time      dc01
Stopped  W32time     Windows Time      sql02
```

As mentioned in a previous chapter, if a cmdlet exists for accomplishing a task, I recommend using it instead of using a method. In the previous scenario, I recommend using the `Stop-Service` cmdlet instead of the stop method. I chose to use the **Stop()** method to prove a point since many people are under the misconception that methods can't be called when using PowerShell remoting. They can't be called on the object

that's returned because it's deserialized, but they can be called in the remote session itself.

PowerShell Sessions

In the last example in the previous section, I ran two commands using the `Invoke-Command` cmdlet. That means two separate sessions had to be set up and torn down to run those two commands.

Similar to the CIM sessions discussed in Chapter 7, a PowerShell session to a remote computer can be used to run multiple commands against the remote computer without the overhead of a new session for each individual command.

Create a PowerShell session to each of the three computers we've been working with in this chapter, DC01, SQL02, and WEB01.

PowerShell

```
$Session = New-PSSession -ComputerName dc01, sql02, web01 -Credential $Cred
```

Now use the variable named `$Session` to start the Windows Time service using a method and check the status of the service.

PowerShell

```
Invoke-Command -Session $Session {(Get-Service -Name W32time).Start()}
Invoke-Command -Session $Session {Get-Service -Name W32time}
```

Output

```
Status   Name        DisplayName       PSComputerName
------   ----        -----------       --------------
Running  W32time     Windows Time      web01
Start... W32time     Windows Time      dc01
Running  W32time     Windows Time      sql02
```

Once the session is created using alternate credentials, it's no longer necessary to specify the credentials each time a command is run.

When you're finished using the sessions, be sure to remove them.

PowerShell

```
Get-PSSession | Remove-PSSession
```

Summary

In this chapter you've learned about PowerShell remoting, how to run commands in an interactive session with one remote computer, and how to run commands against multiple computers using one-to-many remoting. You've also learned the benefits of using a PowerShell session when running multiple commands against the same remote computer.

Review

1. How do you enable PowerShell remoting?
2. What is the PowerShell command for starting an interactive session with a remote computer?
3. What is a benefit of using a PowerShell remoting session versus just specifying the computer name with each command?
4. Can a PowerShell remoting session be used with a one-to-one remoting session?
5. What is the difference in the type of objects that are returned by cmdlets versus those returned when running those same cmdlets against remote computers with `Invoke-Command`?

Recommended Reading

- about_Remote
- about_Remote_Output
- about_Remote_Requirements
- about_Remote_Troubleshooting
- about_Remote_Variables
- PowerShell Remoting FAQ

Chapter 9 - Functions

Article • 11/17/2022

If you're writing PowerShell one-liners or scripts and find yourself often having to modify them for different scenarios, there's a good chance that it's a good candidate to be turned into a function that can be reused.

Whenever possible, I prefer to write functions because they are more tool oriented. I can put the functions in a script module, put that module in the `$env:PSModulePath`, and call the functions without needing to physically locate where they're saved. Using the PowerShellGet module, it's easy to share those modules in a NuGet repository. PowerShellGet ships with PowerShell version 5.0 and higher. It is available as a separate download for PowerShell version 3.0 and higher.

Don't over complicate things. Keep it simple and use the most straight forward way to accomplish a task. Avoid aliases and positional parameters in any code that you reuse. Format your code for readability. Don't hardcode values; use parameters and variables. Don't write unnecessary code even if it doesn't hurt anything. It adds unnecessary complexity. Attention to detail goes a long way when writing any PowerShell code.

Naming

When naming your functions in PowerShell, use a Pascal case name with an approved verb and a singular noun. I also recommend prefixing the noun. For example: `<ApprovedVerb>-<Prefix><SingularNoun>`.

In PowerShell, there's a specific list of approved verbs that can be obtained by running `Get-Verb`.

PowerShell

```powershell
Get-Verb | Sort-Object -Property Verb
```

Output

```
Verb        Group
----        -----
Add         Common
Approve     Lifecycle
Assert      Lifecycle
Backup      Data
Block       Security
Checkpoint  Data
```

```
Clear       Common
Close       Common
Compare     Data
Complete    Lifecycle
Compress    Data
Confirm     Lifecycle
Connect     Communications
Convert     Data
ConvertFrom Data
ConvertTo   Data
Copy        Common
Debug       Diagnostic
Deny        Lifecycle
Disable     Lifecycle
Disconnect  Communications
Dismount    Data
Edit        Data
Enable      Lifecycle
Enter       Common
Exit        Common
Expand      Data
Export      Data
Find        Common
Format      Common
Get         Common
Grant       Security
Group       Data
Hide        Common
Import      Data
Initialize  Data
Install     Lifecycle
Invoke      Lifecycle
Join        Common
Limit       Data
Lock        Common
Measure     Diagnostic
Merge       Data
Mount       Data
Move        Common
New         Common
Open        Common
Optimize    Common
Out         Data
Ping        Diagnostic
Pop         Common
Protect     Security
Publish     Data
Push        Common
Read        Communications
Receive     Communications
Redo        Common
Register    Lifecycle
Remove      Common
Rename      Common
Repair      Diagnostic
```

```
Request     Lifecycle
Reset       Common
Resize      Common
Resolve     Diagnostic
Restart     Lifecycle
Restore     Data
Resume      Lifecycle
Revoke      Security
Save        Data
Search      Common
Select      Common
Send        Communications
Set         Common
Show        Common
Skip        Common
Split       Common
Start       Lifecycle
Step        Common
Stop        Lifecycle
Submit      Lifecycle
Suspend     Lifecycle
Switch      Common
Sync        Data
Test        Diagnostic
Trace       Diagnostic
Unblock     Security
Undo        Common
Uninstall   Lifecycle
Unlock      Common
Unprotect   Security
Unpublish   Data
Unregister  Lifecycle
Update      Data
Use         Other
Wait        Lifecycle
Watch       Common
Write       Communications
```

In the previous example, I've sorted the results by the **Verb** column. The **Group** column gives you an idea of how these verbs are used. It's important to choose an approved verb in PowerShell when functions are added to a module. The module generates a warning message at load time if you choose an unapproved verb. That warning message makes your functions look unprofessional. Unapproved verbs also limit the discoverability of your functions.

A simple function

A function in PowerShell is declared with the function keyword followed by the function name and then an open and closing curly brace. The code that the function will execute

is contained within those curly braces.

PowerShell

```
function Get-Version {
    $PSVersionTable.PSVersion
}
```

The function shown is a simple example that returns the version of PowerShell.

PowerShell

```
Get-Version
```

Output

```
Major  Minor  Build  Revision
-----  -----  -----  --------
5      1      14393  693
```

There's a good chance of name conflict with functions named something like `Get-Version` and default commands in PowerShell or commands that others may write. This is why I recommend prefixing the noun portion of your functions to help prevent naming conflicts. In the following example, I'll use the prefix "PS".

PowerShell

```
function Get-PSVersion {
    $PSVersionTable.PSVersion
}
```

Other than the name, this function is identical to the previous one.

PowerShell

```
Get-PSVersion
```

Output

```
Major  Minor  Build  Revision
-----  -----  -----  --------
5      1      14393  693
```

Even when prefixing the noun with something like PS, there's still a good chance of having a name conflict. I typically prefix my function nouns with my initials. Develop a standard and stick to it.

PowerShell

```
function Get-MrPSVersion {
    $PSVersionTable.PSVersion
}
```

This function is no different than the previous two other than using a more sensible name to try to prevent naming conflicts with other PowerShell commands.

PowerShell

```
Get-MrPSVersion
```

Output

```
Major  Minor  Build  Revision
-----  -----  -----  --------
5      1      14393  693
```

Once loaded into memory, you can see functions on the **Function** PSDrive.

PowerShell

```
Get-ChildItem -Path Function:\Get-*Version
```

Output

```
CommandType     Name                                               Version
Source
-----------     ----                                               -------
------
Function        Get-Version
Function        Get-PSVersion
Function        Get-MrPSVersion
```

If you want to remove these functions from your current session, you'll have to remove them from the **Function** PSDrive or close and reopen PowerShell.

PowerShell

```
Get-ChildItem -Path Function:\Get-*Version | Remove-Item
```

Verify that the functions were indeed removed.

PowerShell

```
Get-ChildItem -Path Function:\Get-*Version
```

If the functions were loaded as part of a module, the module can be unloaded to remove them.

PowerShell

```
Remove-Module -Name <ModuleName>
```

The `Remove-Module` cmdlet removes modules from memory in your current PowerShell session, it doesn't remove them from your system or from disk.

Parameters

Don't statically assign values! Use parameters and variables. When it comes to naming your parameters, use the same name as the default cmdlets for your parameter names whenever possible.

PowerShell

```
function Test-MrParameter {

    param (
        $ComputerName
    )

    Write-Output $ComputerName

}
```

Why did I use **ComputerName** and not **Computer**, **ServerName**, or **Host** for my parameter name? It's because I wanted my function standardized like the default cmdlets.

I'll create a function to query all of the commands on a system and return the number of them that have specific parameter names.

PowerShell

```
function Get-MrParameterCount {
    param (
        [string[]]$ParameterName
    )

    foreach ($Parameter in $ParameterName) {
        $Results = Get-Command -ParameterName $Parameter -ErrorAction
SilentlyContinue

        [pscustomobject]@{
            ParameterName = $Parameter
            NumberOfCmdlets = $Results.Count
        }
    }
}
```

As you can see in the results shown below, 39 commands that have a **ComputerName** parameter. There aren't any cmdlets that have parameters such as **Computer**, **ServerName**, **Host**, or **Machine**.

PowerShell

```
Get-MrParameterCount -ParameterName ComputerName, Computer, ServerName,
Host, Machine
```

Output

```
ParameterName NumberOfCmdlets
------------- ---------------
ComputerName               39
Computer                    0
ServerName                  0
Host                        0
Machine                     0
```

I also recommend using the same case for your parameter names as the default cmdlets. Use `ComputerName`, not `computername`. This makes your functions look and feel like the default cmdlets. People who are already familiar with PowerShell will feel right at home.

The `param` statement allows you to define one or more parameters. The parameter definitions are separated by a comma (`,`). For more information, see about_Functions_Advanced_Parameters.

Advanced Functions

Turning a function in PowerShell into an advanced function is really simple. One of the differences between a function and an advanced function is that advanced functions have a number of common parameters that are added to the function automatically. These common parameters include parameters such as **Verbose** and **Debug**.

I'll start out with the `Test-MrParameter` function that was used in the previous section.

PowerShell

```
function Test-MrParameter {

    param (
        $ComputerName
    )

    Write-Output $ComputerName

}
```

What I want you to notice is that the `Test-MrParameter` function doesn't have any common parameters. There are a couple of different ways to see the common parameters. One is by viewing the syntax using `Get-Command`.

PowerShell

```
Get-Command -Name Test-MrParameter -Syntax
```

Output

```
Test-MrParameter [[-ComputerName] <Object>]
```

Another is to drill down into the parameters with `Get-Command`.

PowerShell

```
(Get-Command -Name Test-MrParameter).Parameters.Keys
```

Output

```
ComputerName
```

Add `CmdletBinding` to turn the function into an advanced function.

PowerShell

```
function Test-MrCmdletBinding {

    [CmdletBinding()] #<<-- This turns a regular function into an advanced
function
    param (
        $ComputerName
    )

    Write-Output $ComputerName

}
```

Adding `CmdletBinding` adds the common parameters automatically. `CmdletBinding` requires a `param` block, but the `param` block can be empty.

PowerShell

```
Get-Command -Name Test-MrCmdletBinding -Syntax
```

Output

```
Test-MrCmdletBinding [[-ComputerName] <Object>] [<CommonParameters>]
```

Drilling down into the parameters with `Get-Command` shows the actual parameter names including the common ones.

PowerShell

```
(Get-Command -Name Test-MrCmdletBinding).Parameters.Keys
```

Output

```
ComputerName
Verbose
Debug
ErrorAction
WarningAction
InformationAction
ErrorVariable
WarningVariable
InformationVariable
OutVariable
OutBuffer
PipelineVariable
```

SupportsShouldProcess

`SupportsShouldProcess` adds **WhatIf** and **Confirm** parameters. These are only needed for commands that make changes.

PowerShell

```
function Test-MrSupportsShouldProcess {

    [CmdletBinding(SupportsShouldProcess)]
    param (
        $ComputerName
    )

    Write-Output $ComputerName

}
```

Notice that there are now **WhatIf** and **Confirm** parameters.

PowerShell

```
Get-Command -Name Test-MrSupportsShouldProcess -Syntax
```

Output

```
Test-MrSupportsShouldProcess [[-ComputerName] <Object>] [-WhatIf] [-Confirm]
[<CommonParameters>]
```

Once again, you can also use `Get-Command` to return a list of the actual parameter names including the common ones along with WhatIf and Confirm.

PowerShell

```
(Get-Command -Name Test-MrSupportsShouldProcess).Parameters.Keys
```

Output

```
ComputerName
Verbose
Debug
ErrorAction
WarningAction
InformationAction
ErrorVariable
WarningVariable
```

```
InformationVariable
OutVariable
OutBuffer
PipelineVariable
WhatIf
Confirm
```

Parameter Validation

Validate input early on. Why allow your code to continue on a path when it's not possible to run without valid input?

Always type the variables that are being used for your parameters (specify a datatype).

PowerShell

```powershell
function Test-MrParameterValidation {

    [CmdletBinding()]
    param (
        [string]$ComputerName
    )

    Write-Output $ComputerName

}
```

In the previous example, I've specified **String** as the datatype for the **ComputerName** parameter. This causes it to allow only a single computer name to be specified. If more than one computer name is specified via a comma-separated list, an error is generated.

PowerShell

```powershell
Test-MrParameterValidation -ComputerName Server01, Server02
```

Output

```
Test-MrParameterValidation : Cannot process argument transformation on
parameter
'ComputerName'. Cannot convert value to type System.String.
At line:1 char:42
+ Test-MrParameterValidation -ComputerName Server01, Server02
+
    + CategoryInfo          : InvalidData: (:) [Test-MrParameterValidation],
ParameterBindingArg
     umentTransformationException
```

```
    + FullyQualifiedErrorId : ParameterArgumentTransformationError,Test-
MrParameterValidation
```

The problem with the current definition is that it's valid to omit the value of the **ComputerName** parameter, but a value is required for the function to complete successfully. This is where the `Mandatory` parameter attribute comes in handy.

PowerShell

```
function Test-MrParameterValidation {

    [CmdletBinding()]
    param (
        [Parameter(Mandatory)]
        [string]$ComputerName
    )

    Write-Output $ComputerName

}
```

The syntax used in the previous example is PowerShell version 3.0 and higher compatible. `[Parameter(Mandatory=$true)]` could be specified instead to make the function compatible with PowerShell version 2.0 and higher. Now that the **ComputerName** is required, if one isn't specified, the function will prompt for one.

PowerShell

```
Test-MrParameterValidation
```

Output

```
cmdlet Test-MrParameterValidation at command pipeline position 1
Supply values for the following parameters:
ComputerName:
```

If you want to allow for more than one value for the **ComputerName** parameter, use the **String** datatype but add open and closed square brackets to the datatype to allow for an array of strings.

PowerShell

```
function Test-MrParameterValidation {

    [CmdletBinding()]
    param (
```

```
        [Parameter(Mandatory)]
        [string[]]$ComputerName
    )

    Write-Output $ComputerName

}
```

Maybe you want to specify a default value for the **ComputerName** parameter if one isn't specified. The problem is that default values can't be used with mandatory parameters. Instead, you'll need to use the `ValidateNotNullOrEmpty` parameter validation attribute with a default value.

PowerShell

```
function Test-MrParameterValidation {

    [CmdletBinding()]
    param (
        [ValidateNotNullOrEmpty()]
        [string[]]$ComputerName = $env:COMPUTERNAME
    )

    Write-Output $ComputerName

}
```

Even when setting a default value, try not to use static values. In the previous example, `$env:COMPUTERNAME` is used as the default value, which is automatically translated into the local computer name if a value is not provided.

Verbose Output

While inline comments are useful, especially if you're writing some complex code, they never get seen by users unless they look into the code itself.

The function shown in the following example has an inline comment in the `foreach` loop. While this particular comment may not be that difficult to locate, imagine if the function included hundreds of lines of code.

PowerShell

```
function Test-MrVerboseOutput {

    [CmdletBinding()]
    param (
```

```
        [ValidateNotNullOrEmpty()]
        [string[]]$ComputerName = $env:COMPUTERNAME
    )

    foreach ($Computer in $ComputerName) {
        #Attempting to perform some action on $Computer <<-- Don't use
        #inline comments like this, use write verbose instead.
        Write-Output $Computer
    }

}
```

A better option is to use `Write-Verbose` instead of inline comments.

PowerShell

```
function Test-MrVerboseOutput {

    [CmdletBinding()]
    param (
        [ValidateNotNullOrEmpty()]
        [string[]]$ComputerName = $env:COMPUTERNAME
    )

    foreach ($Computer in $ComputerName) {
        Write-Verbose -Message "Attempting to perform some action on
$Computer"
        Write-Output $Computer
    }

}
```

When the function is called without the **Verbose** parameter, the verbose output won't be displayed.

PowerShell

```
Test-MrVerboseOutput -ComputerName Server01, Server02
```

When it's called with the **Verbose** parameter, the verbose output will be displayed.

PowerShell

```
Test-MrVerboseOutput -ComputerName Server01, Server02 -Verbose
```

Pipeline Input

When you want your function to accept pipeline input, some additional coding is necessary. As mentioned earlier in this book, commands can accept pipeline input **by value** (by type) or **by property name**. You can write your functions just like the native commands so that they accept either one or both of these types of input.

To accept pipeline input **by value**, specified the `ValueFromPipeline` parameter attribute for that particular parameter. Keep in mind that you can only accept pipeline input **by value** from one of each datatype. For example, if you have two parameters that accept string input, only one of those can accept pipeline input **by value** because if you specified it for both of the string parameters, the pipeline input wouldn't know which one to bind to. This is another reason I call this type of pipeline input *by type* instead of **by value**.

Pipeline input comes in one item at a time similar to the way items are handled in a `foreach` loop. At a minimum, a `process` block is required to process each of these items if you're accepting an array as input. If you're only accepting a single value as input, a `process` block isn't necessary, but I still recommend specifying it for consistency.

PowerShell

```
function Test-MrPipelineInput {

    [CmdletBinding()]
    param (
        [Parameter(Mandatory,
                   ValueFromPipeline)]
        [string[]]$ComputerName
    )

    PROCESS {
        Write-Output $ComputerName
    }

}
```

Accepting pipeline input **by property name** is similar except it's specified with the `ValueFromPipelineByPropertyName` parameter attribute and it can be specified for any number of parameters regardless of datatype. The key is that the output of the command that's being piped in has to have a property name that matches the name of the parameter or a parameter alias of your function.

PowerShell

```
function Test-MrPipelineInput {

    [CmdletBinding()]
```

```
    param (
        [Parameter(Mandatory,
                   ValueFromPipelineByPropertyName)]
        [string[]]$ComputerName
    )

    PROCESS {
            Write-Output $ComputerName
    }

}
```

`BEGIN` and `END` blocks are optional. `BEGIN` would be specified before the `PROCESS` block and is used to perform any initial work prior to the items being received from the pipeline. This is important to understand. Values that are piped in are not accessible in the `BEGIN` block. The `END` block would be specified after the `PROCESS` block and is used for cleanup once all of the items that are piped in have been processed.

Error Handling

The function shown in the following example generates an unhandled exception when a computer can't be contacted.

PowerShell

```
function Test-MrErrorHandling {

    [CmdletBinding()]
    param (
        [Parameter(Mandatory,
                   ValueFromPipeline,
                   ValueFromPipelineByPropertyName)]
        [string[]]$ComputerName
    )

    PROCESS {
        foreach ($Computer in $ComputerName) {
            Test-WSMan -ComputerName $Computer
        }
    }

}
```

There are a couple of different ways to handle errors in PowerShell. `Try/Catch` is the more modern way to handle errors.

PowerShell

```
function Test-MrErrorHandling {

    [CmdletBinding()]
    param (
        [Parameter(Mandatory,
                   ValueFromPipeline,
                   ValueFromPipelineByPropertyName)]
        [string[]]$ComputerName
    )

    PROCESS {
        foreach ($Computer in $ComputerName) {
            try {
                Test-WSMan -ComputerName $Computer
            }
            catch {
                Write-Warning -Message "Unable to connect to Computer:
$Computer"
            }
        }
    }

}
```

Although the function shown in the previous example uses error handling, it also generates an unhandled exception because the command doesn't generate a terminating error. This is also important to understand. Only terminating errors are caught. Specify the **ErrorAction** parameter with **Stop** as the value to turn a non-terminating error into a terminating one.

PowerShell

```
function Test-MrErrorHandling {

    [CmdletBinding()]
    param (
        [Parameter(Mandatory,
                   ValueFromPipeline,
                   ValueFromPipelineByPropertyName)]
        [string[]]$ComputerName
    )

    PROCESS {
        foreach ($Computer in $ComputerName) {
            try {
                Test-WSMan -ComputerName $Computer -ErrorAction Stop
            }
            catch {
                Write-Warning -Message "Unable to connect to Computer:
$Computer"
            }
        }
```

```
    }

}
```

Don't modify the global `$ErrorActionPreference` variable unless absolutely necessary. If you're using something like .NET directly from within your PowerShell function, you can't specify the **ErrorAction** on the command itself. In that scenario, you might need to change the global `$ErrorActionPreference` variable, but if you do change it, change it back immediately after trying the command.

Comment-Based Help

It's considered to be a best practice to add comment based help to your functions so the people you're sharing them with will know how to use them.

PowerShell

```
function Get-MrAutoStoppedService {

<#
.SYNOPSIS
    Returns a list of services that are set to start automatically, are not
    currently running, excluding the services that are set to delayed start.

.DESCRIPTION
    Get-MrAutoStoppedService is a function that returns a list of services
from
    the specified remote computer(s) that are set to start automatically,
are not
    currently running, and it excludes the services that are set to start
automatically
    with a delayed startup.

.PARAMETER ComputerName
    The remote computer(s) to check the status of the services on.

.PARAMETER Credential
    Specifies a user account that has permission to perform this action. The
default
    is the current user.

.EXAMPLE
     Get-MrAutoStoppedService -ComputerName 'Server1', 'Server2'

.EXAMPLE
     'Server1', 'Server2' | Get-MrAutoStoppedService

.EXAMPLE
     Get-MrAutoStoppedService -ComputerName 'Server1' -Credential (Get-
```

```
Credential)

.INPUTS
    String

.OUTPUTS
    PSCustomObject

.NOTES
    Author:  Mike F Robbins
    Website: http://mikefrobbins.com
    Twitter: @mikefrobbins
#>

    [CmdletBinding()]
    param (

    )

    #Function Body

}
```

When you add comment based help to your functions, help can be retrieved for them just like the default built-in commands.

All of the syntax for writing a function in PowerShell can seem overwhelming especially for someone who is just getting started. Often times if I can't remember the syntax for something, I'll open a second copy of the ISE on a separate monitor and view the "Cmdlet (advanced function) - Complete" snippet while typing in the code for my function. Snippets can be accessed in the PowerShell ISE using the <kbd>Ctrl</kbd>+<kbd>J</kbd> key combination.

Summary

In this chapter you've learned the basics of writing functions in PowerShell to include how to turn a function into an advanced function and some of the more important elements that you should consider when writing PowerShell functions such as parameter validation, verbose output, pipeline input, error handling, and comment based help.

Review

1. How do you obtain a list of approved verbs in PowerShell?
2. How do you turn a PowerShell function into an advanced function?
3. When should **WhatIf** and **Confirm** parameters be added to your PowerShell functions?

4. How do you turn a non-terminating error into a terminating one?
5. Why should you add comment based help to your functions?

Recommended Reading

- about_Functions
- about_Functions_Advanced_Parameters
- about_CommonParameters
- about_Functions_CmdletBindingAttribute
- about_Functions_Advanced
- about_Try_Catch_Finally
- about_Comment_Based_Help
- Video: PowerShell Toolmaking with Advanced Functions and Script Modules

Chapter 10 - Script modules

Article • 12/09/2022

Turning your one-liners and scripts in PowerShell into reusable tools becomes even more important if it's something that you're going to use frequently. Packaging your functions in a script module makes them look and feel more professional and makes them easier to share.

Dot-Sourcing Functions

Something that we didn't talk about in the previous chapter is dot-sourcing functions. When a function in a script isn't part of a module, the only way to load it into memory is to dot-source the `.PS1` file that it's saved in.

The following function has been saved as `Get-MrPSVersion.ps1`.

PowerShell

```
function Get-MrPSVersion {
    $PSVersionTable
}
```

When you run the script, nothing happens.

PowerShell

```
.\Get-MrPSVersion.ps1
```

If you try to call the function, it generates an error message.

PowerShell

```
Get-MrPSVersion
```

Output

```
Get-MrPSVersion : The term 'Get-MrPSVersion' is not recognized as the name
of a cmdlet,
function, script file, or operable program. Check the spelling of the name,
or if a path
was included, verify that the path is correct and try again.
At line:1 char:1
+ Get-MrPSVersion
```

```
    + CategoryInfo          : ObjectNotFound: (Get-MrPSVersion:String) [],
CommandNotFou
   ndException
    + FullyQualifiedErrorId : CommandNotFoundException
```

You can determine if functions are loaded into memory by checking to see if they exist on the **Function** PSDrive.

PowerShell

```
Get-ChildItem -Path Function:\Get-MrPSVersion
```

Output

```
Get-ChildItem : Cannot find path 'Get-MrPSVersion' because it does not
exist.
At line:1 char:1
+ Get-ChildItem -Path Function:\Get-MrPSVersion
    + CategoryInfo          : ObjectNotFound: (Get-MrPSVersion:String) [Get-
ChildItem],
   ItemNotFoundException
    + FullyQualifiedErrorId :
PathNotFound,Microsoft.PowerShell.Commands.GetChildItemCommand
```

The problem with calling the script that contains the function is that the functions are loaded in the *Script* scope. When the script completes, that scope is removed and the function is removed with it.

The function needs to be loaded into the *Global* scope. That can be accomplished by dot-sourcing the script that contains the function. The relative path can be used.

PowerShell

```
. .\Get-MrPSVersion.ps1
```

The fully qualified path can also be used.

PowerShell

```
. C:\Demo\Get-MrPSVersion.ps1
```

If a portion of the path is stored in a variable, it can be combined with the remainder of the path. There's no reason to use string concatenation to combine the variable together with the remainder of the path.

PowerShell

```
$Path = 'C:\'
. $Path\Get-MrPSVersion.ps1
```

Now when I check the **Function** PSDrive, the `Get-MrPSVersion` function exists.

PowerShell

```
Get-ChildItem -Path Function:\Get-MrPSVersion
```

Output

```
CommandType     Name                                               Version
Source
-----------     ----                                               -------
------
Function        Get-MrPSVersion
```

Script Modules

A script module in PowerShell is simply a file containing one or more functions that's saved as a `.PSM1` file instead of a `.PS1` file.

How do you create a script module? You're probably guessing with a command named something like `New-Module`. Your assumption would be wrong. While there is a command in PowerShell named `New-Module`, that command creates a dynamic module, not a script module. Always be sure to read the help for a command even when you think you've found the command you need.

PowerShell

```
help New-Module
```

Output

```
NAME
    New-Module

SYNOPSIS
    Creates a new dynamic module that exists only in memory.

SYNTAX
    New-Module [-Name] <String> [-ScriptBlock] <ScriptBlock> [-ArgumentList
```

```
<Object[]>]
    [-AsCustomObject] [-Cmdlet <String[]>] [-Function <String[]>] [-
ReturnResult]
    [<CommonParameters>]

DESCRIPTION
    The New-Module cmdlet creates a dynamic module from a script block. The
members of
    the dynamic module, such as functions and variables, are immediately
available in
    the session and remain available until you close the session.

    Like static modules, by default, the cmdlets and functions in a dynamic
module are
    exported and the variables and aliases are not. However, you can use the
    Export-ModuleMember cmdlet and the parameters of New-Module to override
the defaults.

    You can also use the AsCustomObject parameter of New-Module to return
the dynamic
    module as a custom object. The members of the modules, such as
functions, are
    implemented as script methods of the custom object instead of being
imported into
    the session.

    Dynamic modules exist only in memory, not on disk. Like all modules, the
members of
    dynamic modules run in a private module scope that is a child of the
global scope.
    Get-Module cannot get a dynamic module, but Get-Command can get the
exported members.

    To make a dynamic module available to Get-Module , pipe a New-Module
command to
    Import-Module, or pipe the module object that New-Module returns to
Import-Module .
    This action adds the dynamic module to the Get-Module list, but it does
not save the
    module to disk or make it persistent.

RELATED LINKS
    Online Version: http://go.microsoft.com/fwlink/?LinkId=821495
    Export-ModuleMember
    Get-Module
    Import-Module
    Remove-Module

REMARKS
    To see the examples, type: "get-help New-Module -examples".
    For more information, type: "get-help New-Module -detailed".
    For technical information, type: "get-help New-Module -full".
    For online help, type: "get-help New-Module -online"
```

In the previous chapter, I mentioned that functions should use approved verbs otherwise they'll generate a warning message when the module is imported. The following code uses the `New-Module` cmdlet to create a dynamic module in memory. This module demonstrates the unapproved verb warning.

PowerShell

```
New-Module -Name MyModule -ScriptBlock {

    function Return-MrOsVersion {
        Get-CimInstance -ClassName Win32_OperatingSystem |
        Select-Object -Property @{label='OperatingSystem';expression=
{$_.Caption}}
    }

    Export-ModuleMember -Function Return-MrOsVersion

} | Import-Module
```

Output

```
WARNING: The names of some imported commands from the module 'MyModule'
include
unapproved verbs that might make them less discoverable. To find the
commands with
unapproved verbs, run the Import-Module command again with the Verbose
parameter. For a
list of approved verbs, type Get-Verb.
```

Just to reiterate, although the `New-Module` cmdlet was used in the previous example, that's not the command for creating script modules in PowerShell.

Save the following two functions in a file named `MyScriptModule.psm1`.

PowerShell

```
function Get-MrPSVersion {
    $PSVersionTable
}

function Get-MrComputerName {
    $env:COMPUTERNAME
}
```

Try to call one of the functions.

PowerShell

```
Get-MrComputerName
```

Output

```
Get-MrComputerName : The term 'Get-MrComputerName' is not recognized as the
name of a
cmdlet, function, script file, or operable program. Check the spelling of
the name, or
if a path was included, verify that the path is correct and try again.
At line:1 char:1
+ Get-MrComputerName
    + CategoryInfo          : ObjectNotFound: (Get-MrComputerName:String)
[], CommandNot
   FoundException
    + FullyQualifiedErrorId : CommandNotFoundException
```

An error message is generated saying the function can't be found. You could also check the **Function** PSDrive just like before and you'll find that it doesn't exist there either.

You could manually import the file with the `Import-Module` cmdlet.

PowerShell

```
Import-Module C:\MyScriptModule.psm1
```

The module autoloading feature was introduced in PowerShell version 3. To take advantage of module autoloading, a script module needs to be saved in a folder with the same base name as the `.PSM1` file and in a location specified in `$env:PSModulePath`.

PowerShell

```
$env:PSModulePath
```

Output

```
C:\Users\mike-ladm\Documents\WindowsPowerShell\Modules;C:\Program
Files\WindowsPowerShell\
Modules;C:\Windows\system32\WindowsPowerShell\v1.0\Modules;C:\Program Files
(x86)\Microsof
t SQL Server\130\Tools\PowerShell\Modules\
```

The results are difficult to read. Since the paths are separated by a semicolon, you can split the results to return each path on a separate line. This makes them easier to read.

PowerShell

```
$env:PSModulePath -split ';'
```

Output

```
C:\Users\mike-ladm\Documents\WindowsPowerShell\Modules
C:\Program Files\WindowsPowerShell\Modules
C:\Windows\system32\WindowsPowerShell\v1.0\Modules
C:\Program Files (x86)\Microsoft SQL Server\130\Tools\PowerShell\Modules\
```

The first three paths in the list are the default. When SQL Server Management Studio was installed, it added the last path. For module autoloading to work, the `MyScriptModule.psm1` file needs to be located in a folder named `MyScriptModule` directly inside one of those paths.

Not so fast. For me, my current user path isn't the first one in the list. I almost never use that path since I log into Windows with a different user than the one I use to run PowerShell. That means it's not located in my normal Documents folder.

The second path is the **AllUsers** path. This is the location where I store all of my modules.

The third path is underneath `C:\Windows\System32`. Only Microsoft should be storing modules in that location since it resides within the operating systems folder.

Once the `.PSM1` file is located in the correct path, the module will load automatically when one of its commands is called.

Module Manifests

All modules should have a module manifest. A module manifest contains metadata about your module. The file extension for a module manifest file is `.PSD1`. Not all files with a `.PSD1` extension are module manifests. They can also be used for things such as storing the environmental portion of a DSC configuration. `New-ModuleManifest` is used to create a module manifest. **Path** is the only value that's required. However, the module won't work if **RootModule** isn't specified. It's a good idea to specify **Author** and **Description** in case you decide to upload your module to a NuGet repository with PowerShellGet since those values are required in that scenario.

The version of a module without a manifest is 0.0. This is a dead giveaway that the module doesn't have a manifest.

PowerShell

```
Get-Module -Name MyScriptModule
```

Output

```
ModuleType Version    Name                                ExportedCommands
---------- -------    ----                                ----------------
Script     0.0        myscriptmodule                      {Get-
MrComputerName, Get-MrP...
```

The module manifest can be created with all of the recommended information.

PowerShell

```
New-ModuleManifest -Path
$env:ProgramFiles\WindowsPowerShell\Modules\MyScriptModule\MyScriptModule.ps
d1 -RootModule MyScriptModule -Author 'Mike F Robbins' -Description
'MyScriptModule' -CompanyName 'mikefrobbins.com'
```

If any of this information is missed during the initial creation of the module manifest, it can be added or updated later using `Update-ModuleManifest`. Don't recreate the manifest using `New-ModuleManifest` once it's already created because the GUID will change.

Defining Public and Private Functions

You may have helper functions that you may want to be private and only accessible by other functions within the module. They are not intended to be accessible to users of your module. There are a couple of different ways to accomplish this.

If you're not following the best practices and only have a `.PSM1` file, then your only option is to use the `Export-ModuleMember` cmdlet.

PowerShell

```
function Get-MrPSVersion {
    $PSVersionTable
}

function Get-MrComputerName {
    $env:COMPUTERNAME
}

Export-ModuleMember -Function Get-MrPSVersion
```

In the previous example, only the `Get-MrPSVersion` function is available to the users of your module, but the `Get-MrComputerName` function is available to other functions within the module itself.

PowerShell

```
Get-Command -Module MyScriptModule
```

Output

```
CommandType     Name                                               Version
Source
-----------     ----                                               -------    -
-----
Function        Get-MrPSVersion                                    1.0
MyScriptModule
```

If you've added a module manifest to your module (and you should), then I recommend specifying the individual functions you want to export in the **FunctionsToExport** section of the module manifest.

PowerShell

```
FunctionsToExport = 'Get-MrPSVersion'
```

It's not necessary to use both `Export-ModuleMember` in the `.PSM1` file and the **FunctionsToExport** section of the module manifest. One or the other is sufficient.

Summary

In this chapter you've learned how to turn your functions into a script module in PowerShell. You've also learned some of the best practices for creating script modules such as creating a module manifest for your script module.

Review

1. How do you create a script module in PowerShell?
2. Why is it important for your functions to use an approved verb?
3. How do you create a module manifest in PowerShell?
4. What are the two options for exporting only certain functions from your module?
5. What is required for your modules to load automatically when a command is called?

Recommended Reading

- How to Create PowerShell Script Modules and Module Manifests
- about_Modules
- New-ModuleManifest
- Export-ModuleMember

Appendix A - Help Syntax

Article • 11/17/2022

The following example shows the **SYNTAX** section of the help for the `Get-EventLog` cmdlet.

PowerShell

```
help Get-EventLog
```

Output

```
NAME
    Get-EventLog

SYNOPSIS
    Gets the events in an event log, or a list of the event logs, on the
local or remote
    computers.


SYNTAX
    Get-EventLog [-LogName] <String> [[-InstanceId] <Int64[]>] [-After
<DateTime>]
    [-AsBaseObject] [-Before <DateTime>] [-ComputerName <String[]>] [-
EntryType {Error |
    Information | FailureAudit | SuccessAudit | Warning}] [-Index <Int32[]>]
[-Message
    <String>] [-Newest <Int32>] [-Source <String[]>] [-UserName <String[]>]
    [<CommonParameters>]

    Get-EventLog [-AsString] [-ComputerName <String[]>] [-List]
[<CommonParameters>]
```

Only the relevant portion of the help is shown in this example.

The syntax is primarily made up of several sets of opening and closing brackets (`[]`). These have two different meanings depending on how they're used. Anything contained within square brackets is optional unless they're a set of empty square brackets `[]`. Empty square brackets only appear after a datatype such as `<string[]>`. This means that particular parameter can accept more than one value of that type.

The first parameter in the first parameter set of `Get-EventLog` is **LogName**. LogName is surrounded by square brackets which means that it's a positional parameter. In other words, specifying the name of the parameter itself is optional as long as it's specified in

the correct position. The information in the angle brackets (`<>`) after the parameter name indicates that it needs a single **string** value. The entire parameter name and datatype are not surrounded by square brackets so the **LogName** parameter is required when using this parameter set.

PowerShell

```
Get-EventLog [-LogName] <String>
```

The second parameter is **InstanceId**. Notice that the parameter name and the datatype are both completely surrounded by square brackets. This means that the **InstanceId** parameter is optional, not mandatory. Also notice that **InstanceId** is surrounded by its own set of square brackets. As with the **LogName** parameter, this means the parameter is positional. There's one last set of square brackets after the datatype. This means that it can accept more than one value in the form of an array or a comma-separated list.

```
[[-InstanceId] <Int64[]>]
```

The second parameter set has a **List** parameter. It's a switch parameter because there's no datatype following the parameter name. When the **List** parameter is specified, the value is **True**. When it's not specified, the value is **False**.

```
[-List]
```

The syntax information for a command can also be retrieved using `Get-Command` using the **Syntax** parameter. This is a handy shortcut that I use all the time. It allows me to quickly learn how to use a command without having to sift through multiple pages of help information. If I end up needing more information, then I'll revert to using the actual help content.

PowerShell

```
Get-Command -Name Get-EventLog -Syntax
```

Output

```
Get-EventLog [-LogName] <string> [[-InstanceId] <long[]>] [-ComputerName
<string[]>] [-Newest <int>]
 [-After <datetime>] [-Before <datetime>] [-UserName <string[]>] [-Index
```

```
<int[]> ]
 [-EntryType <string[]>] [-Source <string[]>] [-Message <string>] [-
AsBaseObject]
 [<CommonParameters>]

Get-EventLog [-ComputerName <string[]>] [-List] [-AsString]
[<CommonParameters>]
```

The more you use the help system in PowerShell, the easier remembering all of the different nuances becomes. Before you know it, using it becomes second nature.

Optimizing your shell experience

Article • 12/01/2022

PowerShell is a command-line shell and a scripting language used for automation.

Wikipedia includes the following description of a shell:

> A shell manages the user-system interaction by prompting users for input, interpreting their input, and then handling output from the underlying operating system (much like a read-eval-print loop or REPL).

Similar to other shells like `bash` or `cmd.exe`, PowerShell allows you to run any command available on your system, not just PowerShell commands.

PowerShell commands are known as *cmdlets* (pronounced command-lets). Cmdlets are PowerShell commands, not stand-alone executables. PowerShell commands can't be run in other shells without running PowerShell first.

Features of the PowerShell command-line interface

PowerShell is a modern command shell that includes the best features of other popular shells. Unlike most shells that only accept and return text, PowerShell accepts and returns .NET objects. The shell has several features that you can use to optimize your interactive user experience.

- Robust command-line history
- Tab completion and command prediction
- Supports command and parameter aliases
- Pipeline for chaining commands
- In-console help system, similar to Unix `man` pages

Running commands in the shell

Article • 01/19/2023

PowerShell is a command-line shell and a scripting language used for automation. Similar to other shells, like `bash` on Linux or the Windows Command Shell (`cmd.exe`), PowerShell lets you to run any command available on your system, not just PowerShell commands.

Types of commands

For any shell in any operating system there are three types of commands:

- **Shell language keywords** are part of the shell's scripting language.
  - Examples of `bash` keywords include: `if`, `then`, `else`, `elif`, and `fi`.
  - Examples of `cmd.exe` keywords include: `dir`, `copy`, `move`, `if`, and `echo`.
  - Examples of PowerShell keywords include: `for`, `foreach`, `try`, `catch`, and `trap`.

  Shell language keywords can only be used within the runtime environment of the shell. There is no executable file, external to the shell, that provides the keyword's functionality.

- **OS-native commands** are executable files installed in the operating system. The executables can be run from any command-line shell, like PowerShell. This includes script files that may require other shells to work properly. For example, if you run a Windows batch script (`.cmd` file) in PowerShell, PowerShell runs `cmd.exe` and passes in the batch file for execution.

- **Shell environment-specifc commands** are commands defined in external files that can only be used within the runtime environment of the shell. These include scripts and functions, or they can be specially compiled modules that add commands to the shell runtime. In PowerShell, these commands are known as *cmdlets* (pronounced "command-lets").

Running native commands

Any native command can be run from the PowerShell command line. Usually you run the command exactly as you would in `bash` or `cmd.exe`. The following example shows running the `grep` command in `bash` on Ubuntu Linux.

Bash

```
sdwheeler@circumflex:~$ grep sdwheeler /etc/passwd
sdwheeler:x:1000:1000:,,,:/home/sdwheeler:/bin/bash
sdwheeler@circumflex:~$ pwsh
PowerShell 7.2.6
Copyright (c) Microsoft Corporation.

https://aka.ms/powershell
Type 'help' to get help.
```

After starting PowerShell on Ubuntu, you can run the same command from the PowerShell command line:

PowerShell

```
PS /home/sdwheeler> grep sdwheeler /etc/passwd
sdwheeler:x:1000:1000:,,,:/home/sdwheeler:/bin/bash
```

Passing arguments to native commands

Most shells include features for using variables, evaluating expressions, and handling strings. But each shell does these things differently. In PowerShell, all parameters start with a hyphen (`-`) character. In `cmd.exe`, most parameters use a slash (`/`) character. Other command-line tools may not have a special character for parameters.

Each shell has its own way of handling and evaluating strings on the command line. When running native commands in PowerShell that expect strings to be quoted in a specific way, you may need adjust how you pass those strings.

For more information, see the following articles:

- about_Parsing
- about_Quoting_Rules

PowerShell 7.2 introduced a new experimental feature `PSnativeCommandArgumentPassing` that improved native command handling. For more information, see PSnativeCommandArgumentPassing.

Handling output and errors

PowerShell also has several more output streams than other shells. The `bash` and `cmd.exe` shells have **stdout** and **stderr**. PowerShell has six output streams. For more information, see about_Redirection and about_Output_Streams.

In general, the output sent to **stdout** by an native command is sent to the **Success** stream in PowerShell. Output sent to **stderr** by an native command is sent to the **Error** stream in PowerShell.

When an native command has a non-zero exit code, `$?` is set to `$false`. If the exit code is zero, `$?` is set to `$true`.

However, this changed in PowerShell 7.2. Error records redirected from native commands, like when using redirection operators (`2>&1`), aren't written to PowerShell's `$Error` variable and the preference variable `$ErrorActionPreference` doesn't affect the redirected output.

Many native commands write to **stderr** as an alternative stream for additional information. This behavior can cause confusion in PowerShell when looking through errors and the additional output information can be lost if `$ErrorActionPreference` is set to a state that mutes the output.

PowerShell 7.3 added a new experimental feature `PSnativeCommandErrorActionPreference` that allows you to control whether output to `stderr` is treated as an error. For more information, see PSnativeCommandErrorActionPreference.

Running PowerShell commands

As previously noted, PowerShell commands are known as cmdlets. Cmdlets are collected into PowerShell modules that can be loaded on demand. Cmdlets can be written in any compiled .NET language or using the PowerShell scripting language itself.

PowerShell commands that run other commands

The PowerShell **call operator** (`&`) lets you run commands that are stored in variables and represented by strings or script blocks. You can use this to run any native command or PowerShell command. This is useful in a script when you need to dynamically construct the command-line parameters for an native command. For more information, see the call operator.

The `Start-Process` cmdlet can be used to run native commands, but should only be used when you need to control how the command is executed. The cmdlet has parameters to support the following scenarios:

- Run a command using different credentials
- Hide the console window created by the new process

- Redirect **stdin**, **stdout**, and **stderr** streams
- Use a different working directory for the command

The following example runs the native command `sort.exe` with redirected input and output streams.

PowerShell

```
$processOptions = @{
    FilePath = "sort.exe"
    RedirectStandardInput = "TestSort.txt"
    RedirectStandardOutput = "Sorted.txt"
    RedirectStandardError = "SortError.txt"
    UseNewEnvironment = $true
}
Start-Process @processOptions
```

For more information, see Start-Process.

On Windows, the `Invoke-Item` cmdlet performs the default action for the specified item. For example, it runs an executable file or opens a document file using the application associated with the document file type. The default action depends on the type of item and is resolved by the PowerShell provider that provides access to the item.

The following example opens the PowerShell source code repository in your default web browser.

PowerShell

```
Invoke-Item https://github.com/PowerShell/PowerShell
```

For more information, see Invoke-Item.

Using tab-completion in the shell

Article • 02/08/2023

PowerShell provides completions on input to provide hints, enable discovery, and speed up input entry. Command names, parameter names, argument values and file paths can all be completed by pressing the `Tab` key.

The `Tab` key is the default key binding on Windows. **PSReadLine** also provides a `MenuComplete` function that's bound to `Ctrl`+`Space`. The `MenuComplete` function displays a list of matching completions below the command line.

These keybindings can be changed using **PSReadLine** cmdlets or the application that's hosting PowerShell. Keybindings can be different on non-Windows platforms. For more information, see about_PSReadLine_Functions.

Built-in tab completion features

PowerShell has enabled tab completion for many aspects of the command line experience.

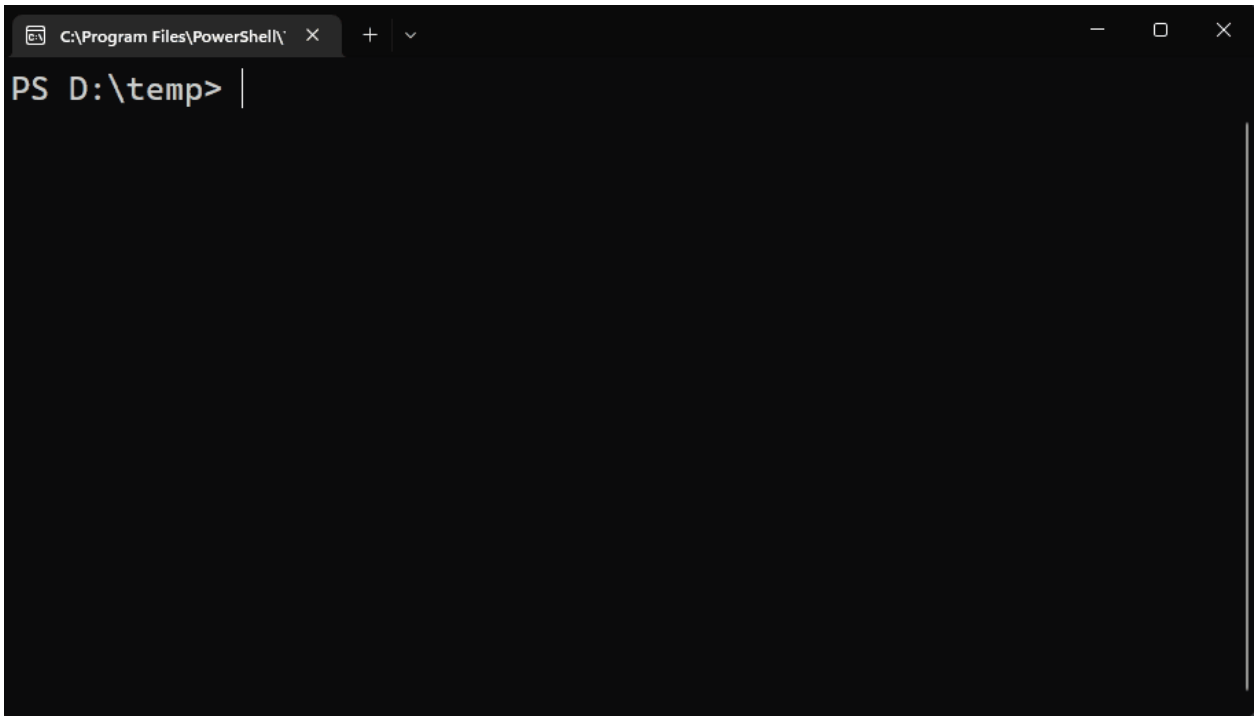
Filename completion

To fill in a filename or path from the available choices automatically, type part of the name and press the `Tab` key. PowerShell automatically expands the name to the first match that it finds. Pressing the `Tab` key again cycles through all the available choices with each key press.

Command and parameter name completion

The tab expansion of cmdlet names is slightly different. To use tab expansion on a cmdlet name, type the entire first part of the name (the verb) and the hyphen that follows it. You can fill in more of the name for a partial match. For example, if you type `get-co` and then press the `Tab` key, PowerShell automatically expands this to the `Get-Command` cmdlet (notice that it also changes the case of letters to their standard form). If you press `Tab` key again, PowerShell replaces this with the only other matching cmdlet name, `Get-Content`. Tab completion also works to resolve PowerShell aliases and native executables.

The following graphic shows examples of tab and menu completion.



Other tab completion enhancements

Each new version of PowerShell includes improvements to tab completion that fix bugs and improve usability.

PowerShell 7.0

- Tab completion resolves variable assignments that are enums or are type constrained
- Tab completion expands abbreviated cmdlets and functions. For example, `i-psdf<tab>` returns `Import-PowerShellDataFile`

PowerShell 7.2

- Fix tab completion for unlocalized `about*` topics
- Fix splatting being treated as positional parameter in completions
- Add completions for Comment-based Help keywords
- Add completion for `#requires` statements
- Add tab completion for **View** parameter of `Format-*` cmdlets
- Add support for class-based argument completers

PowerShell 7.3

- Fix tab completion within the script block specified for the `ValidateScriptAttribute`
- Added tab completion for loop labels after `break` and `continue`
- Improve Hashtable completion in multiple scenarios

    - Parameter splatting
    - **Arguments** parameter for `Invoke-CimMethod`
    - **FilterHashtable** parameter for `Get-WinEvent`
    - **Property** parameter for the CIM cmdlets
    - Removes duplicates from member completion scenarios
- Support forward slashes in network share (UNC path) completion
- Improve member auto completion
- Prioritize `ValidateSet` completions over enums for parameters
- Add type inference support for generic methods with type parameters
- Improve type inference and completions
    - Allows methods to be shown in completion results for `ForEach-Object -MemberName`
    - Prevents completion on expressions that return **void** like (`[void]("")`)
    - Allows non-default Class constructors to show up when class completion is based on the AST

Other ways to enhance tab completion of command parameters

Built-in tab expansion is controlled by the internal function **TabExpansion** or **TabExpansion2**. It's possible to create functions or modules that replace the default behavior of these functions. You can find examples in the PowerShell Gallery by searching for the TabExpansion keyword.

Using the `ValidateSet` or `ArgumentCompletions` attributes with parameters

The `ArgumentCompletions` attribute allows you to add tab completion values to a specific parameter. The `ArgumentCompletions` attribute is similar to `ValidateSet`. Both attributes takes a list of values to be presented when the user presses `Tab` after the parameter name. However, unlike `ValidateSet`, the values aren't validated.

For more information, see:

- ArgumentCompletions
- ValidateSet

Using the `ArgumentCompleter` attribute or `Register-ArgumentCompleter` with parameters

An argument completer is a script block or function that provides dynamic tab completion for parameter values.

The `ArgumentCompleter` attribute allows you to register a function that provides tab completion values to for the parameter. The argument completer function must be available to the function containing the parameter with the `ArgumentCompleter` attribute. Usually, the function is defined in the same script or module.

For more information, see ArgumentCompleter.

The `Register-ArgumentCompleter` cmdlet registers a script block as an argument completer function at run time for any command you specify. This allows you to define argument completers outside of the script or module or for native commands. For more information, see Register-ArgumentCompleter.

Predictive IntelliSense in PSReadLine

PSReadLine 2.1.0 introduced the **Predictive IntelliSense** feature. Predictive IntelliSense provides suggestions for full commands based on items from your **PSReadLine** history.

PSReadLine 2.2.2 extends the power of Predictive IntelliSense by adding support for plug-in modules that use advanced logic to provide suggestions for full commands. The **Az.Tools.Predictor** module was the first plug-in for Predictive IntelliSense. It uses Machine Learning to predict what Azure PowerShell command you want to run and the parameters you want to use.

For more information, see Using predictors.

Using predictors in PSReadLine

Article • 12/01/2022

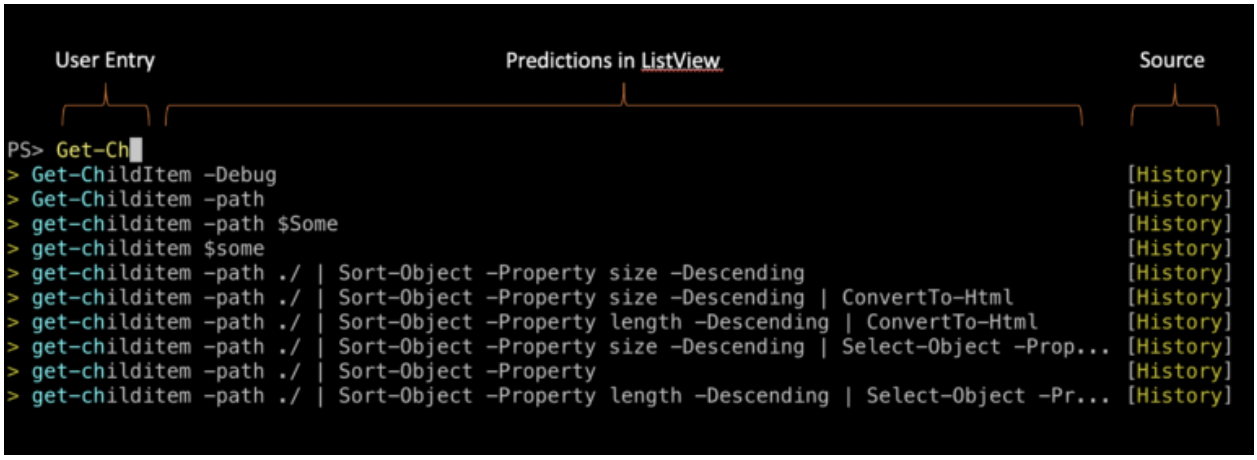
PSReadLine 2.1.0 introduced the **Predictive IntelliSense** feature. Predictive IntelliSense provides suggestions for full commands based on items from your **PSReadLine** history. **PSReadLine** 2.2.2 extends the power of Predictive IntelliSense by adding support for plug-in modules that use advanced logic to provide suggestions for full commands. The latest version, **PSReadLine** 2.2.6, enables predictions by default.

Using Predictive IntelliSense

When Predictive IntelliSense is enabled, the prediction suggestion appears as colored text following the user's cursor. The suggestions from Predictive IntelliSense help new and experienced users of PowerShell discover, edit, and execute full commands based on matching predictions. Suggestions can come from the user's history and additional domain specific plugins.

The previous images shows the default `InlineView` of the suggestion. Pressing `RightArrow` key accepts an inline suggestion. After accepting the suggestion, you can edit the command line before hitting `Enter` to run the command.

PSReadLine also offers a `ListView` presentation of the suggestions.



When in the list view, you can use the arrow keys to scroll through the available suggestions. List view also shows the source of the prediction.

PSReadLine defaults to `InlineView`. You can switch between `InlineView` and `ListView` by pressing the F2 key. You can also use the **PredictionViewStyle** parameter of `Set-PSReadLineOption` to change the view.

Managing Predictive IntelliSense

To use Predictive IntelliSense you must have a newer version of **PSReadLine** installed. For best results, install the latest version of the module.

To install **PSReadLine** using **PowerShellGet**:

```PowerShell
Install-Module -Name PSReadLine
```

Or install using the new PowerShellGet v3 module:

```PowerShell
Install-PSResource -Name PSReadLine
```

PSReadLine can be installed in Window PowerShell 5.1 or in PowerShell 7 or higher. To use predictor plug-ins you must be running in PowerShell 7.2 or higher. Window PowerShell 5.1 can use the history-based predictor.

In **PSReadLine** 2.2.6, Predictive IntelliSense is enabled by default depending on the following conditions:

- If Virtual Terminal (VT) is supported and **PSReadLine** running in PowerShell 7.2 or higher, **PredictionSource** is set to `HistoryAndPlugin`
- If VT is supported and **PSReadLine** running in PowerShell older than 7.2, **PredictionSource** is set to `History`
- If VT isn't supported, **PredictionSource** is set to `None`.

Use the following command to see the current setting:

```PowerShell
Get-PSReadLineOption | Select-Object -Property PredictionSource
```

You can change the prediction source using the `Set-PSReadLineOption` cmdlet with the **PredictionSource** parameter. The **PredictionSource** can be set to:

- `None`
- `History`
- `Plugin`
- `HistoryAndPlugin`

> **Note**
>
> History-based predictions come from the history maintained by **PSReadLine**. That history is more comprehensive than the session-based history you can see using `Get-History`. For more information, see **Command history** section of **about_PSReadLine**.

Setting the prediction color

By default, predictions appear in light grey text on the same line the user is typing. To support accessibility needs, you can customize the prediction color. Colors are defined using ANSI escape sequences. You can use `$PSStyle` to compose ANSI escape sequences.

PowerShell

```
Set-PSReadLineOption -Colors @{ InlinePrediction = $PSStyle.Background.Blue
}
```

Or you can create your own. The default light-grey prediction text color can be restored using the following ANSI escape sequence.

PowerShell

```
Set-PSReadLineOption -Colors @{ InlinePrediction = "`e[38;5;238m" }
```

For more information about setting prediction color and other PSReadLine settings, see Set-PSReadLineOption.

Changing keybindings

PSReadLine contains functions to navigate and accept predictions. For example:

- `AcceptSuggestion` - Accept the current inline suggestion
- `AcceptNextSuggestionWord` - Accept the next word of the inline suggestion

- `AcceptSuggestion` is built within `ForwardChar`, which is bound to `RightArrow` by default
- `AcceptNextSuggestionWord` is built within the function `ForwardWord`, which can be bound to `Ctrl`+`f`

You can use the `Set-PSReadLineKeyHandler` cmdlet to change key bindings.

```PowerShell
Set-PSReadLineKeyHandler -Chord "Ctrl+f" -Function ForwardWord
```

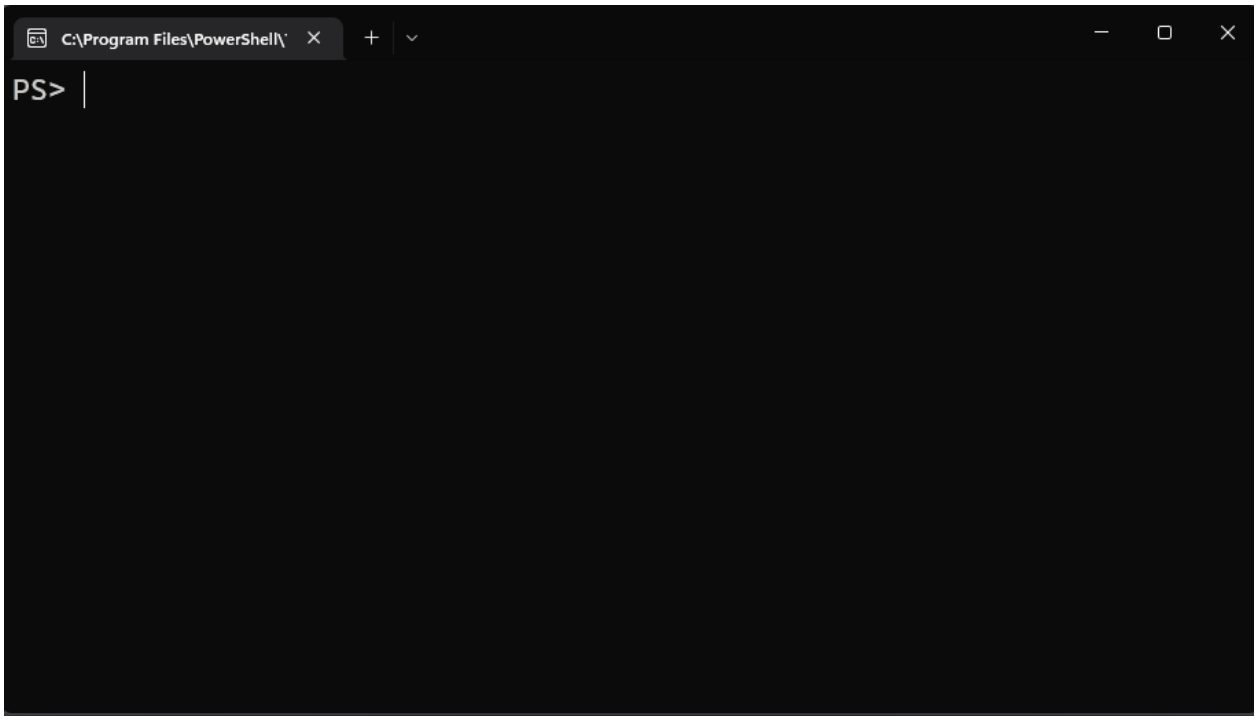
With this binding, pressing `Ctrl`+`f` accepts the next word of an inline suggestion when the cursor is at the end of current editing line. You can bind other keys to `AcceptSuggestion` and `AcceptNextSuggestionWord` for similar functionalities. For example, you may want to make `RightArrow` accept the next word of the inline suggestion, instead of the whole suggestion line.

```PowerShell
Set-PSReadLineKeyHandler -Chord "RightArrow" -Function ForwardWord
```

Using other predictor plug-ins

The **Az.Tools.Predictor** module was the first plug-in for Predictive IntelliSense. It uses Machine Learning to predict what Azure PowerShell command you want to run and the parameters you want to use. For more information and installation instructions, see Announcing General Availability of Az.Tools.Predictor.

The **CompletionPredictor** module adds an IntelliSense experience for anything that can be tab-completed in PowerShell. With **PSReadLine** set to `InlineView`, you get the normal tab completion experience. When you switch to `ListView`, you get the IntelliSense experience. You can install the CompletionPredictor module from the PowerShell Gallery.



As previously noted, `ListView` shows you the source of the prediction. If you have multiple plug-ins installed the predictions are grouped by source with **History** listed first followed by each plug-in in the order that they were loaded.

Creating your own predictor module

You can write your own predictor using C# to create a compiled PowerShell module. The module must implement the **System.Management.Automation.Subsystem.Prediction.ICommandPredictor** interface. This interface declares the methods used to query for prediction results and provide feedback.

For more information, see How to create a command-line predictor.

Using dynamic help

Article • 03/27/2023

Dynamic Help provides just-in-time help that allows you to stay focused on your work without losing your place typing on the command line.

Getting cmdlet help

Dynamic Help provides a view of full cmdlet help shown in an alternative screen buffer. **PSReadLine** maps the function `ShowCommandHelp` to the `F1` key.

- When the cursor is at the end of a fully expanded cmdlet name, pressing `F1` displays the help for that cmdlet.
- When the cursor is at the end of a fully expanded parameter name, pressing `F1` displays the help for the cmdlet beginning at the parameter.

The pager in **PSReadLine** allows you to scroll the displayed help using the up and down arrow keys. Pressing `Q` exits the alternative screen buffer and returns to the current cursor position on the command line on the primary screen.

Getting focused parameter help

Pressing `Alt`+`h` provides dynamic help for parameters. The help is shown below the current command line similar to MenuComplete. The cursor must be at the end of the

fully expanded parameter name when you press the Alt+h key.

```
PS>
PS> Get-ChildItem -path

-Path <System.String[]>

DESC: Specifies a path to one or more locations. Wildcards are accepted. The default
 location is the current directory (`.`).
Required: false, Position: 0, Default Value: Current directory, Pipeline Input: True
 (ByPropertyName, ByValue), WildCard: true
```

Selecting arguments on the command line

To quickly select and edit the arguments of a cmdlet without disturbing your syntax using Alt+a. Based on the cursor position, it searches from the current cursor position and stops when it finds any arguments on the command line.

```
PS>
PS> get-childitem -path ./ | Sort-Object -Property length -Descending | format-table
 -AutoSize
```

Choosing keybindings

Not all keybindings work for all operating systems and terminal applications. For example, keybindings for the Alt key don't work on macOS by default. On Linux, Ctrl+[is the same as Escape. And Ctrl+Spacebar generates a Control+2 key sequence instead of the Control+Spacebar sequence expected.

To work around these quirks, map the PSReadLine function to an available key combination. For example:

PowerShell

```
Set-PSReadLineKeyHandler -chord 'Ctrl+l' -Function ShowParameterHelp
Set-PSReadLineKeyHandler -Chord 'Ctrl+k' -Function SelectCommandArgument
```

For more information about keybindings and workarounds, see Using PSReadLine key handlers.

Using aliases

Article • 11/17/2022

An alias is an alternate name or shorthand name for a cmdlet or for a command element, such as a function, script, file, or executable file. You can run the command using the alias instead of the executable name.

Managing command aliases

PowerShell provides cmdlets for managing command aliases.

PowerShell

```
Get-Command -Noun Alias
```

Output

```
CommandType Name         Version Source
----------- ----         ------- ------
Cmdlet      Export-Alias 7.0.0.0 Microsoft.PowerShell.Utility
Cmdlet      Get-Alias    7.0.0.0 Microsoft.PowerShell.Utility
Cmdlet      Import-Alias 7.0.0.0 Microsoft.PowerShell.Utility
Cmdlet      New-Alias    7.0.0.0 Microsoft.PowerShell.Utility
Cmdlet      Remove-Alias 7.0.0.0 Microsoft.PowerShell.Utility
Cmdlet      Set-Alias    7.0.0.0 Microsoft.PowerShell.Utility
```

For more information, see about_Aliases.

Use the Get-Alias cmdlet to list the aliases available in your environment. To list the aliases for a single cmdlet, use the **Definition** parameter and specify the executable name.

PowerShell

```
Get-Alias -Definition Get-ChildItem
```

Output

```
CommandType     Name
-----------     ----
Alias           dir -> Get-ChildItem
Alias           gci -> Get-ChildItem
Alias           ls -> Get-ChildItem
```

To get the definition of a single alias, use the **Name** parameter.

PowerShell

```
Get-Alias -Name gci
```

Output

```
CommandType     Name
-----------     ----
Alias           gci -> Get-ChildItem
```

Compatibility aliases in Windows

PowerShell has several aliases that allow **UNIX** and **cmd.exe** users to use familiar commands in Windows. The following table show common commands, the related PowerShell cmdlet, and the PowerShell alias:

cmd.exe command	UNIX command	PowerShell cmdlet	PowerShell alias
cd, chdir	cd	`Set-Location`	`sl`, `cd`, `chdir`
cls	clear	`Clear-Host`	`cls` `clear`
copy	cp	`Copy-Item`	`cpi`, `cp`, `copy`
del, erase, rd, rmdir	rm	`Remove-Item`	`ri`, `del`, `erase`, `rd`, `rm`, `rmdir`
dir	ls	`Get-ChildItem`	`gci`, `dir`, `ls`
echo	echo	`Write-Output`	`write` `echo`
md	mkdir	`New-Item`	`ni`
move	mv	`Move-Item`	`mi`, `move`, `mi`
popd	popd	`Pop-Location`	`popd`
	pwd	`Get-Location`	`gl`, `pwd`
pushd	pushd	`Push-Location`	`pushd`
ren	mv	`Rename-Item`	`rni`, `ren`
type	cat	`Get-Content`	`gc`, `cat`, `type`

> **Note**
>
> The aliases in this table are Windows-specific. Some aliases aren't available on other platforms. This is to allow the native command to work in a PowerShell session. For example, `ls` isn't defined as a PowerShell alias on macOS or Linux so that the native command is run instead of `Get-ChildItem`.

Creating alternate names for commands with parameters

You can assign an alias to a cmdlet, script, function, or executable file. Unlike some Unix shells, you cannot assign an alias to a command with parameters. For example, you can assign an alias to the `Get-Eventlog` cmdlet, but you cannot assign an alias to the `Get-Eventlog -LogName System` command. You must create a function that contains the command with parameters.

For more information, see about_Aliases.

Parameter aliases and shorthand names

PowerShell also provides ways to create shorthand names for parameters. Parameter aliases are defined using the `Alias` attribute when you declare the parameter. These can't be defined using the `*-Alias` cmdlets.

For more information, see the Alias attribute documentation.

In addition to parameter aliases, PowerShell lets you specify the parameter name using the fewest characters needed to uniquely identify the parameter. For example, the `Get-ChildItem` cmdlet has the **Recurse** and **ReadOnly** parameters. To uniquely identify the **Recurse** parameter you only need to provide `-rec`. If you combine that with the command alias, `Get-ChildItem -Recurse` can be shortened to `dir -rec`.

Don't use aliases in scripts

Aliases are a convenience feature to be used interactively in the shell. You should always use the full command and parameter names in your scripts.

- Aliases can be deleted or redefined in a profile script
- Any aliases you define may not be available to the user of your scripts

- Aliases make your code harder to read and maintain

Customizing your shell environment

Article • 12/01/2022

A PowerShell profile is a script that runs when PowerShell starts. You can use the profile to customize the environment. You can:

- add aliases, functions, and variables
- load modules
- create PowerShell drives
- run arbitrary commands
- and change preference settings

Putting these settings in your profile ensures that they're available whenever you start PowerShell on your system.

> **Note**
>
> To run scripts in Windows, the PowerShell execution policy needs to be set to `RemoteSigned` at a minimum. Execution policies don't apply to macOS and Linux. For more information, see **about_Execution_Policy**.

The $PROFILE variable

The `$PROFILE` automatic variable stores the paths to the PowerShell profiles that are available in the current session.

There are four possible profiles available to support different user scopes and different PowerShell hosts. The fully qualified paths for each profile script are stored in the following member properties of `$PROFILE`.

- **AllUsersAllHosts**
- **AllUsersCurrentHost**
- **CurrentUserAllHosts**
- **CurrentUserCurrentHost**

You can create profile scripts that run for all users or just one user, the **CurrentUser**. **CurrentUser** profiles are stored in the user's home directory.

There are also profiles that run for all PowerShell hosts or specific hosts. The profile script for each PowerShell host has a name unique for that host. For example, the filename for the standard Console Host on Windows or the default terminal application

on other platforms is `Microsoft.PowerShell_profile.ps1`. For Visual Studio Code (VS Code), the filename is `Microsoft.VSCode_profile.ps1`.

For more information, see about_Profiles.

By default, referencing the `$PROFILE` variable returns the path to the "Current User, Current Host" profile. The other profiles path can be accessed through the properties of the `$PROFILE` variable. For example:

PowerShell

```
PS> $PROFILE
C:\Users\user1\Documents\PowerShell\Microsoft.PowerShell_profile.ps1
PS> $PROFILE.AllUsersAllHosts
C:\Program Files\PowerShell\7\profile.ps1
```

How to create your personal profile

When you first install PowerShell on a system, the profile script files and the directories they belong to don't exist. The following command creates the "Current User, Current Current Host" profile script file if it doesn't exist.

PowerShell

```
if (!(Test-Path -Path $PROFILE)) {
  New-Item -ItemType File -Path $PROFILE -Force
}
```

The **Force** parameter of `New-Item` cmdlet creates the necessary folders when they don't exist. Once you have created the script file, you can use your favorite editor to customize your shell environment.

Adding customizations to your profile

The previous articles talked about using tab completion, command predictors, and aliases. These articles showed the commands used to load the required modules, create custom completers, define keybindings, and other settings. These are the kinds of customizations that you want to have available in every PowerShell interactive session. The profile script is the place for these settings.

The simplest way to edit your profile script is to open the file in your favorite code editor. For example, the following command opens the profile in VS Code.

PowerShell

```
code $PROFILE
```

You could also use `notepad.exe` on Windows, `vi` on Linux, or any other text editor.

The following profile script has examples for many of the customizations mentioned in the previous articles. You can use any of these settings in your own profile.

PowerShell

```
## Map PSDrives to other registry hives
if (!(Test-Path HKCR:)) {
    $null = New-PSDrive -Name HKCR -PSProvider Registry -Root
HKEY_CLASSES_ROOT
    $null = New-PSDrive -Name HKU -PSProvider Registry -Root HKEY_USERS
}

## Customize the prompt
function prompt {
    $identity = [Security.Principal.WindowsIdentity]::GetCurrent()
    $principal = [Security.Principal.WindowsPrincipal] $identity
    $adminRole = [Security.Principal.WindowsBuiltInRole]::Administrator

    $prefix = $(if (Test-Path variable:/PSDebugContext) { '[DBG]: ' }
                elseif ($principal.IsInRole($adminRole)) { "[ADMIN]: " }
                else { '' })
    $body = 'PS ' + $(Get-Location)
    $suffix = $(if ($NestedPromptLevel -ge 1) { '>>' }) + '> '
    $prefix + $body + $suffix
}

## Create $PSStyle if running on a version older than 7.2
## - Add other ANSI color definitions as needed

if ($PSVersionTable.PSVersion.ToString() -lt '7.2.0') {
    # define escape char since "`e" may not be supported
    $esc = [char]0x1b
    $PSStyle = [pscustomobject]@{
        Foreground = @{
            Magenta = "${esc}[35m"
            BrightYellow = "${esc}[93m"
        }
        Background = @{
            BrightBlack = "${esc}[100m"
        }
    }
}

## Set PSReadLine options and keybindings
$PSROptions = @{
    ContinuationPrompt = '  '
```

```
    Colors             = @{
        Operator         = $PSStyle.Foreground.Magenta
        Parameter        = $PSStyle.Foreground.Magenta
        Selection        = $PSStyle.Background.BrightBlack
        InLinePrediction = $PSStyle.Foreground.BrightYellow +
$PSStyle.Background.BrightBlack
    }
}
Set-PSReadLineOption @PSROptions
Set-PSReadLineKeyHandler -Chord 'Ctrl+f' -Function ForwardWord
Set-PSReadLineKeyHandler -Chord 'Enter' -Function ValidateAndAcceptLine

## Add argument completer for the dotnet CLI tool
$scriptblock = {
    param($wordToComplete, $commandAst, $cursorPosition)
    dotnet complete --position $cursorPosition $commandAst.ToString() |
        ForEach-Object {
            [System.Management.Automation.CompletionResult]::new($_, $_,
'ParameterValue', $_)
        }
}
Register-ArgumentCompleter -Native -CommandName dotnet -ScriptBlock
$scriptblock
```

This profile script provides examples for the following customization:

- Adds two new PSDrives for the other root registry hives.
- Creates a customized prompt that changes if you are running in an elevated session.
- Configures **PSReadLine** and adds keybinding. The color settings use the $PSStyle feature to define the ANSI color settings.
- Adds tab completion for the dotnet CLI tool. The tool provides parameters to help resolve the command-line arguments. The script block for Register-ArgumentCompleter uses that feature to provide the tab completion.

Using PSReadLine key handlers

Article • 03/27/2023

The **PSReadLine** module provides key handlers that map **PSReadLine** functions to keyboard chords. Keyboard chords are a sequence of one or more keystrokes that are pressed at the same time. For example, the chord `Ctrl`+`Spacebar` is the combination of the `Ctrl` and `Spacebar` keys pressed at the same time. A **PSReadLine** function is a predefined action that can be performed on a command line. For example, the `MenuComplete` function allows you to choose from a list of options from a menu complete the input on the command line.

PSReadLine has several predefined key handlers that are bound by default. You can also define your own custom key handlers. Run the following command to list the key handlers that are currently defined.

PowerShell

```
Get-PSReadLineKeyHandler
```

You can also get a list of all unbound **PSReadLine** functions that are available to be bound to a key chord.

PowerShell

```
Get-PSReadLineKeyHandler -Unbound
```

You can use the `Set-PSReadLineKeyHandler` cmdlet to bind a function to a key handler. The following command binds the `MenuComplete` function to the chord `Ctrl`+`Spacebar`.

PowerShell

```
Set-PSReadLineKeyHandler -Chord 'Ctrl+Spacebar' -Function MenuComplete
```

Finding key names and chord bindings

The names of the keys in the chord are defined by the `[System.ConsoleKey]` enumeration. For more information, see System.ConsoleKey documentation. For example, the name of the `2` key in `[System.ConsoleKey]` is `D2`, whereas the name of the `2` key on the numeric keypad is `NumPad2`. You can use the `[System.Console]::ReadKey()` method to find the name of the key you pressed.

PowerShell

```
[System.Console]::ReadKey()
```

The following output shows the information returned by the `ReadKey()` method for the `Ctrl`+`2` key chord.

Output

```
KeyChar Key Modifiers
------- --- ---------
        D2   Control
```

For the **PSReadLine** key handler cmdlets, this chord is represented as `Ctrl+D2`. The following example binds this chord to a function.

PowerShell

```
Set-PSReadLineKeyHandler -Chord 'Ctrl+D2' -Function MenuComplete
```

You can bind multiple cords to a single function. By default, the `BackwardDeleteChar` function is bound to two chords.

PowerShell

```
Get-PSReadLineKeyHandler -Chord Backspace, Ctrl+h
```

Output

```
Key       Function           Description
---       --------           -----------
Backspace BackwardDeleteChar Delete the character before the cursor
Ctrl+h    BackwardDeleteChar Delete the character before the cursor
```

> ⓘ **Note**
>
> The **Chord** parameter is **case-sensitive**. Meaning, you can create different bindings for `Ctrl`+`X` and `Ctrl`+`x`.

On Windows, you can also use the `Alt`+`?` key chord to show the function bound to the next key chord you enter. When you type `Alt`+`?` you see the following prompt:

Output

```
what-is-key:
```

When you hit the `Backspace` key you get the following response:

Output

```
Backspace: BackwardDeleteChar - Delete the character before the cursor
```

Key handlers on non-Windows computers

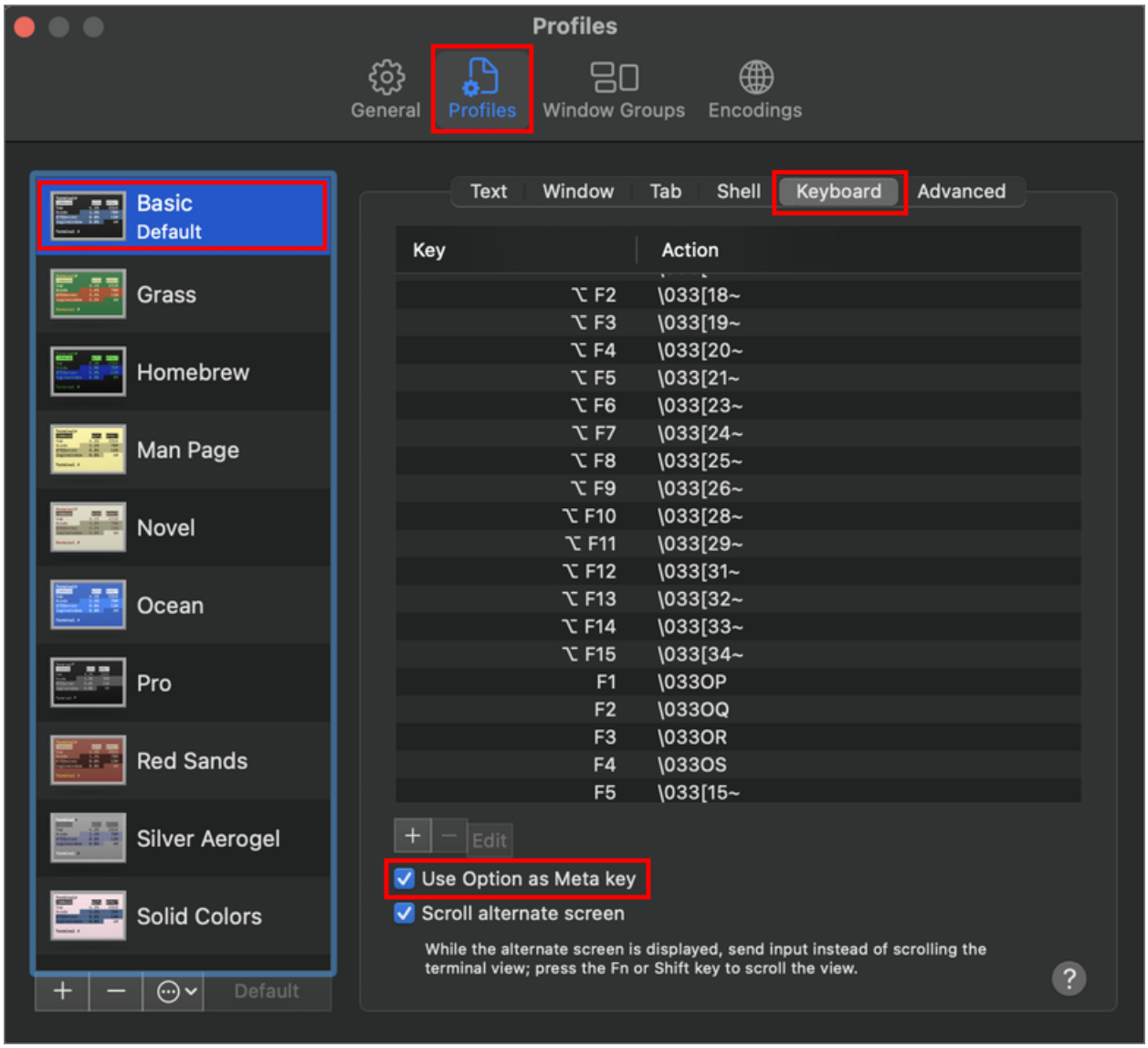
The key codes generated by your keyboard can be different depending on the operating system and terminal application you are using.

macOS

The Macintosh keyboard doesn't have an `Alt` key like Windows and Linux systems. Instead, it has the `⌥ Option` key. macOS uses this key differently than the `Alt` key on other systems. However, you can configure the terminal and iTerm2 applications on macOS to treat it as an `Alt` key.

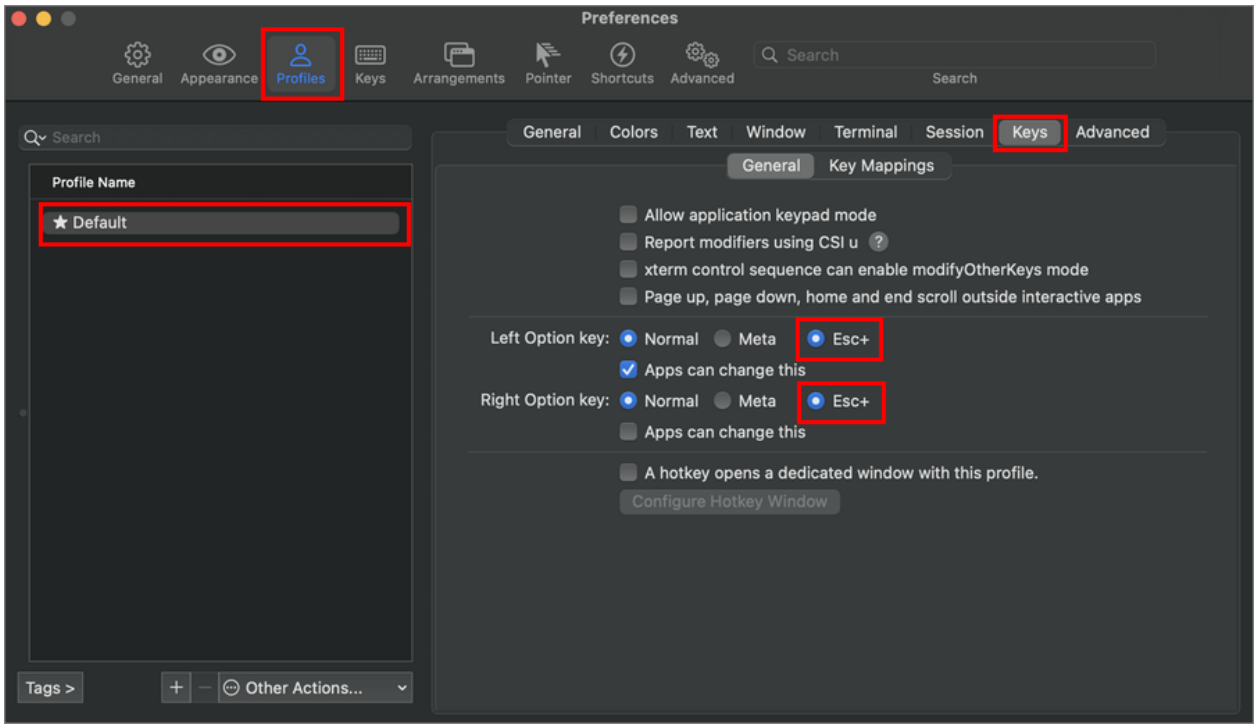
Configuring the Terminal application

Open the **Settings** window from the App bar in Terminal.app. Select **Profiles** and choose the profile you want to configure. Select the **Keyboard** tab of the configuration options. Below the list of keys, select the **Use Option as Meta Key** setting. This setting allows the `⌥ Option` key to act as `Alt` in the Terminal application.



Configuring the iTerm2 application

Open the **Settings** window from the App Bar in iTerm.app. Select **Profiles** and choose the profile you want to configure. Select the **Keys** tab of the configuration options. Select the **Esc+** option for both the **Left Option Key** and **Right Option Key** settings. This setting allows the `⌥ Option` key to act as `Alt` in the iTerm application.



> **Note**
>
> The exact steps may vary depending on the versions of macOS and the terminal applications. These examples were captured on macOS Ventura 13.2.1 and iTerm2 v3.4.16.

Linux

On Linux platforms, the key code generated can be different than other systems. For example:

- `Ctrl`+`[` is the same as `Escape`
- `Ctrl`+`Spacebar` generates the key codes for `Ctrl`+`D2`. If you want to map a function `Ctrl`+`Spacebar` you must use the chord `Ctrl+D2`.

  PowerShell

  ```
  Set-PSReadLineKeyHandler -Chord 'Ctrl+D2' -Function MenuComplete
  ```

Use the `ReadKey()` method to verify the key codes generated by your keyboard.

Commonly used key handlers

Here are a few commonly used key handlers that are bound by default on Windows. Note that the key binding may be different on non-Windows platforms.

MenuComplete

Complete the input by selecting from a menu of possible completion values.

Default chord: `Ctrl+Spacebar`

The following example shows the menu of possible completions for commands beginning with `select`.

Output

```
PS C:\> select<Ctrl+Spacebar>
select                   Select-Object            Select-PSFPropertyValue
Select-Xml
Select-AzContext         Select-PSFConfig         Select-PSMDBuildProject
Select-AzSubscription    Select-PSFObject         Select-String

Select-Object
```

Use the arrow keys to select the completion you want. Press the `Enter` key to complete the input. As you move through the selections, help for the selected command is displayed below the menu.

ClearScreen

This function clears the screen similar to the `cls` or `clear` commands.

Default chord: `Ctrl+l`

SelectCommandArgument

Selects the next argument on the command line.

Default chord: `Alt+a`

You may have command in your history that you want to run again with different parameter values. You can use the chord to cycle through each parameter and change the value as needed.

```
New-AzVM -ResourceGroupName myRGName -Location eastus -Name myVM
```

Pressing `Alt`+`a` selects the next parameter argument in turn: `myRGName`, `eastus`, `myVM`.

GotoBrace

Moves the cursor to the matching brace.

Default chord: `Ctrl+]`

This functions moves your cursor to the closing brace that matches the brace at the current cursor position on the command line. The function works for brackets (`[]`), braces (`{}`), and parentheses, (`()`).

DigitArgument

Start or accumulate a numeric argument use to repeat a keystroke the specified number of times.

Default chord: `Alt+0` through `Alt+9`

For example, typing `Alt`+`4`+`#` enters `####` on the command line.

See also

- Get-PSReadLineKeyHandler
- Set-PSReadLineKeyHandler

Configuring a light colored theme

Article • 03/07/2023

The default colors for both PowerShell and **PSReadLine** are selected for a dark background terminal. However, some users may choose to use a light background with dark text. Since most of the default colors don't set the background, using light foreground colors on a light background produces unreadable text.

PSReadLine allows you to define colors for 18 different syntax elements. You can view the current settings using the `Get-PSReadLineOption` cmdlet.

Output

```
EditMode                               : Windows
AddToHistoryHandler                    :
System.Func`2[System.String,System.Object]
HistoryNoDuplicates                    : True
HistorySavePath                        :
C:\Users\user1\AppData\Roaming\Microsoft\Wind...
HistorySaveStyle                       : SaveIncrementally
HistorySearchCaseSensitive             : False
HistorySearchCursorMovesToEnd          : False
MaximumHistoryCount                    : 4096
ContinuationPrompt                     : >>
ExtraPromptLineCount                   : 0
PromptText                             : {> }
BellStyle                              : Audible
DingDuration                           : 50
DingTone                               : 1221
CommandsToValidateScriptBlockArguments : {ForEach-Object, %, Invoke-Command,
icm...}
CommandValidationHandler               :
CompletionQueryItems                   : 100
MaximumKillRingCount                   : 10
ShowToolTips                           : True
ViModeIndicator                        : None
WordDelimiters                         : ;:,.[]{}()/\|^&*-=+'"-——
AnsiEscapeTimeout                      : 100
PredictionSource                       : HistoryAndPlugin
PredictionViewStyle                    : InlineView
CommandColor                           : "`e[93m"
CommentColor                           : "`e[32m"
ContinuationPromptColor                : "`e[37m"
DefaultTokenColor                      : "`e[37m"
EmphasisColor                          : "`e[96m"
ErrorColor                             : "`e[91m"
InlinePredictionColor                  : "`e[38;5;238m"
KeywordColor                           : "`e[92m"
ListPredictionColor                    : "`e[33m"
ListPredictionSelectedColor            : "`e[48;5;238m"
```

```
MemberColor                             : "`e[97m"
NumberColor                             : "`e[97m"
OperatorColor                           : "`e[90m"
ParameterColor                          : "`e[90m"
SelectionColor                          : "`e[30;47m"
StringColor                             : "`e[36m"
TypeColor                               : "`e[37m"
VariableColor                           : "`e[92m"
```

The color settings are stored as strings containing ANSI escape sequences that change the color in your terminal. Using the `Set-PSReadLineOption` cmdlet you can change the colors to values that work better for a light-colored background.

Defining colors for a light theme

The PowerShell ISE can be configured to use a light theme for both the editor and console panes. You can also view and change the colors that the ISE uses for various syntax and output types. You can use these color choices to define a similar theme for **PSReadLine**.

The following hashtable defines colors for **PSReadLine** that mimic the colors in the PowerShell ISE.

PowerShell

```
$ISETheme = @{
    Command                 = $PSStyle.Foreground.FromRGB(0x0000FF)
    Comment                 = $PSStyle.Foreground.FromRGB(0x006400)
    ContinuationPrompt      = $PSStyle.Foreground.FromRGB(0x0000FF)
    Default                 = $PSStyle.Foreground.FromRGB(0x0000FF)
    Emphasis                = $PSStyle.Foreground.FromRGB(0x287BF0)
    Error                   = $PSStyle.Foreground.FromRGB(0xE50000)
    InlinePrediction        = $PSStyle.Foreground.FromRGB(0x93A1A1)
    Keyword                 = $PSStyle.Foreground.FromRGB(0x00008b)
    ListPrediction          = $PSStyle.Foreground.FromRGB(0x06DE00)
    Member                  = $PSStyle.Foreground.FromRGB(0x000000)
    Number                  = $PSStyle.Foreground.FromRGB(0x800080)
    Operator                = $PSStyle.Foreground.FromRGB(0x757575)
    Parameter               = $PSStyle.Foreground.FromRGB(0x000080)
    String                  = $PSStyle.Foreground.FromRGB(0x8b0000)
    Type                    = $PSStyle.Foreground.FromRGB(0x008080)
    Variable                = $PSStyle.Foreground.FromRGB(0xff4500)
    ListPredictionSelected  = $PSStyle.Background.FromRGB(0x93A1A1)
    Selection               = $PSStyle.Background.FromRGB(0x00BFFF)
}
```

ⓘ Note

In PowerShell 7.2 and higher you can use the `FromRGB()` method of `$PSStyle` to create the ANSI escape sequences for the colors you want.

For more information about `$PSStyle`, see **about_ANSI_Terminals**.

For more information about ANSI escape sequences, see the **ANSI escape code** article in Wikipedia.

Setting the color theme in your profile

To have the color settings you want in every PowerShell session, you must add the configuration settings to your PowerShell profile script. For an example, see Customizing your shell environment

Add the `$ISETheme` variable and the following `Set-PSReadLineOption` command to your profile.

PowerShell

```
Set-PSReadLineOption -Colors $ISETheme
```

Beginning in PowerShell 7.2, PowerShell adds colorized output to the default console experience. The colors used are defined in the `$PSStyle` variable and are designed for a dark background. The following settings work better for a light background terminal.

PowerShell

```
$PSStyle.Formatting.FormatAccent       = "`e[32m"
$PSStyle.Formatting.TableHeader        = "`e[32m"
$PSStyle.Formatting.ErrorAccent        = "`e[36m"
$PSStyle.Formatting.Error              = "`e[31m"
$PSStyle.Formatting.Warning            = "`e[33m"
$PSStyle.Formatting.Verbose            = "`e[33m"
$PSStyle.Formatting.Debug              = "`e[33m"
$PSStyle.Progress.Style                = "`e[33m"
$PSStyle.FileInfo.Directory            =
$PSStyle.Background.FromRgb(0x2f6aff) +
                                         $PSStyle.Foreground.BrightWhite
$PSStyle.FileInfo.SymbolicLink         = "`e[36m"
$PSStyle.FileInfo.Executable           = "`e[95m"
$PSStyle.FileInfo.Extension['.ps1']    = "`e[36m"
$PSStyle.FileInfo.Extension['.ps1xml'] = "`e[36m"
$PSStyle.FileInfo.Extension['.psd1']   = "`e[36m"
$PSStyle.FileInfo.Extension['.psm1']   = "`e[36m"
```

Choosing colors for accessibility

The ISE color theme may not work for users with color-blindness or other conditions that limit their ability to see colors.

The World Wide Web Consortium (W3C) has recommendations for using colors for accessibility. The Web Content Accessibility Guidelines (WCAG) 2.1 recommends that "visual presentation of text and images of text has a contrast ratio of at least 4.5:1." For more information, see Success Criterion 1.4.3 Contrast (Minimum).

The Contrast Ratio website provides a tool that lets you pick foreground and background colors and measure the contrast. You can use this tool to find color combinations that work best for you.

Deep dive articles

Article • 11/17/2022

The articles in this section are designed to be an in-depth look into PowerShell topics. These articles don't replace the reference articles, but provide diverse examples, illustrate edge cases, and warn about pitfalls and common mistakes.

This collection is also a showcase for community contributions. The inaugural set of articles come from @KevinMarquette and were originally published at PowerShellExplained.com.

How to contribute content

If you're interested in contributing content to this collection, please read the Contributor Guide. When you are ready to propose a contribution, submit an issue in the GitHub repository using the Document Idea template and include a link to the existing content you want to share.

Everything you wanted to know about arrays

Article • 11/17/2022

Arrays are a fundamental language feature of most programming languages. They're a collection of values or objects that are difficult to avoid. Let's take a close look at arrays and everything they have to offer.

> **Note**
>
> The **original version** of this article appeared on the blog written by **@KevinMarquette**. The PowerShell team thanks Kevin for sharing this content with us. Please check out his blog at **PowerShellExplained.com**.

What is an array?

I'm going to start with a basic technical description of what arrays are and how they are used by most programming languages before I shift into the other ways PowerShell makes use of them.

An array is a data structure that serves as a collection of multiple items. You can iterate over the array or access individual items using an index. The array is created as a sequential chunk of memory where each value is stored right next to the other.

I'll touch on each of those details as we go.

Basic usage

Because arrays are such a basic feature of PowerShell, there is a simple syntax for working with them in PowerShell.

Create an array

An empty array can be created by using `@()`

PowerShell

```
PS> $data = @()
PS> $data.count
```

```
0
```

We can create an array and seed it with values just by placing them in the `@()` parentheses.

PowerShell

```
PS> $data = @('Zero','One','Two','Three')
PS> $data.count
4

PS> $data
Zero
One
Two
Three
```

This array has 4 items. When we call the `$data` variable, we see the list of our items. If it's an array of strings, then we get one line per string.

We can declare an array on multiple lines. The comma is optional in this case and generally left out.

PowerShell

```
$data = @(
    'Zero'
    'One'
    'Two'
    'Three'
)
```

I prefer to declare my arrays on multiple lines like that. Not only does it get easier to read when you have multiple items, it also makes it easier to compare to previous versions when using source control.

Other syntax

It's commonly understood that `@()` is the syntax for creating an array, but comma-separated lists work most of the time.

PowerShell

```
$data = 'Zero','One','Two','Three'
```

Write-Output to create arrays

One cool little trick worth mentioning is that you can use `Write-Output` to quickly create strings at the console.

PowerShell

```
$data = Write-Output Zero One Two Three
```

This is handy because you don't have to put quotes around the strings when the parameter accepts strings. I would never do this in a script but it's fair game in the console.

Accessing items

Now that you have an array with items in it, you may want to access and update those items.

Offset

To access individual items, we use the brackets `[]` with an offset value starting at 0. This is how we get the first item in our array:

PowerShell

```
PS> $data = 'Zero','One','Two','Three'
PS> $data[0]
Zero
```

The reason why we use zero here is because the first item is at the beginning of the list so we use an offset of 0 items to get to it. To get to the second item, we would need to use an offset of 1 to skip the first item.

PowerShell

```
PS> $data[1]
One
```

This would mean that the last item is at offset 3.

PowerShell

```
PS> $data[3]
Three
```

Index

Now you can see why I picked the values that I did for this example. I introduced this as an offset because that is what it really is, but this offset is more commonly referred to as an index. An index that starts at `0`. For the rest of this article I will call the offset an index.

Special index tricks

In most languages, you can only specify a single number as the index and you get a single item back. PowerShell is much more flexible. You can use multiple indexes at once. By providing a list of indexes, we can select several items.

PowerShell

```
PS> $data[0,2,3]
Zero
Two
Three
```

The items are returned based on the order of the indexes provided. If you duplicate an index, you get that item both times.

PowerShell

```
PS> $data[3,0,3]
Three
Zero
Three
```

We can specify a sequence of numbers with the built-in `..` operator.

PowerShell

```
PS> $data[1..3]
One
Two
Three
```

This works in reverse too.

PowerShell

```
PS> $data[3..1]
Three
Two
One
```

You can use negative index values to offset from the end. So if you need the last item in the list, you can use `-1`.

PowerShell

```
PS> $data[-1]
Three
```

One word of caution here with the `..` operator. The sequence `0..-1` and `-1..0` evaluate to the values `0,-1` and `-1,0`. It's easy to see `$data[0..-1]` and think it would enumerate all items if you forget this detail. `$data[0..-1]` gives you the same value as `$data[0,-1]` by giving you the first and last item in the array (and none of the other values). Here is a larger example:

PowerShell

```
PS> $a = 1,2,3,4,5,6,7,8
PS> $a[2..-1]
3
2
1
8
```

This is the same as:

PowerShell

```
PS> $a[2,1,0,-1]
3
2
1
8
```

Out of bounds

In most languages, if you try to access an index of an item that is past the end of the array, you would get some type of error or an exception. PowerShell silently returns

nothing.

```
PowerShell

PS> $null -eq $data[9000]
True
```

Cannot index into a null array

If your variable is `$null` and you try to index it like an array, you get a `System.Management.Automation.RuntimeException` exception with the message `Cannot index into a null array`.

```
PowerShell

PS> $empty = $null
PS> $empty[0]
Error: Cannot index into a null array.
```

So make sure your arrays are not `$null` before you try to access elements inside them.

Count

Arrays and other collections have a count property that tells you how many items are in the array.

```
PowerShell

PS> $data.count
4
```

PowerShell 3.0 added a count property to most objects. you can have a single object and it should give you a count of `1`.

```
PowerShell

PS> $date = Get-Date
PS> $date.count
1
```

Even `$null` has a count property except it returns `0`.

```
PowerShell
```

```
PS> $null.count
0
```

There are some traps here that I will revisit when I cover checking for `$null` or empty arrays later on in this article.

Off-by-one errors

A common programming error is created because arrays start at index 0. Off-by-one errors can be introduced in two ways.

The first is by mentally thinking you want the second item and using an index of `2` and really getting the third item. Or by thinking that you have four items and you want last item, so you use the count to access the last item.

PowerShell

```
$data[ $data.count ]
```

PowerShell is perfectly happy to let you do that and give you exactly what item exists at index 4: `$null`. You should be using `$data.count - 1` or the `-1` that we learned about above.

PowerShell

```
PS> $data[ $data.count - 1 ]
Three
```

This is where you can use the `-1` index to get the last element.

PowerShell

```
PS> $data[ -1 ]
Three
```

Lee Dailey also pointed out to me that we can use `$data.GetUpperBound(0)` to get the max index number.

PowerShell

```
PS> $data.GetUpperBound(0)
3
```

```
PS> $data[ $data.GetUpperBound(0) ]
Three
```

The second most common way is when iterating the list and not stopping at the right time. I'll revisit this when we talk about using the `for` loop.

Updating items

We can use the same index to update existing items in the array. This gives us direct access to update individual items.

PowerShell

```
$data[2] = 'dos'
$data[3] = 'tres'
```

If we try to update an item that is past the last element, then we get an `Index was outside the bounds of the array.` error.

PowerShell

```
PS> $data[4] = 'four'
Index was outside the bounds of the array.
At line:1 char:1
+ $data[4] = 'four'
+ ~~~~~~~~~~~~
+ CategoryInfo          : OperationStopped: (:) [], IndexOutOfRangeException
+ FullyQualifiedErrorId : System.IndexOutOfRangeException
```

I'll revisit this later when I talk about how to make an array larger.

Iteration

At some point, you might need to walk or iterate the entire list and perform some action for each item in the array.

Pipeline

Arrays and the PowerShell pipeline are meant for each other. This is one of the simplest ways to process over those values. When you pass an array to a pipeline, each item inside the array is processed individually.

PowerShell

```
PS> $data = 'Zero','One','Two','Three'
PS> $data | ForEach-Object {"Item: [$PSItem]"}
Item: [Zero]
Item: [One]
Item: [Two]
Item: [Three]
```

If you have not seen `$PSItem` before, just know that it's the same thing as `$_`. You can use either one because they both represent the current object in the pipeline.

ForEach loop

The `ForEach` loop works well with collections. Using the syntax: `foreach ( <variable> in <collection> )`

PowerShell

```
foreach ( $node in $data )
{
    "Item: [$node]"
}
```

ForEach method

I tend to forget about this one but it works well for simple operations. PowerShell allows you to call `.ForEach()` on a collection.

PowerShell

```
PS> $data.foreach({"Item [$PSItem]"})
Item [Zero]
Item [One]
Item [Two]
Item [Three]
```

The `.foreach()` takes a parameter that is a script block. You can drop the parentheses and just provide the script block.

PowerShell

```
$data.foreach{"Item [$PSItem]"}
```

This is a lesser known syntax but it works just the same. This `foreach` method was added in PowerShell 4.0.

For loop

The `for` loop is used heavily in most other languages but you don't see it much in PowerShell. When you do see it, it's often in the context of walking an array.

PowerShell

```
for ( $index = 0; $index -lt $data.count; $index++)
{
    "Item: [{0}]" -f $data[$index]
}
```

The first thing we do is initialize an `$index` to `0`. Then we add the condition that `$index` must be less than `$data.count`. Finally, we specify that every time we loop that we must increase the index by `1`. In this case `$index++` is short for `$index = $index + 1`. The format operator (`-f`) is used to insert the value of `$data[$index]` in the output string.

Whenever you're using a `for` loop, pay special attention to the condition. I used `$index -lt $data.count` here. It's easy to get the condition slightly wrong to get an off-by-one error in your logic. Using `$index -le $data.count` or `$index -lt ($data.count - 1)` are ever so slightly wrong. That would cause your result to process too many or too few items. This is the classic off-by-one error.

Switch loop

This is one that is easy to overlook. If you provide an array to a switch statement, it checks each item in the array.

PowerShell

```
$data = 'Zero','One','Two','Three'
switch( $data )
{
    'One'
    {
        'Tock'
    }
    'Three'
    {
        'Tock'
    }
    Default
```

```
    {
        'Tick'
    }
}
```

Output

```
Tick
Tock
Tick
Tock
```

There are a lot of cool things that we can do with the switch statement. I have another article dedicated to this.

- Everything you ever wanted to know about the switch statement

Updating values

When your array is a collection of string or integers (value types), sometimes you may want to update the values in the array as you loop over them. Most of the loops above use a variable in the loop that holds a copy of the value. If you update that variable, the original value in the array is not updated.

The exception to that statement is the `for` loop. If you want to walk an array and update values inside it, then the `for` loop is what you're looking for.

PowerShell

```
for ( $index = 0; $index -lt $data.count; $index++ )
{
    $data[$index] = "Item: [{0}]" -f $data[$index]
}
```

This example takes a value by index, makes a few changes, and then uses that same index to assign it back.

Arrays of Objects

So far, the only thing we've placed in an array is a value type, but arrays can also contain objects.

PowerShell

```
$data = @(
    [pscustomobject]@{FirstName='Kevin';LastName='Marquette'}
    [pscustomobject]@{FirstName='John'; LastName='Doe'}
)
```

Many cmdlets return collections of objects as arrays when you assign them to a variable.

PowerShell

```
$processList = Get-Process
```

All of the basic features we already talked about still apply to arrays of objects with a few details worth pointing out.

Accessing properties

We can use an index to access an individual item in a collection just like with value types.

PowerShell

```
PS> $data[0]

FirstName LastName
-----     ----
Kevin     Marquette
```

We can access and update properties directly.

PowerShell

```
PS> $data[0].FirstName

Kevin

PS> $data[0].FirstName = 'Jay'
PS> $data[0]

FirstName LastName
-----     ----
Jay       Marquette
```

Array properties

Normally you would have to enumerate the whole list like this to access all the properties:

PowerShell

```
PS> $data | ForEach-Object {$_.LastName}

Marquette
Doe
```

Or by using the `Select-Object -ExpandProperty` cmdlet.

PowerShell

```
PS> $data | Select-Object -ExpandProperty LastName

Marquette
Doe
```

But PowerShell offers us the ability to request `LastName` directly. PowerShell enumerates them all for us and returns a clean list.

PowerShell

```
PS> $data.LastName

Marquette
Doe
```

The enumeration still happens but we don't see the complexity behind it.

Where-Object filtering

This is where `Where-Object` comes in so we can filter and select what we want out of the array based on the properties of the object.

PowerShell

```
PS> $data | Where-Object {$_.FirstName -eq 'Kevin'}

FirstName LastName
-----     ----
Kevin     Marquette
```

We can write that same query to get the `FirstName` we are looking for.

PowerShell

```
$data | Where FirstName -eq Kevin
```

Where()

Arrays have a `Where()` method on them that allows you to specify a `scriptblock` for the filter.

PowerShell

```
$data.Where({$_.FirstName -eq 'Kevin'})
```

This feature was added in PowerShell 4.0.

Updating objects in loops

With value types, the only way to update the array is to use a for loop because we need to know the index to replace the value. We have more options with objects because they are reference types. Here is a quick example:

PowerShell

```
foreach($person in $data)
{
    $person.FirstName = 'Kevin'
}
```

This loop is walking every object in the `$data` array. Because objects are reference types, the `$person` variable references the exact same object that is in the array. So updates to its properties do update the original.

You still can't replace the whole object this way. If you try to assign a new object to the `$person` variable, you're updating the variable reference to something else that no longer points to the original object in the array. This doesn't work like you would expect:

PowerShell

```
foreach($person in $data)
{
    $person = [pscustomobject]@{
        FirstName='Kevin'
        LastName='Marquette'
```

```
    }
}
```

Operators

The operators in PowerShell also work on arrays. Some of them work slightly differently.

-join

The `-join` operator is the most obvious one so let's look at it first. I like the `-join` operator and use it often. It joins all elements in the array with the character or string that you specify.

PowerShell

```
PS> $data = @(1,2,3,4)
PS> $data -join '-'
1-2-3-4
PS> $data -join ','
1,2,3,4
```

One of the features that I like about the `-join` operator is that it handles single items.

PowerShell

```
PS> 1 -join '-'
1
```

I use this inside logging and verbose messages.

PowerShell

```
PS> $data = @(1,2,3,4)
PS> "Data is $($data -join ',')."
Data is 1,2,3,4.
```

-join $array

Here is a clever trick that Lee Dailey pointed out to me. If you ever want to join everything without a delimiter, instead of doing this:

PowerShell

```
PS> $data = @(1,2,3,4)
PS> $data -join $null
1234
```

You can use `-join` with the array as the parameter with no prefix. Take a look at this example to see that I'm talking about.

PowerShell

```
PS> $data = @(1,2,3,4)
PS> -join $data
1234
```

-replace and -split

The other operators like `-replace` and `-split` execute on each item in the array. I can't say that I have ever used them this way but here is an example.

PowerShell

```
PS> $data = @('ATX-SQL-01','ATX-SQL-02','ATX-SQL-03')
PS> $data -replace 'ATX','LAX'
LAX-SQL-01
LAX-SQL-02
LAX-SQL-03
```

-contains

The `-contains` operator allows you to check an array of values to see if it contains a specified value.

PowerShell

```
PS> $data = @('red','green','blue')
PS> $data -contains 'green'
True
```

-in

When you have a single value that you would like to verify matches one of several values, you can use the `-in` operator. The value would be on the left and the array on the right-hand side of the operator.

PowerShell

```
PS> $data = @('red','green','blue')
PS> 'green' -in $data
True
```

This can get expensive if the list is large. I often use a regex pattern if I'm checking more than a few values.

PowerShell

```
PS> $data = @('red','green','blue')
PS> $pattern = "^({0})$" -f ($data -join '|')
PS> $pattern
^(red|green|blue)$

PS> 'green' -match $pattern
True
```

-eq and -ne

Equality and arrays can get complicated. When the array is on the left side, every item gets compared. Instead of returning `True`, it returns the object that matches.

PowerShell

```
PS> $data = @('red','green','blue')
PS> $data -eq 'green'
green
```

When you use the `-ne` operator, we get all the values that are not equal to our value.

PowerShell

```
PS> $data = @('red','green','blue')
PS> $data -ne 'green'
red
blue
```

When you use this in an `if()` statement, a value that is returned is a `True` value. If no value is returned, then it's a `False` value. Both of these next statements evaluate to `True`.

PowerShell

```
$data = @('red','green','blue')
if ( $data -eq 'green' )
{
    'Green was found'
}
if ( $data -ne 'green' )
{
    'And green was not found'
}
```

I'll revisit this in a moment when we talk about testing for `$null`.

-match

The `-match` operator tries to match each item in the collection.

PowerShell

```
PS> $servers = @(
    'LAX-SQL-01'
    'LAX-API-01'
    'ATX-SQL-01'
    'ATX-API-01'
)
PS> $servers -match 'SQL'
LAX-SQL-01
ATX-SQL-01
```

When you use `-match` with a single value, a special variable `$Matches` gets populated with match info. This isn't the case when an array is processed this way.

We can take the same approach with `Select-String`.

PowerShell

```
$servers | Select-String SQL
```

I take a closer look at `Select-String`, `-match` and the `$matches` variable in another post called The many ways to use regex.

$null or empty

Testing for `$null` or empty arrays can be tricky. Here are the common traps with arrays.

At a glance, this statement looks like it should work.

PowerShell

```powershell
if ( $array -eq $null)
{
    'Array is $null'
}
```

But I just went over how `-eq` checks each item in the array. So we can have an array of several items with a single $null value and it would evaluate to `$true`

PowerShell

```powershell
$array = @('one',$null,'three')
if ( $array -eq $null)
{
    'I think Array is $null, but I would be wrong'
}
```

This is why it's a best practice to place the `$null` on the left side of the operator. This makes this scenario a non-issue.

PowerShell

```powershell
if ( $null -eq $array )
{
    'Array actually is $null'
}
```

A `$null` array isn't the same thing as an empty array. If you know you have an array, check the count of objects in it. If the array is `$null`, the count is `0`.

PowerShell

```powershell
if ( $array.count -gt 0 )
{
    "Array isn't empty"
}
```

There is one more trap to watch out for here. You can use the `count` even if you have a single object, unless that object is a `PSCustomObject`. This is a bug that is fixed in PowerShell 6.1. That's good news, but a lot of people are still on 5.1 and need to watch out for it.

PowerShell

```
PS> $object = [PSCustomObject]@{Name='TestObject'}
PS> $object.count
$null
```

If you're still on PowerShell 5.1, you can wrap the object in an array before checking the count to get an accurate count.

PowerShell

```powershell
if ( @($array).count -gt 0 )
{
    "Array isn't empty"
}
```

To fully play it safe, check for `$null`, then check the count.

PowerShell

```powershell
if ( $null -ne $array -and @($array).count -gt 0 )
{
    "Array isn't empty"
}
```

All -eq

I recently saw someone ask how to verify that every value in an array matches a given value. Reddit user **/u/bis** had this clever solution that checks for any incorrect values and then flips the result.

PowerShell

```powershell
$results = Test-Something
if ( -not ( $results -ne 'Passed') )
{
    'All results a Passed'
}
```

Adding to arrays

At this point, you're starting to wonder how to add items to an array. The quick answer is that you can't. An array is a fixed size in memory. If you need to grow it or add a single item to it, then you need to create a new array and copy all the values over from

the old array. This sounds like a lot of work, however, PowerShell hides the complexity of creating the new array. PowerShell implements the addition operator (`+`) for arrays.

> ⓘ **Note**
>
> PowerShell does not implement a subtraction operation. If you want a flexible alternative to an array, you need to use a **generic List** object.

Array addition

We can use the addition operator with arrays to create a new array. So given these two arrays:

PowerShell

```
$first = @(
    'Zero'
    'One'
)
$second = @(
    'Two'
    'Three'
)
```

We can add them together to get a new array.

PowerShell

```
PS> $first + $second

Zero
One
Two
Three
```

Plus equals +=

We can create a new array in place and add an item to it like this:

PowerShell

```
$data = @(
    'Zero'
    'One'
    'Two'
```

```
    'Three'
)
$data += 'four'
```

Just remember that every time you use `+=` that you're duplicating and creating a new array. This is a not an issue for small datasets but it scales extremely poorly.

Pipeline assignment

You can assign the results of any pipeline into a variable. It's an array if it contains multiple items.

PowerShell

```
$array = 1..5 | ForEach-Object {
    "ATX-SQL-$PSItem"
}
```

Normally when we think of using the pipeline, we think of the typical PowerShell one-liners. We can leverage the pipeline with `foreach()` statements and other loops. So instead of adding items to an array in a loop, we can drop items onto the pipeline.

PowerShell

```
$array = foreach ( $node in (1..5))
{
    "ATX-SQL-$node"
}
```

Array Types

By default, an array in PowerShell is created as a `[PSObject[]]` type. This allows it to contain any type of object or value. This works because everything is inherited from the `PSObject` type.

Strongly typed arrays

You can create an array of any type using a similar syntax. When you create a strongly typed array, it can only contain values or objects the specified type.

PowerShell

```
PS> [int[]] $numbers = 1,2,3
PS> [int[]] $numbers2 = 'one','two','three'
ERROR: Cannot convert value "one" to type "System.Int32". Input string was
not in a correct format."

PS> [string[]] $strings = 'one','two','three'
```

ArrayList

Adding items to an array is one of its biggest limitations, but there are a few other collections that we can turn to that solve this problem.

The `ArrayList` is commonly one of the first things that we think of when we need an array that is faster to work with. It acts like an object array every place that we need it, but it handles adding items quickly.

Here is how we create an `ArrayList` and add items to it.

PowerShell

```
$myarray = [System.Collections.ArrayList]::new()
[void]$myArray.Add('Value')
```

We are calling into .NET to get this type. In this case, we are using the default constructor to create it. Then we call the `Add` method to add an item to it.

The reason I'm using `[void]` at the beginning of the line is to suppress the return code. Some .NET calls do this and can create unexpected output.

If the only data that you have in your array is strings, then also take a look at using StringBuilder. It's almost the same thing but has some methods that are just for dealing with strings. The `StringBuilder` is specially designed for performance.

It's common to see people move to `ArrayList` from arrays. But it comes from a time where C# didn't have generic support. The `ArrayList` is deprecated in support for the generic `List[]`

Generic List

A generic type is a special type in C# that defines a generalized class and the user specifies the data types it uses when created. So if you want a list of numbers or strings, you would define that you want list of `int` or `string` types.

Here is how you create a List for strings.

```PowerShell
$mylist = [System.Collections.Generic.List[string]]::new()
```

Or a list for numbers.

```PowerShell
$mylist = [System.Collections.Generic.List[int]]::new()
```

We can cast an existing array to a list like this without creating the object first:

```PowerShell
$mylist = [System.Collections.Generic.List[int]]@(1,2,3)
```

We can shorten the syntax with the `using namespace` statement in PowerShell 5 and newer. The `using` statement needs to be the first line of your script. By declaring a namespace, PowerShell lets you leave it off of the data types when you reference them.

```PowerShell
using namespace System.Collections.Generic
$myList = [List[int]]@(1,2,3)
```

This makes the `List` much more usable.

You have a similar `Add` method available to you. Unlike the ArrayList, there is no return value on the `Add` method so we don't have to `void` it.

```PowerShell
$myList.Add(10)
```

And we can still access the elements like other arrays.

```PowerShell
PS> $myList[-1]
10
```

List[PSObject]

You can have a list of any type, but when you don't know the type of objects, you can use `[List[PSObject]]` to contain them.

PowerShell

```
$list = [List[PSObject]]::new()
```

Remove()

The `ArrayList` and the generic `List[]` both support removing items from the collection.

PowerShell

```
using namespace System.Collections.Generic
$myList = [List[string]]@('Zero','One','Two','Three')
[void]$myList.Remove("Two")
Zero
One
Three
```

When working with value types, it removes the first one from the list. You can call it over and over again to keep removing that value. If you have reference types, you have to provide the object that you want removed.

PowerShell

```
[list[System.Management.Automation.PSDriveInfo]]$drives = Get-PSDrive
$drives.remove($drives[2])
```

PowerShell

```
$delete = $drives[2]
$drives.remove($delete)
```

The remove method returns `true` if it was able to find and remove the item from the collection.

More collections

There are many other collections that can be used but these are the good generic array replacements. If you're interested in learning about more of these options, take a look at this Gist that Mark Kraus put together.

Other nuances

Now that I have covered all the major functionality, here are a few more things that I wanted to mention before I wrap this up.

Pre-sized arrays

I mentioned that you can't change the size of an array once it's created. We can create an array of a pre-determined size by calling it with the `new($size)` constructor.

PowerShell

```
$data = [Object[]]::new(4)
$data.count
4
```

Multiplying arrays

An interesting little trick is that you can multiply an array by an integer.

PowerShell

```
PS> $data = @('red','green','blue')
PS> $data * 3
red
green
blue
red
green
blue
red
green
blue
```

Initialize with 0

A common scenario is that you want to create an array with all zeros. If you're only going to have integers, a strongly typed array of integers defaults to all zeros.

PowerShell

```
PS> [int[]]::new(4)
0
0
0
0
```

We can use the multiplying trick to do this too.

PowerShell

```
PS> $data = @(0) * 4
PS> $data
0
0
0
0
```

The nice thing about the multiplying trick is that you can use any value. So if you would rather have `255` as your default value, this would be a good way to do it.

PowerShell

```
PS> $data = @(255) * 4
PS> $data
255
255
255
255
```

Nested arrays

An array inside an array is called a nested array. I don't use these much in PowerShell but I have used them more in other languages. Consider using an array of arrays when your data fits in a grid like pattern.

Here are two ways we can create a two-dimensional array.

PowerShell

```
$data = @(@(1,2,3),@(4,5,6),@(7,8,9))

$data2 = @(
    @(1,2,3),
    @(4,5,6),
```

```
    @(7,8,9)
)
```

The comma is very important in those examples. I gave an earlier example of a normal array on multiple lines where the comma was optional. That isn't the case with a multi-dimensional array.

The way we use the index notation changes slightly now that we've a nested array. Using the `$data` above, this is how we would access the value 3.

PowerShell

```
PS> $outside = 0
PS> $inside = 2
PS> $data[$outside][$inside]
3
```

Add a set of bracket for each level of array nesting. The first set of brackets is for the outer most array and then you work your way in from there.

Write-Output -NoEnumerate

PowerShell likes to unwrap or enumerate arrays. This is a core aspect of the way PowerShell uses the pipeline but there are times that you don't want that to happen.

I commonly pipe objects to `Get-Member` to learn more about them. When I pipe an array to it, it gets unwrapped and Get-Member sees the members of the array and not the actual array.

PowerShell

```
PS> $data = @('red','green','blue')
PS> $data | Get-Member
TypeName: System.String
...
```

To prevent that unwrap of the array, you can use `Write-Output -NoEnumerate`.

PowerShell

```
PS> Write-Output -NoEnumerate $data | Get-Member
TypeName: System.Object[]
...
```

I have a second way that's more of a hack (and I try to avoid hacks like this). You can place a comma in front of the array before you pipe it. This wraps `$data` into another array where it is the only element, so after the unwrapping the outer array we get back `$data` unwrapped.

PowerShell

```
PS> ,$data | Get-Member
TypeName: System.Object[]
...
```

Return an array

This unwrapping of arrays also happens when you output or return values from a function. You can still get an array if you assign the output to a variable so this isn't commonly an issue.

The catch is that you have a new array. If that is ever a problem, you can use `Write-Output -NoEnumerate $array` or `return ,$array` to work around it.

Anything else?

I know this is all a lot to take in. My hope is that you learn something from this article every time you read it and that it turns out to be a good reference for you for a long time to come. If you found this to be helpful, please share it with others you think may get value out of it.

From here, I would recommend you check out a similar post that I wrote about hashtables.

Everything you wanted to know about hashtables

Article • 06/25/2023

I want to take a step back and talk about hashtables. I use them all the time now. I was teaching someone about them after our user group meeting last night and I realized I had the same confusion about them as he had. Hashtables are really important in PowerShell so it's good to have a solid understanding of them.

> **Note**
>
> The **original version** of this article appeared on the blog written by **@KevinMarquette**. The PowerShell team thanks Kevin for sharing this content with us. Please check out his blog at **PowerShellExplained.com**.

Hashtable as a collection of things

I want you to first see a **Hashtable** as a collection in the traditional definition of a hashtable. This definition gives you a fundamental understanding of how they work when they get used for more advanced stuff later. Skipping this understanding is often a source of confusion.

What is an array?

Before I jump into what a **Hashtable** is, I need to mention arrays first. For the purpose of this discussion, an array is a list or collection of values or objects.

PowerShell

```
$array = @(1,2,3,5,7,11)
```

Once you have your items into an array, you can either use `foreach` to iterate over the list or use an index to access individual elements in the array.

PowerShell

```
foreach($item in $array)
{
    Write-Output $item
```

```
}

Write-Output $array[3]
```

You can also update values using an index in the same way.

PowerShell

```
$array[2] = 13
```

I just scratched the surface on arrays but that should put them into the right context as I move onto hashtables.

What is a hashtable?

I'm going to start with a basic technical description of what hashtables are, in the general sense, before I shift into the other ways PowerShell uses them.

A hashtable is a data structure, much like an array, except you store each value (object) using a key. It's a basic key/value store. First, we create an empty hashtable.

PowerShell

```
$ageList = @{}
```

Notice that braces, instead of parentheses, are used to define a hashtable. Then we add an item using a key like this:

PowerShell

```
$key = 'Kevin'
$value = 36
$ageList.add( $key, $value )

$ageList.add( 'Alex', 9 )
```

The person's name is the key and their age is the value that I want to save.

Using the brackets for access

Once you add your values to the hashtable, you can pull them back out using that same key (instead of using a numeric index like you would have for an array).

PowerShell

```
$ageList['Kevin']
$ageList['Alex']
```

When I want Kevin's age, I use his name to access it. We can use this approach to add or update values into the hashtable too. This is just like using the `add()` function above.

PowerShell

```
$ageList = @{}

$key = 'Kevin'
$value = 36
$ageList[$key] = $value

$ageList['Alex'] = 9
```

There's another syntax you can use for accessing and updating values that I'll cover in a later section. If you're coming to PowerShell from another language, these examples should fit in with how you may have used hashtables before.

Creating hashtables with values

So far I've created an empty hashtable for these examples. You can pre-populate the keys and values when you create them.

PowerShell

```
$ageList = @{
    Kevin = 36
    Alex  = 9
}
```

As a lookup table

The real value of this type of a hashtable is that you can use them as a lookup table. Here is a simple example.

PowerShell

```
$environments = @{
    Prod = 'SrvProd05'
    QA   = 'SrvQA02'
    Dev  = 'SrvDev12'
```

```
}

$server = $environments[$env]
```

In this example, you specify an environment for the `$env` variable and it will pick the correct server. You could use a `switch($env){...}` for a selection like this but a hashtable is a nice option.

This gets even better when you dynamically build the lookup table to use it later. So think about using this approach when you need to cross reference something. I think we would see this even more if PowerShell wasn't so good at filtering on the pipe with `Where-Object`. If you're ever in a situation where performance matters, this approach needs to be considered.

I won't say that it's faster, but it does fit into the rule of If performance matters, test it.

Multiselection

Generally, you think of a hashtable as a key/value pair, where you provide one key and get one value. PowerShell allows you to provide an array of keys to get multiple values.

PowerShell

```
$environments[@('QA','DEV')]
$environments[('QA','DEV')]
$environments['QA','DEV']
```

In this example, I use the same lookup hashtable from above and provide three different array styles to get the matches. This is a hidden gem in PowerShell that most people aren't aware of.

Iterating hashtables

Because a hashtable is a collection of key/value pairs, you iterate over it differently than you do for an array or a normal list of items.

The first thing to notice is that if you pipe your hashtable, the pipe treats it like one object.

PowerShell

```
PS> $ageList | Measure-Object
count : 1
```

Even though the `.count` property tells you how many values it contains.

PowerShell

```
PS> $ageList.count
2
```

You get around this issue by using the `.values` property if all you need is just the values.

PowerShell

```
PS> $ageList.values | Measure-Object -Average
Count   : 2
Average : 22.5
```

It's often more useful to enumerate the keys and use them to access the values.

PowerShell

```
PS> $ageList.keys | ForEach-Object{
    $message = '{0} is {1} years old!' -f $_, $ageList[$_]
    Write-Output $message
}
Kevin is 36 years old
Alex is 9 years old
```

Here is the same example with a `foreach(){...}` loop.

PowerShell

```
foreach($key in $ageList.keys)
{
    $message = '{0} is {1} years old' -f $key, $ageList[$key]
    Write-Output $message
}
```

We are walking each key in the hashtable and then using it to access the value. This is a common pattern when working with hashtables as a collection.

GetEnumerator()

That brings us to `GetEnumerator()` for iterating over our hashtable.

PowerShell

```
$ageList.GetEnumerator() | ForEach-Object{
    $message = '{0} is {1} years old!' -f $_.key, $_.value
    Write-Output $message
}
```

The enumerator gives you each key/value pair one after another. It was designed specifically for this use case. Thank you to Mark Kraus for reminding me of this one.

BadEnumeration

One important detail is that you can't modify a hashtable while it's being enumerated. If we start with our basic `$environments` example:

PowerShell

```
$environments = @{
    Prod = 'SrvProd05'
    QA   = 'SrvQA02'
    Dev  = 'SrvDev12'
}
```

And trying to set every key to the same server value fails.

PowerShell

```
$environments.Keys | ForEach-Object {
    $environments[$_] = 'SrvDev03'
}

An error occurred while enumerating through a collection: Collection was
modified;
enumeration operation may not execute.
+ CategoryInfo          : InvalidOperation:
tableEnumerator:HashtableEnumerator) [],
 RuntimeException
+ FullyQualifiedErrorId : BadEnumeration
```

This will also fail even though it looks like it should also be fine:

PowerShell

```
foreach($key in $environments.keys) {
    $environments[$key] = 'SrvDev03'
}

Collection was modified; enumeration operation may not execute.
    + CategoryInfo          : OperationStopped: (:) [],
```

```
InvalidOperationException
    + FullyQualifiedErrorId : System.InvalidOperationException
```

The trick to this situation is to clone the keys before doing the enumeration.

PowerShell

```
$environments.Keys.Clone() | ForEach-Object {
    $environments[$_] = 'SrvDev03'
}
```

Hashtable as a collection of properties

So far the type of objects we placed in our hashtable were all the same type of object. I used ages in all those examples and the key was the person's name. This is a great way to look at it when your collection of objects each have a name. Another common way to use hashtables in PowerShell is to hold a collection of properties where the key is the name of the property. I'll step into that idea in this next example.

Property-based access

The use of property-based access changes the dynamics of hashtables and how you can use them in PowerShell. Here is our usual example from above treating the keys as properties.

PowerShell

```
$ageList = @{}
$ageList.Kevin = 35
$ageList.Alex = 9
```

Just like the examples above, this example adds those keys if they don't exist in the hashtable already. Depending on how you defined your keys and what your values are, this is either a little strange or a perfect fit. The age list example has worked great up until this point. We need a new example for this to feel right going forward.

PowerShell

```
$person = @{
    name = 'Kevin'
    age  = 36
}
```

And we can add and access attributes on the `$person` like this.

PowerShell

```
$person.city = 'Austin'
$person.state = 'TX'
```

All of a sudden this hashtable starts to feel and act like an object. It's still a collection of things, so all the examples above still apply. We just approach it from a different point of view.

Checking for keys and values

In most cases, you can just test for the value with something like this:

PowerShell

```
if( $person.age ){...}
```

It's simple but has been the source of many bugs for me because I was overlooking one important detail in my logic. I started to use it to test if a key was present. When the value was `$false` or zero, that statement would return `$false` unexpectedly.

PowerShell

```
if( $person.age -ne $null ){...}
```

This works around that issue for zero values but not $null vs non-existent keys. Most of the time you don't need to make that distinction but there are functions for when you do.

PowerShell

```
if( $person.ContainsKey('age') ){...}
```

We also have a `ContainsValue()` for the situation where you need to test for a value without knowing the key or iterating the whole collection.

Removing and clearing keys

You can remove keys with the `.Remove()` function.

```
```

PowerShell

```
$person.remove('age')
```

Assigning them a `$null` value just leaves you with a key that has a `$null` value.

A common way to clear a hashtable is to just initialize it to an empty hashtable.

PowerShell

```
$person = @{}
```

While that does work, try to use the `clear()` function instead.

PowerShell

```
$person.clear()
```

This is one of those instances where using the function creates self-documenting code and it makes the intentions of the code very clean.

All the fun stuff

Ordered hashtables

By default, hashtables aren't ordered (or sorted). In the traditional context, the order doesn't matter when you always use a key to access values. You may find that you want the properties to stay in the order that you define them. Thankfully, there's a way to do that with the `ordered` keyword.

PowerShell

```
$person = [ordered]@{
    name = 'Kevin'
    age  = 36
}
```

Now when you enumerate the keys and values, they stay in that order.

Inline hashtables

When you're defining a hashtable on one line, you can separate the key/value pairs with a semicolon.

```PowerShell
$person = @{ name = 'kevin'; age = 36; }
```

This will come in handy if you're creating them on the pipe.

Custom expressions in common pipeline commands

There are a few cmdlets that support the use of hashtables to create custom or calculated properties. You commonly see this with `Select-Object` and `Format-Table`. The hashtables have a special syntax that looks like this when fully expanded.

```PowerShell
$property = @{
    name = 'totalSpaceGB'
    expression = { ($_.used + $_.free) / 1GB }
}
```

The `name` is what the cmdlet would label that column. The `expression` is a script block that is executed where `$_` is the value of the object on the pipe. Here is that script in action:

```PowerShell
$drives = Get-PSDrive | Where Used
$drives | Select-Object -Property name, $property

Name     totalSpaceGB
----     ------------
C    238.472652435303
```

I placed that in a variable but it could easily be defined inline and you can shorten `name` to `n` and `expression` to `e` while you're at it.

```PowerShell
$drives | Select-Object -property name, @{n='totalSpaceGB';e={($_.used +
$_.free) / 1GB}}
```

I personally don't like how long that makes commands and it often promotes some bad behaviors that I won't get into. I'm more likely to create a new hashtable or `pscustomobject` with all the fields and properties that I want instead of using this approach in scripts. But there's a lot of code out there that does this so I wanted you to be aware of it. I talk about creating a `pscustomobject` later on.

Custom sort expression

It's easy to sort a collection if the objects have the data that you want to sort on. You can either add the data to the object before you sort it or create a custom expression for `Sort-Object`.

PowerShell

```
Get-ADUser | Sort-Object -Property @{ e={ Get-TotalSales $_.Name } }
```

In this example I'm taking a list of users and using some custom cmdlet to get additional information just for the sort.

Sort a list of Hashtables

If you have a list of hashtables that you want to sort, you'll find that the `Sort-Object` doesn't treat your keys as properties. We can get a round that by using a custom sort expression.

PowerShell

```
$data = @(
    @{name='a'}
    @{name='c'}
    @{name='e'}
    @{name='f'}
    @{name='d'}
    @{name='b'}
)

$data | Sort-Object -Property @{e={$_.name}}
```

Splatting hashtables at cmdlets

This is one of my favorite things about hashtables that many people don't discover early on. The idea is that instead of providing all the properties to a cmdlet on one line, you

can instead pack them into a hashtable first. Then you can give the hashtable to the function in a special way. Here is an example of creating a DHCP scope the normal way.

PowerShell

```
Add-DhcpServerV4Scope -Name 'TestNetwork' -StartRange '10.0.0.2' -EndRange
'10.0.0.254' -SubnetMask '255.255.255.0' -Description 'Network for testlab
A' -LeaseDuration (New-TimeSpan -Days 8) -Type "Both"
```

Without using splatting, all those things need to be defined on a single line. It either scrolls off the screen or will wrap where ever it feels like. Now compare that to a command that uses splatting.

PowerShell

```
$DHCPScope = @{
    Name          = 'TestNetwork'
    StartRange    = '10.0.0.2'
    EndRange      = '10.0.0.254'
    SubnetMask    = '255.255.255.0'
    Description   = 'Network for testlab A'
    LeaseDuration = (New-TimeSpan -Days 8)
    Type          = "Both"
}
Add-DhcpServerV4Scope @DHCPScope
```

The use of the `@` sign instead of the `$` is what invokes the splat operation.

Just take a moment to appreciate how easy that example is to read. They are the exact same command with all the same values. The second one is easier to understand and maintain going forward.

I use splatting anytime the command gets too long. I define too long as causing my window to scroll right. If I hit three properties for a function, odds are that I'll rewrite it using a splatted hashtable.

Splatting for optional parameters

One of the most common ways I use splatting is to deal with optional parameters that come from some place else in my script. Let's say I have a function that wraps a `Get-CIMInstance` call that has an optional `$Credential` argument.

PowerShell

```
$CIMParams = @{
    ClassName = 'Win32_Bios'
```

```
    ComputerName = $ComputerName
}

if($Credential)
{
    $CIMParams.Credential = $Credential
}

Get-CIMInstance @CIMParams
```

I start by creating my hashtable with common parameters. Then I add the `$Credential` if it exists. Because I'm using splatting here, I only need to have the call to `Get-CIMInstance` in my code once. This design pattern is very clean and can handle lots of optional parameters easily.

To be fair, you could write your commands to allow `$null` values for parameters. You just don't always have control over the other commands you're calling.

Multiple splats

You can splat multiple hashtables to the same cmdlet. If we revisit our original splatting example:

PowerShell

```
$Common = @{
    SubnetMask  = '255.255.255.0'
    LeaseDuration = (New-TimeSpan -Days 8)
    Type = "Both"
}

$DHCPScope = @{
    Name        = 'TestNetwork'
    StartRange  = '10.0.0.2'
    EndRange    = '10.0.0.254'
    Description = 'Network for testlab A'
}

Add-DhcpServerv4Scope @DHCPScope @Common
```

I'll use this method when I have a common set of parameters that I'm passing to lots of commands.

Splatting for clean code

There's nothing wrong with splatting a single parameter if makes you code cleaner.

PowerShell

```powershell
$log = @{Path = '.\logfile.log'}
Add-Content "logging this command" @log
```

Splatting executables

Splatting also works on some executables that use a `/param:value` syntax. `Robocopy.exe`, for example, has some parameters like this.

PowerShell

```powershell
$robo = @{R=1;W=1;MT=8}
robocopy source destination @robo
```

I don't know that this is all that useful, but I found it interesting.

Adding hashtables

Hashtables support the addition operator to combine two hashtables.

PowerShell

```powershell
$person += @{Zip = '78701'}
```

This only works if the two hashtables don't share a key.

Nested hashtables

We can use hashtables as values inside a hashtable.

PowerShell

```powershell
$person = @{
    name = 'Kevin'
    age  = 36
}
$person.location = @{}
$person.location.city = 'Austin'
$person.location.state = 'TX'
```

I started with a basic hashtable containing two keys. I added a key called `location` with an empty hashtable. Then I added the last two items to that `location` hashtable. We can do this all inline too.

PowerShell

```
$person = @{
    name = 'Kevin'
    age  = 36
    location = @{
        city  = 'Austin'
        state = 'TX'
    }
}
```

This creates the same hashtable that we saw above and can access the properties the same way.

PowerShell

```
$person.location.city
Austin
```

There are many ways to approach the structure of your objects. Here is a second way to look at a nested hashtable.

PowerShell

```
$people = @{
    Kevin = @{
        age  = 36
        city = 'Austin'
    }
    Alex = @{
        age  = 9
        city = 'Austin'
    }
}
```

This mixes the concept of using hashtables as a collection of objects and a collection of properties. The values are still easy to access even when they're nested using whatever approach you prefer.

PowerShell

```
PS> $people.kevin.age
36
```

```
PS> $people.kevin['city']
Austin
PS> $people['Alex'].age
9
PS> $people['Alex']['City']
Austin
```

I tend to use the dot property when I'm treating it like a property. Those are generally things I've defined statically in my code and I know them off the top of my head. If I need to walk the list or programmatically access the keys, I use the brackets to provide the key name.

PowerShell

```
foreach($name in $people.keys)
{
    $person = $people[$name]
    '{0}, age {1}, is in {2}' -f $name, $person.age, $person.city
}
```

Having the ability to nest hashtables gives you a lot of flexibility and options.

Looking at nested hashtables

As soon as you start nesting hashtables, you're going to need an easy way to look at them from the console. If I take that last hashtable, I get an output that looks like this and it only goes so deep:

PowerShell

```
PS> $people
Name                           Value
----                           -----
Kevin                          {age, city}
Alex                           {age, city}
```

My go to command for looking at these things is `ConvertTo-JSON` because it's very clean and I frequently use JSON on other things.

PowerShell

```
PS> $people | ConvertTo-Json
{
    "Kevin":  {
                "age":  36,
                "city":  "Austin"
```

```
            },
    "Alex":  {
                "age":  9,
                "city":  "Austin"
            }
}
```

Even if you don't know JSON, you should be able to see what you're looking for. There's a `Format-Custom` command for structured data like this but I still like the JSON view better.

Creating objects

Sometimes you just need to have an object and using a hashtable to hold properties just isn't getting the job done. Most commonly you want to see the keys as column names. A `pscustomobject` makes that easy.

PowerShell

```
$person = [pscustomobject]@{
    name = 'Kevin'
    age  = 36
}

$person

name  age
----  ---
Kevin  36
```

Even if you don't create it as a `pscustomobject` initially, you can always cast it later when needed.

PowerShell

```
$person = @{
    name = 'Kevin'
    age  = 36
}

[pscustomobject]$person

name  age
----  ---
Kevin  36
```

I already have detailed write-up for pscustomobject that you should go read after this one. It builds on a lot of the things learned here.

Reading and writing hashtables to file

Saving to CSV

Struggling with getting a hashtable to save to a CSV is one of the difficulties that I was referring to above. Convert your hashtable to a `pscustomobject` and it will save correctly to CSV. It helps if you start with a `pscustomobject` so the column order is preserved. But you can cast it to a `pscustomobject` inline if needed.

PowerShell

```
$person | ForEach-Object{ [pscustomobject]$_ } | Export-CSV -Path $path
```

Again, check out my write-up on using a pscustomobject.

Saving a nested hashtable to file

If I need to save a nested hashtable to a file and then read it back in again, I use the JSON cmdlets to do it.

PowerShell

```
$people | ConvertTo-JSON | Set-Content -Path $path
$people = Get-Content -Path $path -Raw | ConvertFrom-JSON
```

There are two important points about this method. First is that the JSON is written out multiline so I need to use the `-Raw` option to read it back into a single string. The Second is that the imported object is no longer a `[hashtable]`. It's now a `[pscustomobject]` and that can cause issues if you don't expect it.

Watch for deeply-nested hashtables. When you convert it to JSON you might not get the results you expect.

PowerShell

```
@{ a = @{ b = @{ c = @{ d = "e" }}}} | ConvertTo-Json

{
  "a": {
```

```
    "b": {
      "c": "System.Collections.Hashtable"
    }
  }
}
```

Use **Depth** parameter to ensure that you have expanded all the nested hashtables.

PowerShell

```
@{ a = @{ b = @{ c = @{ d = "e" }}}} | ConvertTo-Json -Depth 3

{
  "a": {
    "b": {
      "c": {
        "d": "e"
      }
    }
  }
}
```

If you need it to be a `[hashtable]` on import, then you need to use the `Export-CliXml` and `Import-CliXml` commands.

Converting JSON to Hashtable

If you need to convert JSON to a `[hashtable]`, there's one way that I know of to do it with the JavaScriptSerializer in .NET.

PowerShell

```
[Reflection.Assembly]::LoadWithPartialName("System.Web.Script.Serialization")
)
$JSSerializer =
[System.Web.Script.Serialization.JavaScriptSerializer]::new()
$JSSerializer.Deserialize($json,'Hashtable')
```

Beginning in PowerShell v6, JSON support uses the NewtonSoft JSON.NET and adds hashtable support.

PowerShell

```
'{ "a": "b" }' | ConvertFrom-Json -AsHashtable

Name      Value
```

```
----      -----
a         b
```

PowerShell 6.2 added the **Depth** parameter to `ConvertFrom-Json`. The default **Depth** is 1024.

Reading directly from a file

If you have a file that contains a hashtable using PowerShell syntax, there's a way to import it directly.

PowerShell

```
$content = Get-Content -Path $Path -Raw -ErrorAction Stop
$scriptBlock = [scriptblock]::Create( $content )
$scriptBlock.CheckRestrictedLanguage( $allowedCommands, $allowedVariables,
$true )
$hashtable = ( & $scriptBlock )
```

It imports the contents of the file into a `scriptblock`, then checks to make sure it doesn't have any other PowerShell commands in it before it executes it.

On that note, did you know that a module manifest (the psd1 file) is just a hashtable?

Keys can be any object

Most of the time, the keys are just strings. So we can put quotes around anything and make it a key.

PowerShell

```
$person = @{
    'full name' = 'Kevin Marquette'
    '#' = 3978
}
$person['full name']
```

You can do some odd things that you may not have realized you could do.

PowerShell

```
$person.'full name'

$key = 'full name'
$person.$key
```

Just because you can do something, it doesn't mean that you should. That last one just looks like a bug waiting to happen and would be easily misunderstood by anyone reading your code.

Technically your key doesn't have to be a string but they're easier to think about if you only use strings. However, indexing doesn't work well with the complex keys.

PowerShell

```
$ht = @{ @(1,2,3) = "a" }
$ht

Name                           Value
----                           -----
{1, 2, 3}                      a
```

Accessing a value in the hashtable by its key doesn't always work. For example:

PowerShell

```
$key = $ht.keys[0]
$ht.$($key)
a
$ht[$key]
a
```

When the key is an array, you must wrap the `$key` variable in a subexpression so that it can be used with member access (`.`) notation. Or, you can use array index (`[]`) notation.

Use in automatic variables

$PSBoundParameters

$PSBoundParameters is an automatic variable that only exists inside the context of a function. It contains all the parameters that the function was called with. This isn't exactly a hashtable but close enough that you can treat it like one.

That includes removing keys and splatting it to other functions. If you find yourself writing proxy functions, take a closer look at this one.

See about_Automatic_Variables for more details.

PSBoundParameters gotcha

One important thing to remember is that this only includes the values that are passed in as parameters. If you also have parameters with default values but aren't passed in by the caller, `$PSBoundParameters` doesn't contain those values. This is commonly overlooked.

$PSDefaultParameterValues

This automatic variable lets you assign default values to any cmdlet without changing the cmdlet. Take a look at this example.

PowerShell

```
$PSDefaultParameterValues["Out-File:Encoding"] = "UTF8"
```

This adds an entry to the `$PSDefaultParameterValues` hashtable that sets `UTF8` as the default value for the `Out-File -Encoding` parameter. This is session-specific so you should place it in your `$profile`.

I use this often to pre-assign values that I type quite often.

PowerShell

```
$PSDefaultParameterValues[ "Connect-VIServer:Server" ] =
'VCENTER01.contoso.local'
```

This also accepts wildcards so you can set values in bulk. Here are some ways you can use that:

PowerShell

```
$PSDefaultParameterValues[ "Get-*:Verbose" ] = $true
$PSDefaultParameterValues[ "*:Credential" ] = Get-Credential
```

For a more in-depth breakdown, see this great article on Automatic Defaults by Michael Sorens.

Regex $Matches

When you use the `-match` operator, an automatic variable called `$matches` is created with the results of the match. If you have any sub expressions in your regex, those sub

matches are also listed.

PowerShell

```powershell
$message = 'My SSN is 123-45-6789.'

$message -match 'My SSN is (.+)\.'
$Matches[0]
$Matches[1]
```

Named matches

This is one of my favorite features that most people don't know about. If you use a named regex match, then you can access that match by name on the matches.

PowerShell

```powershell
$message = 'My Name is Kevin and my SSN is 123-45-6789.'

if($message -match 'My Name is (?<Name>.+) and my SSN is (?<SSN>.+)\.')
{
    $Matches.Name
    $Matches.SSN
}
```

In the example above, the `(?<Name>.*)` is a named sub expression. This value is then placed in the `$Matches.Name` property.

Group-Object -AsHashtable

One little known feature of `Group-Object` is that it can turn some datasets into a hashtable for you.

PowerShell

```powershell
Import-CSV $Path | Group-Object -AsHashtable -Property email
```

This will add each row into a hashtable and use the specified property as the key to access it.

Copying Hashtables

One important thing to know is that hashtables are objects. And each variable is just a reference to an object. This means that it takes more work to make a valid copy of a hashtable.

Assigning reference types

When you have one hashtable and assign it to a second variable, both variables point to the same hashtable.

PowerShell

```
PS> $orig = @{name='orig'}
PS> $copy = $orig
PS> $copy.name = 'copy'
PS> 'Copy: [{0}]' -f $copy.name
PS> 'Orig: [{0}]' -f $orig.name

Copy: [copy]
Orig: [copy]
```

This highlights that they're the same because altering the values in one will also alter the values in the other. This also applies when passing hashtables into other functions. If those functions make changes to that hashtable, your original is also altered.

Shallow copies, single level

If we have a simple hashtable like our example above, we can use `.Clone()` to make a shallow copy.

PowerShell

```
PS> $orig = @{name='orig'}
PS> $copy = $orig.Clone()
PS> $copy.name = 'copy'
PS> 'Copy: [{0}]' -f $copy.name
PS> 'Orig: [{0}]' -f $orig.name

Copy: [copy]
Orig: [orig]
```

This will allow us to make some basic changes to one that don't impact the other.

Shallow copies, nested

The reason why it's called a shallow copy is because it only copies the base level properties. If one of those properties is a reference type (like another hashtable), then those nested objects will still point to each other.

PowerShell

```
PS> $orig = @{
        person=@{
            name='orig'
        }
    }
PS> $copy = $orig.Clone()
PS> $copy.person.name = 'copy'
PS> 'Copy: [{0}]' -f $copy.person.name
PS> 'Orig: [{0}]' -f $orig.person.name

Copy: [copy]
Orig: [copy]
```

So you can see that even though I cloned the hashtable, the reference to `person` wasn't cloned. We need to make a deep copy to truly have a second hashtable that isn't linked to the first.

Deep copies

There are a couple of ways to make a deep copy of a hashtable (and keep it as a hashtable). Here's a function using PowerShell to recursively create a deep copy:

PowerShell

```
function Get-DeepClone
{
    [CmdletBinding()]
    param(
        $InputObject
    )
    process
    {
        if($InputObject -is [hashtable]) {
            $clone = @{}
            foreach($key in $InputObject.keys)
            {
                $clone[$key] = Get-DeepClone $InputObject[$key]
            }
            return $clone
        } else {
            return $InputObject
        }
```

```
    }
}
```

It doesn't handle any other reference types or arrays, but it's a good starting point.

Another way is to use .Net to deserialize it using **CliXml** like in this function:

PowerShell

```
function Get-DeepClone
{
    param(
        $InputObject
    )
    $TempCliXmlString =
[System.Management.Automation.PSSerializer]::Serialize($obj,
[int32]::MaxValue)
    return
[System.Management.Automation.PSSerializer]::Deserialize($TempCliXmlString)
}
```

For extremely large hashtables, the deserializing function is faster as it scales out. However, there are some things to consider when using this method. Since it uses **CliXml**, it's memory intensive and if you are cloning huge hashtables, that might be a problem. Another limitation of the **CliXml** is there is a depth limitation of 48. Meaning, if you have a hashtable with 48 layers of nested hashtables, the cloning will fail and no hashtable will be output at all.

Anything else?

I covered a lot of ground quickly. My hope is that you walk away leaning something new or understanding it better every time you read this. Because I covered the full spectrum of this feature, there are aspects that just may not apply to you right now. That is perfectly OK and is kind of expected depending on how much you work with PowerShell.

Everything you wanted to know about PSCustomObject

Article • 06/07/2023

`PSCustomObject` is a great tool to add into your PowerShell tool belt. Let's start with the basics and work our way into the more advanced features. The idea behind using a `PSCustomObject` is to have a simple way to create structured data. Take a look at the first example and you'll have a better idea of what that means.

> **Note**
>
> The **original version** of this article appeared on the blog written by **@KevinMarquette**. The PowerShell team thanks Kevin for sharing this content with us. Please check out his blog at **PowerShellExplained.com**.

Creating a PSCustomObject

I love using `[PSCustomObject]` in PowerShell. Creating a usable object has never been easier. Because of that, I'm going to skip over all the other ways you can create an object but I need to mention that most of these examples are PowerShell v3.0 and newer.

PowerShell

```
$myObject = [PSCustomObject]@{
    Name     = 'Kevin'
    Language = 'PowerShell'
    State    = 'Texas'
}
```

This method works well for me because I use hashtables for just about everything. But there are times when I would like PowerShell to treat hashtables more like an object. The first place you notice the difference is when you want to use `Format-Table` or `Export-CSV` and you realize that a hashtable is just a collection of key/value pairs.

You can then access and use the values like you would a normal object.

PowerShell

```
$myObject.Name
```

Converting a hashtable

While I am on the topic, did you know you could do this:

PowerShell

```
$myHashtable = @{
    Name     = 'Kevin'
    Language = 'PowerShell'
    State    = 'Texas'
}
$myObject = [pscustomobject]$myHashtable
```

I do prefer to create the object from the start but there are times you have to work with a hashtable first. This example works because the constructor takes a hashtable for the object properties. One important note is that while this method works, it isn't an exact equivalent. The biggest difference is that the order of the properties isn't preserved.

If you want to preserve the order, see Ordered hashtables.

Legacy approach

You may have seen people use `New-Object` to create custom objects.

PowerShell

```
$myHashtable = @{
    Name     = 'Kevin'
    Language = 'PowerShell'
    State    = 'Texas'
}

$myObject = New-Object -TypeName PSObject -Property $myHashtable
```

This way is quite a bit slower but it may be your best option on early versions of PowerShell.

Saving to a file

I find the best way to save a hashtable to a file is to save it as JSON. You can import it back into a `[PSCustomObject]`

PowerShell

```
$myObject | ConvertTo-Json -depth 1 | Set-Content -Path $Path
$myObject = Get-Content -Path $Path | ConvertFrom-Json
```

I cover more ways to save objects to a file in my article on The many ways to read and write to files.

Working with properties

Adding properties

You can still add new properties to your `PSCustomObject` with `Add-Member`.

PowerShell

```
$myObject | Add-Member -MemberType NoteProperty -Name 'ID' -Value
'KevinMarquette'

$myObject.ID
```

Remove properties

You can also remove properties off of an object.

PowerShell

```
$myObject.psobject.properties.remove('ID')
```

The `.psobject` is an intrinsic member that gives you access to base object metadata. For more information about intrinsic members, see about_Intrinsic_Members.

Enumerating property names

Sometimes you need a list of all the property names on an object.

PowerShell

```
$myObject | Get-Member -MemberType NoteProperty | Select -ExpandProperty
Name
```

We can get this same list off of the `psobject` property too.

```
```

PowerShell

```
$myobject.psobject.properties.name
```

Dynamically accessing properties

I already mentioned that you can access property values directly.

PowerShell

```
$myObject.Name
```

You can use a string for the property name and it will still work.

PowerShell

```
$myObject.'Name'
```

We can take this one more step and use a variable for the property name.

PowerShell

```
$property = 'Name'
$myObject.$property
```

I know that looks strange, but it works.

Convert PSCustomObject into a hashtable

To continue on from the last section, you can dynamically walk the properties and create a hashtable from them.

PowerShell

```
$hashtable = @{}
foreach( $property in $myobject.psobject.properties.name )
{
    $hashtable[$property] = $myObject.$property
}
```

Testing for properties

If you need to know if a property exists, you could just check for that property to have a value.

PowerShell

```powershell
if( $null -ne $myObject.ID )
```

But if the value could be `$null` you can check to see if it exists by checking the `psobject.properties` for it.

PowerShell

```powershell
if( $myobject.psobject.properties.match('ID').Count )
```

Adding object methods

If you need to add a script method to an object, you can do it with `Add-Member` and a `ScriptBlock`. You have to use the `this` automatic variable reference the current object. Here is a `scriptblock` to turn an object into a hashtable. (same code form the last example)

PowerShell

```powershell
$ScriptBlock = {
    $hashtable = @{}
    foreach( $property in $this.psobject.properties.name )
    {
        $hashtable[$property] = $this.$property
    }
    return $hashtable
}
```

Then we add it to our object as a script property.

PowerShell

```powershell
$memberParam = @{
    MemberType = "ScriptMethod"
    InputObject = $myobject
    Name = "ToHashtable"
    Value = $scriptBlock
}
Add-Member @memberParam
```

Then we can call our function like this:

```PowerShell
$myObject.ToHashtable()
```

Objects vs Value types

Objects and value types don't handle variable assignments the same way. If you assign value types to each other, only the value get copied to the new variable.

```PowerShell
$first = 1
$second = $first
$second = 2
```

In this case, `$first` is 1 and `$second` is 2.

Object variables hold a reference to the actual object. When you assign one object to a new variable, they still reference the same object.

```PowerShell
$third = [PSCustomObject]@{Key=3}
$fourth = $third
$fourth.Key = 4
```

Because `$third` and `$fourth` reference the same instance of an object, both `$third.key` and `$fourth.Key` are 4.

psobject.copy()

If you need a true copy of an object, you can clone it.

```PowerShell
$third = [PSCustomObject]@{Key=3}
$fourth = $third.psobject.copy()
$fourth.Key = 4
```

Clone creates a shallow copy of the object. They have different instances now and `$third.key` is 3 and `$fourth.Key` is 4 in this example.

I call this a shallow copy because if you have nested objects (objects with properties contain other objects), only the top-level values are copied. The child objects will reference each other.

PSTypeName for custom object types

Now that we have an object, there are a few more things we can do with it that may not be nearly as obvious. First thing we need to do is give it a `PSTypeName`. This is the most common way I see people do it:

PowerShell

```
$myObject.PSObject.TypeNames.Insert(0,"My.Object")
```

I recently discovered another way to do this from this post by /u/markekraus. I did a little digging and more posts about the idea from Adam Bertram and Mike Shepard where they talk about this approach that allows you to define it inline.

PowerShell

```
$myObject = [PSCustomObject]@{
    PSTypeName = 'My.Object'
    Name       = 'Kevin'
    Language   = 'PowerShell'
    State      = 'Texas'
}
```

I love how nicely this just fits into the language. Now that we have an object with a proper type name, we can do some more things.

> **Note**
>
> You can also create custom PowerShell types using PowerShell classes. For more information, see **PowerShell Class Overview**.

Using DefaultPropertySet (the long way)

PowerShell decides for us what properties to display by default. A lot of the native commands have a `.ps1xml` formatting file that does all the heavy lifting. From this post by Boe Prox, there's another way for us to do this on our custom object using just PowerShell. We can give it a `MemberSet` for it to use.

PowerShell

```
$defaultDisplaySet = 'Name','Language'
$defaultDisplayPropertySet = New-Object
System.Management.Automation.PSPropertySet('DefaultDisplayPropertySet',
[string[]]$defaultDisplaySet)
$PSStandardMembers =
[System.Management.Automation.PSMemberInfo[]]@($defaultDisplayPropertySet)
$MyObject | Add-Member MemberSet PSStandardMembers $PSStandardMembers
```

Now when my object just falls to the shell, it will only show those properties by default.

Update-TypeData with DefaultPropertySet

This is nice but I recently saw a better way using Update-TypeData to specify the default properties.

PowerShell

```
$TypeData = @{
    TypeName = 'My.Object'
    DefaultDisplayPropertySet = 'Name','Language'
}
Update-TypeData @TypeData
```

That is simple enough that I could almost remember it if I didn't have this post as a quick reference. Now I can easily create objects with lots of properties and still give it a nice clean view when looking at it from the shell. If I need to access or see those other properties, they're still there.

PowerShell

```
$myObject | Format-List *
```

Update-TypeData with ScriptProperty

Something else I got out of that video was creating script properties for your objects. This would be a good time to point out that this works for existing objects too.

PowerShell

```
$TypeData = @{
    TypeName = 'My.Object'
    MemberType = 'ScriptProperty'
    MemberName = 'UpperCaseName'
```

```
    Value = {$this.Name.toUpper()}
}
Update-TypeData @TypeData
```

You can do this before your object is created or after and it will still work. This is what makes this different then using `Add-Member` with a script property. When you use `Add-Member` the way I referenced earlier, it only exists on that specific instance of the object. This one applies to all objects with this `TypeName`.

Function parameters

You can now use these custom types for parameters in your functions and scripts. You can have one function create these custom objects and then pass them into other functions.

PowerShell

```
param( [PSTypeName('My.Object')]$Data )
```

PowerShell requires that the object is the type you specified. It throws a validation error if the type doesn't match automatically to save you the step of testing for it in your code. A great example of letting PowerShell do what it does best.

Function OutputType

You can also define an `OutputType` for your advanced functions.

PowerShell

```
function Get-MyObject
{
    [OutputType('My.Object')]
    [CmdletBinding()]
        param
        (
            ...
```

The **OutputType** attribute value is only a documentation note. It isn't derived from the function code or compared to the actual function output.

The main reason you would use an output type is so that meta information about your function reflects your intentions. Things like `Get-Command` and `Get-Help` that your

development environment can take advantage of. If you want more information, then take a look at the help for it: about_Functions_OutputTypeAttribute.

With that said, if you're using Pester to unit test your functions then it would be a good idea to validate the output objects match your **OutputType**. This could catch variables that just fall to the pipe when they shouldn't.

Closing thoughts

The context of this was all about `[PSCustomObject]`, but a lot of this information applies to objects in general.

I have seen most of these features in passing before but never saw them presented as a collection of information on `PSCustomObject`. Just this last week I stumbled upon another one and was surprised that I had not seen it before. I wanted to pull all these ideas together so you can hopefully see the bigger picture and be aware of them when you have an opportunity to use them. I hope you learned something and can find a way to work this into your scripts.

Everything you wanted to know about variable substitution in strings

Article • 11/16/2022

There are many ways to use variables in strings. I'm calling this variable substitution but I'm referring to any time you want to format a string to include values from variables. This is something that I often find myself explaining to new scripters.

> **Note**
>
> The **original version** of this article appeared on the blog written by **@KevinMarquette**. The PowerShell team thanks Kevin for sharing this content with us. Please check out his blog at **PowerShellExplained.com**.

Concatenation

The first class of methods can be referred to as concatenation. It's basically taking several strings and joining them together. There's a long history of using concatenation to build formatted strings.

PowerShell

```
$name = 'Kevin Marquette'
$message = 'Hello, ' + $name
```

Concatenation works out OK when there are only a few values to add. But this can get complicated quickly.

PowerShell

```
$first = 'Kevin'
$last = 'Marquette'
```

PowerShell

```
$message = 'Hello, ' + $first + ' ' + $last + '.'
```

This simple example is already getting harder to read.

Variable substitution

PowerShell has another option that is easier. You can specify your variables directly in the strings.

```PowerShell
$message = "Hello, $first $last."
```

The type of quotes you use around the string makes a difference. A double quoted string allows the substitution but a single quoted string doesn't. There are times you want one or the other so you have an option.

Command substitution

Things get a little tricky when you start trying to get the values of properties into a string. This is where many new people get tripped up. First let me show you what they think should work (and at face value almost looks like it should).

```PowerShell
$directory = Get-Item 'c:\windows'
$message = "Time: $directory.CreationTime"
```

You would be expecting to get the `CreationTime` off of the `$directory`, but instead you get this `Time: c:\windows.CreationTime` as your value. The reason is that this type of substitution only sees the base variable. It considers the period as part of the string so it stops resolving the value any deeper.

It just so happens that this object gives a string as a default value when placed into a string. Some objects give you the type name instead like `System.Collections.Hashtable`. Just something to watch for.

PowerShell allows you to do command execution inside the string with a special syntax. This allows us to get the properties of these objects and run any other command to get a value.

```PowerShell
$message = "Time: $($directory.CreationTime)"
```

This works great for some situations but it can get just as crazy as concatenation if you have just a few variables.

Command execution

You can run commands inside a string. Even though I have this option, I don't like it. It gets cluttered quickly and hard to debug. I either run the command and save to a variable or use a format string.

PowerShell

```
$message = "Date: $(Get-Date)"
```

Format string

.NET has a way to format strings that I find fairly easy to work with. First let me show you the static method for it before I show you the PowerShell shortcut to do the same thing.

PowerShell

```
# .NET string format string
[string]::Format('Hello, {0} {1}.',$first,$last)

# PowerShell format string
'Hello, {0} {1}.' -f $first, $last
```

What is happening here is that the string is parsed for the tokens `{0}` and `{1}`, then it uses that number to pick from the values provided. If you want to repeat one value some place in the string, you can reuse that values number.

The more complicated the string gets, the more value you get out of this approach.

Format values as arrays

If your format line gets too long, you can place your values into an array first.

PowerShell

```
$values = @(
    "Kevin"
    "Marquette"
)
'Hello, {0} {1}.' -f $values
```

This is not splatting because I'm passing the whole array in, but the idea is similar.

Advanced formatting

I intentionally called these out as coming from .NET because there are lots of formatting options already well documented on it. There are built in ways to format various data types.

PowerShell

```
"{0:yyyyMMdd}" -f (Get-Date)
"Population {0:N0}" -f  8175133
```

Output

```
20211110
Population 8,175,133
```

I'm not going to go into them but I just wanted to let you know that this is a very powerful formatting engine if you need it.

Joining strings

Sometimes you actually do want to concatenate a list of values together. There's a `-join` operator that can do that for you. It even lets you specify a character to join between the strings.

PowerShell

```
$servers = @(
    'server1'
    'server2'
    'server3'
)

$servers  -join ','
```

If you want to `-join` some strings without a separator, you need to specify an empty string `''`. But if that is all you need, there's a faster option.

PowerShell

```
[string]::Concat('server1','server2','server3')
[string]::Concat($servers)
```

It's also worth pointing out that you can also `-split` strings too.

Join-Path

This is often overlooked but a great cmdlet for building a file path.

PowerShell

```
$folder = 'Temp'
Join-Path -Path 'c:\windows' -ChildPath $folder
```

The great thing about this is it works out the backslashes correctly when it puts the values together. This is especially important if you are taking values from users or config files.

This also goes well with `Split-Path` and `Test-Path`. I also cover these in my post about reading and saving to files.

Strings are arrays

I do need to mention adding strings here before I go on. Remember that a string is just an array of characters. When you add multiple strings together, a new array is created each time.

Look at this example:

PowerShell

```
$message = "Numbers: "
foreach($number in 1..10000)
{
    $message += " $number"
}
```

It looks very basic but what you don't see is that each time a string is added to `$message` that a whole new string is created. Memory gets allocated, data gets copied and the old one is discarded. Not a big deal when it's only done a few times, but a loop like this would really expose the issue.

StringBuilder

StringBuilder is also very popular for building large strings from lots of smaller strings. The reason why is because it just collects all the strings you add to it and only concatenates all of them at the end when you retrieve the value.

PowerShell

```
$stringBuilder = New-Object -TypeName "System.Text.StringBuilder"

[void]$stringBuilder.Append("Numbers: ")
foreach($number in 1..10000)
{
    [void]$stringBuilder.Append(" $number")
}
$message = $stringBuilder.ToString()
```

Again, this is something that I'm reaching out to .NET for. I don't use it often anymore but it's good to know it's there.

Delineation with braces

This is used for suffix concatenation within the string. Sometimes your variable doesn't have a clean word boundary.

PowerShell

```
$test = "Bet"
$tester = "Better"
Write-Host "$test $tester ${test}ter"
```

Thank you /u/real_parbold for that one.

Here is an alternate to this approach:

PowerShell

```
Write-Host "$test $tester $($test)ter"
Write-Host "{0} {1} {0}ter" -f $test, $tester
```

I personally use format string for this, but this is good to know incase you see it in the wild.

Find and replace tokens

While most of these features limit your need to roll your own solution, there are times where you may have large template files where you want to replace strings inside.

Let us assume you pulled in a template from a file that has a lot of text.

PowerShell

```
$letter = Get-Content -Path TemplateLetter.txt -RAW
$letter = $letter -replace '#FULL_NAME#', 'Kevin Marquette'
```

You may have lots of tokens to replace. The trick is to use a very distinct token that is easy to find and replace. I tend to use a special character at both ends to help distinguish it.

I recently found a new way to approach this. I decided to leave this section in here because this is a pattern that is commonly used.

Replace multiple tokens

When I have a list of tokens that I need to replace, I take a more generic approach. I would place them in a hashtable and iterate over them to do the replace.

PowerShell

```
$tokenList = @{
    Full_Name = 'Kevin Marquette'
    Location = 'Orange County'
    State = 'CA'
}

$letter = Get-Content -Path TemplateLetter.txt -RAW
foreach( $token in $tokenList.GetEnumerator() )
{
    $pattern = '#{0}#' -f $token.key
    $letter = $letter -replace $pattern, $token.Value
}
```

Those tokens could be loaded from JSON or CSV if needed.

ExecutionContext ExpandString

There's a clever way to define a substitution string with single quotes and expand the variables later. Look at this example:

PowerShell

```
$message = 'Hello, $Name!'
$name = 'Kevin Marquette'
$string = $ExecutionContext.InvokeCommand.ExpandString($message)
```

The call to `.InvokeCommand.ExpandString` on the current execution context uses the variables in the current scope for substitution. The key thing here is that the `$message` can be defined very early before the variables even exist.

If we expand on that just a little bit, we can perform this substitution over and over wih different values.

PowerShell

```
$message = 'Hello, $Name!'
$nameList = 'Mark Kraus','Kevin Marquette','Lee Dailey'
foreach($name in $nameList){
    $ExecutionContext.InvokeCommand.ExpandString($message)
}
```

To keep going on this idea; you could be importing a large email template from a text file to do this. I have to thank Mark Kraus for this suggestion.

Whatever works the best for you

I'm a fan of the format string approach. I definitely do this with the more complicated strings or if there are multiple variables. On anything that is very short, I may use any one of these.

Anything else?

I covered a lot of ground on this one. My hope is that you walk away learning something new.

Links

If you'd like to learn more about the methods and features that make string interpolation possible, see the following list for the reference documentation.

- Concatenation uses the addition operator
- Variable and command substitution follow the quoting rules
- Formatting uses the format operator

- Joining strings uses the join operator and references Join-Path, but you could also read about Join-String
- Arrays are documented in About arrays
- StringBuilder is a .NET class, with its own documentation
- Braces in strings is also covered in the quoting rules
- Token replacement uses the replace operator
- The `$ExecutionContext.InvokeCommand.ExpandString()` method has .NET API reference documentation

Everything you wanted to know about the `if` statement

Article • 11/17/2022

Like many other languages, PowerShell has statements for conditionally executing code in your scripts. One of those statements is the If statement. Today we will take a deep dive into one of the most fundamental commands in PowerShell.

> **Note**
>
> The **original version** of this article appeared on the blog written by **@KevinMarquette**. The PowerShell team thanks Kevin for sharing this content with us. Please check out his blog at **PowerShellExplained.com**.

Conditional execution

Your scripts often need to make decisions and perform different logic based on those decisions. This is what I mean by conditional execution. You have one statement or value to evaluate, then execute a different section of code based on that evaluation. This is exactly what the `if` statement does.

The `if` statement

Here is a basic example of the `if` statement:

PowerShell

```
$condition = $true
if ( $condition )
{
    Write-Output "The condition was true"
}
```

The first thing the `if` statement does is evaluate the expression in parentheses. If it evaluates to `$true`, then it executes the `scriptblock` in the braces. If the value was `$false`, then it would skip over that scriptblock.

In the previous example, the `if` statement was just evaluating the `$condition` variable. It was `$true` and would have executed the `Write-Output` command inside the

scriptblock.

In some languages, you can place a single line of code after the `if` statement and it gets executed. That isn't the case in PowerShell. You must provide a full `scriptblock` with braces for it to work correctly.

Comparison operators

The most common use of the `if` statement for is comparing two items with each other. PowerShell has special operators for different comparison scenarios. When you use a comparison operator, the value on the left-hand side is compared to the value on the right-hand side.

-eq for equality

The `-eq` does an equality check between two values to make sure they're equal to each other.

PowerShell

```
$value = Get-MysteryValue
if ( 5 -eq $value )
{
    # do something
}
```

In this example, I'm taking a known value of `5` and comparing it to my `$value` to see if they match.

One possible use case is to check the status of a value before you take an action on it. You could get a service and check that the status was running before you called `Restart-Service` on it.

It's common in other languages like C# to use `==` for equality (ex: `5 == $value`) but that doesn't work with PowerShell. Another common mistake that people make is to use the equals sign (ex: `5 = $value`) that is reserved for assigning values to variables. By placing your known value on the left, it makes that mistake more awkward to make.

This operator (and others) has a few variations.

- `-eq` case-insensitive equality
- `-ieq` case-insensitive equality
- `-ceq` case-sensitive equality

-ne not equal

Many operators have a related operator that is checking for the opposite result. `-ne` verifies that the values don't equal each other.

PowerShell

```
if ( 5 -ne $value )
{
    # do something
}
```

Use this to make sure that the action only executes if the value isn't `5`. A good use-cases where would be to check if a service was in the running state before you try to start it.

Variations:

- `-ne` case-insensitive not equal
- `-ine` case-insensitive not equal
- `-cne` case-sensitive not equal

These are inverse variations of `-eq`. I'll group these types together when I list variations for other operators.

-gt -ge -lt -le for greater than or less than

These operators are used when checking to see if a value is larger or smaller than another value. The `-gt -ge -lt -le` stand for GreaterThan, GreaterThanOrEqual, LessThan, and LessThanOrEqual.

PowerShell

```
if ( $value -gt 5 )
{
    # do something
}
```

Variations:

- `-gt` greater than
- `-igt` greater than, case-insensitive
- `-cgt` greater than, case-sensitive
- `-ge` greater than or equal

- `-ige` greater than or equal, case-insensitive
- `-cge` greater than or equal, case-sensitive
- `-lt` less than
- `-ilt` less than, case-insensitive
- `-clt` less than, case-sensitive
- `-le` less than or equal
- `-ile` less than or equal, case-insensitive
- `-cle` less than or equal, case-sensitive

I don't know why you would use case-sensitive and insensitive options for these operators.

-like wildcard matches

PowerShell has its own wildcard-based pattern matching syntax and you can use it with the `-like` operator. These wildcard patterns are fairly basic.

- `?` matches any single character
- `*` matches any number of characters

PowerShell

```
$value = 'S-ATX-SQL01'
if ( $value -like 'S-*-SQL??')
{
    # do something
}
```

It's important to point out that the pattern matches the whole string. If you need to match something in the middle of the string, you need to place the `*` on both ends of the string.

PowerShell

```
$value = 'S-ATX-SQL02'
if ( $value -like '*SQL*')
{
    # do something
}
```

Variations:

- `-like` case-insensitive wildcard

- `-ilike` case-insensitive wildcard
- `-clike` case-sensitive wildcard
- `-notlike` case-insensitive wildcard not matched
- `-inotlike` case-insensitive wildcard not matched
- `-cnotlike` case-sensitive wildcard not matched

-match regular expression

The `-match` operator allows you to check a string for a regular-expression-based match. Use this when the wildcard patterns aren't flexible enough for you.

PowerShell

```
$value = 'S-ATX-SQL01'
if ( $value -match 'S-\w\w\w-SQL\d\d')
{
    # do something
}
```

A regex pattern matches anywhere in the string by default. So you can specify a substring that you want matched like this:

PowerShell

```
$value = 'S-ATX-SQL01'
if ( $value -match 'SQL')
{
    # do something
}
```

Regex is a complex language of its own and worth looking into. I talk more about `-match` and the many ways to use regex in another article.

Variations:

- `-match` case-insensitive regex
- `-imatch` case-insensitive regex
- `-cmatch` case-sensitive regex
- `-notmatch` case-insensitive regex not matched
- `-inotmatch` case-insensitive regex not matched
- `-cnotmatch` case-sensitive regex not matched

-is of type

You can check a value's type with the `-is` operator.

PowerShell

```powershell
if ( $value -is [string] )
{
    # do something
}
```

You may use this if you're working with classes or accepting various objects over the pipeline. You could have either a service or a service name as your input. Then check to see if you have a service and fetch the service if you only have the name.

PowerShell

```powershell
if ( $Service -isnot [System.ServiceProcess.ServiceController] )
{
    $Service = Get-Service -Name $Service
}
```

Variations:

- `-is` of type
- `-isnot` not of type

Collection operators

When you use the previous operators with a single value, the result is `$true` or `$false`. This is handled slightly differently when working with a collection. Each item in the collection gets evaluated and the operator returns every value that evaluates to `$true`.

PowerShell

```powershell
PS> 1,2,3,4 -eq 3
3
```

This still works correctly in a `if` statement. So a value is returned by your operator, then the whole statement is `$true`.

PowerShell

```powershell
$array = 1..6
if ( $array -gt 3 )
{
```

```
    # do something
}
```

There's one small trap hiding in the details here that I need to point out. When using the `-ne` operator this way, it's easy to mistakenly look at the logic backwards. Using `-ne` with a collection returns `$true` if any item in the collection doesn't match your value.

PowerShell

```
PS> 1,2,3 -ne 4
1
2
3
```

This may look like a clever trick, but we have operators `-contains` and `-in` that handle this more efficiently. And `-notcontains` does what you expect.

-contains

The `-contains` operator checks the collection for your value. As soon as it finds a match, it returns `$true`.

PowerShell

```
$array = 1..6
if ( $array -contains 3 )
{
    # do something
}
```

This is the preferred way to see if a collection contains your value. Using `Where-Object` (or `-eq`) walks the entire list every time and is significantly slower.

Variations:

- `-contains` case-insensitive match
- `-icontains` case-insensitive match
- `-ccontains` case-sensitive match
- `-notcontains` case-insensitive not matched
- `-inotcontains` case-insensitive not matched
- `-cnotcontains` case-sensitive not matched

-in

The `-in` operator is just like the `-contains` operator except the collection is on the right-hand side.

PowerShell

```
$array = 1..6
if ( 3 -in $array )
{
    # do something
}
```

Variations:

- `-in` case-insensitive match
- `-iin` case-insensitive match
- `-cin` case-sensitive match
- `-notin` case-insensitive not matched
- `-inotin` case-insensitive not matched
- `-cnotin` case-sensitive not matched

Logical operators

Logical operators are used to invert or combine other expressions.

-not

The `-not` operator flips an expression from `$false` to `$true` or from `$true` to `$false`. Here is an example where we want to perform an action when `Test-Path` is `$false`.

PowerShell

```
if ( -not ( Test-Path -Path $path ) )
```

Most of the operators we talked about do have a variation where you do not need to use the `-not` operator. But there are still times it is useful.

! operator

You can use `!` as an alias for `-not`.

PowerShell

```
if ( -not $value ){}
if ( !$value ){}
```

You may see `!` used more by people that come from another languages like C#. I prefer to type it out because I find it hard to see when quickly looking at my scripts.

-and

You can combine expressions with the `-and` operator. When you do that, both sides need to be `$true` for the whole expression to be `$true`.

PowerShell

```
if ( ($age -gt 13) -and ($age -lt 55) )
```

In that example, `$age` must be 13 or older for the left side and less than 55 for the right side. I added extra parentheses to make it clearer in that example but they're optional as long as the expression is simple. Here is the same example without them.

PowerShell

```
if ( $age -gt 13 -and $age -lt 55 )
```

Evaluation happens from left to right. If the first item evaluates to `$false`, it exits early and doesn't perform the right comparison. This is handy when you need to make sure a value exists before you use it. For example, `Test-Path` throws an error if you give it a `$null` path.

PowerShell

```
if ( $null -ne $path -and (Test-Path -Path $path) )
```

-or

The `-or` allows for you to specify two expressions and returns `$true` if either one of them is `$true`.

PowerShell

```
if ( $age -le 13 -or $age -ge 55 )
```

Just like with the `-and` operator, the evaluation happens from left to right. Except that if the first part is `$true`, then the whole statement is `$true` and it doesn't process the rest of the expression.

Also make note of how the syntax works for these operators. You need two separate expressions. I have seen users try to do something like this `$value -eq 5 -or 6` without realizing their mistake.

-xor exclusive or

This one is a little unusual. `-xor` allows only one expression to evaluate to `$true`. So if both items are `$false` or both items are `$true`, then the whole expression is `$false`. Another way to look at this is the expression is only `$true` when the results of the expression are different.

It's rare that anyone would ever use this logical operator and I can't think up a good example as to why I would ever use it.

Bitwise operators

Bitwise operators perform calculations on the bits within the values and produce a new value as the result. Teaching bitwise operators is beyond the scope of this article, but here is the list the them.

- `-band` binary AND
- `-bor` binary OR
- `-bxor` binary exclusive OR
- `-bnot` binary NOT
- `-shl` shift left
- `-shr` shift right

PowerShell expressions

We can use normal PowerShell inside the condition statement.

PowerShell

```
if ( Test-Path -Path $Path )
```

`Test-Path` returns `$true` or `$false` when it executes. This also applies to commands that return other values.

```powershell
if ( Get-Process Notepad* )
```

It evaluates to `$true` if there's a returned process and `$false` if there'sn'thing. It's perfectly valid to use pipeline expressions or other PowerShell statements like this:

```powershell
if ( Get-Process | Where Name -eq Notepad )
```

These expressions can be combined with each other with the `-and` and `-or` operators, but you may have to use parenthesis to break them into subexpressions.

```powershell
if ( (Get-Process) -and (Get-Service) )
```

Checking for $null

Having a no result or a `$null` value evaluates to `$false` in the `if` statement. When checking specifically for `$null`, it's a best practice to place the `$null` on the left-hand side.

```powershell
if ( $null -eq $value )
```

There are quite a few nuances when dealing with `$null` values in PowerShell. If you're interested in diving deeper, I have an article about everything you wanted to know about $null.

Variable assignment within the condition

I almost forgot to add this one until Prasoon Karunan V reminded me of it.

```powershell
```

```
if ($process=Get-Process notepad -ErrorAction ignore) {$process} else
{$false}
```

Normally when you assign a value to a variable, the value isn't passed onto the pipeline or console. When you do a variable assignment in a sub expression, it does get passed on to the pipeline.

PowerShell

```
PS> $first = 1
PS> ($second = 2)
2
```

See how the `$first` assignment has no output and the `$second` assignment does? When an assignment is done in an `if` statement, it executes just like the `$second` assignment above. Here is a clean example on how you could use it:

PowerShell

```
if ( $process = Get-Process Notepad* )
{
    $process | Stop-Process
}
```

If `$process` gets assigned a value, then the statement is `$true` and `$process` gets stopped.

Make sure you don't confuse this with `-eq` because this isn't an equality check. This is a more obscure feature that most people don't realize works this way.

Variable assignment from the scriptblock

You can also use the `if` statement scriptblock to assign a value to a variable.

PowerShell

```
$discount = if ( $age -ge 55 )
{
    Get-SeniorDiscount
}
elseif ( $age -le 13 )
{
    Get-ChildDiscount
}
```

```
else
{
    0.00
}
```

Each script block is writing the results of the commands, or the value, as output. We can assign the result of the `if` statement to the `$discount` variable. That example could have just as easily assigned those values to the `$discount` variable directly in each scriptblock. I can't say that I use this with the `if` statement often, but I do have an example where I used this recently.

Alternate execution path

The `if` statement allows you to specify an action for not only when the statement is `$true`, but also for when it's `$false`. This is where the `else` statement comes into play.

else

The `else` statement is always the last part of the `if` statement when used.

PowerShell

```
if ( Test-Path -Path $Path -PathType Leaf )
{
    Move-Item -Path $Path -Destination $archivePath
}
else
{
    Write-Warning "$path doesn't exist or isn't a file."
}
```

In this example, we check the `$path` to make sure it's a file. If we find the file, we move it. If not, we write a warning. This type of branching logic is very common.

Nested if

The `if` and `else` statements take a script block, so we can place any PowerShell command inside them, including another `if` statement. This allows you to make use of much more complicated logic.

PowerShell

```
if ( Test-Path -Path $Path -PathType Leaf )
{
    Move-Item -Path $Path -Destination $archivePath
}
else
{
    if ( Test-Path -Path $Path )
    {
        Write-Warning "A file was required but a directory was found
instead."
    }
    else
    {
        Write-Warning "$path could not be found."
    }
}
```

In this example, we test the happy path first and then take action on it. If that fails, we do another check and to provide more detailed information to the user.

elseif

We aren't limited to just a single conditional check. We can chain `if` and `else` statements together instead of nesting them by using the `elseif` statement.

PowerShell

```
if ( Test-Path -Path $Path -PathType Leaf )
{
    Move-Item -Path $Path -Destination $archivePath
}
elseif ( Test-Path -Path $Path )
{
    Write-Warning "A file was required but a directory was found instead."
}
else
{
    Write-Warning "$path could not be found."
}
```

The execution happens from the top to the bottom. The top `if` statement is evaluated first. If that is `$false`, then it moves down to the next `elseif` or `else` in the list. That last `else` is the default action to take if none of the others return `$true`.

switch

At this point, I need to mention the `switch` statement. It provides an alternate syntax for doing multiple comparisons with a value. With the `switch`, you specify an expression and that result gets compared with several different values. If one of those values match, the matching code block is executed. Take a look at this example:

PowerShell

```
$itemType = 'Role'
switch ( $itemType )
{
    'Component'
    {
        'is a component'
    }
    'Role'
    {
        'is a role'
    }
    'Location'
    {
        'is a location'
    }
}
```

There three possible values that can match the `$itemType`. In this case, it matches with `Role`. I used a simple example just to give you some exposure to the `switch` operator. I talk more about everything you ever wanted to know about the switch statement in another article.

Array inline

I have a function called Invoke-SnowSql that launches an executable with several command-line arguments. Here is a clip from that function where I build the array of arguments.

PowerShell

```
$snowSqlParam = @(
    '--accountname', $Endpoint
    '--username', $Credential.UserName
    '--option', 'exit_on_error=true'
    '--option', 'output_format=csv'
    '--option', 'friendly=false'
    '--option', 'timing=false'
    if ($Debug)
    {
        '--option', 'log_level=DEBUG'
    }
```

```
    if ($Path)
    {
        '--filename', $Path
    }
    else
    {
        '--query', $singleLineQuery
    }
)
```

The `$Debug` and `$Path` variables are parameters on the function that are provided by the end user. I evaluate them inline inside the initialization of my array. If `$Debug` is true, then those values fall into the `$snowSqlParam` in the correct place. Same holds true for the `$Path` variable.

Simplify complex operations

It's inevitable that you run into a situation that has way too many comparisons to check and your `If` statement scrolls way off the right side of the screen.

PowerShell

```
$user = Get-ADUser -Identity $UserName
if ( $null -ne $user -and $user.Department -eq 'Finance' -and $user.Title -
match 'Senior' -and $user.HomeDrive -notlike '\\server\*' )
{
    # Do Something
}
```

They can be hard to read and that make you more prone to make mistakes. There are a few things we can do about that.

Line continuation

There some operators in PowerShell that let you wrap you command to the next line. The logical operators `-and` and `-or` are good operators to use if you want to break your expression into multiple lines.

PowerShell

```
if ($null -ne $user -and
    $user.Department -eq 'Finance' -and
    $user.Title -match 'Senior' -and
    $user.HomeDrive -notlike '\\server\*'
)
```

```
{
    # Do Something
}
```

There's still a lot going on there, but placing each piece on its own line makes a big difference. I generally use this when I get more than two comparisons or if I have to scroll to the right to read any of the logic.

Pre-calculating results

We can take that statement out of the `if` statement and only check the result.

PowerShell

```
$needsSecureHomeDrive = $null -ne $user -and
    $user.Department -eq 'Finance' -and
    $user.Title -match 'Senior' -and
    $user.HomeDrive -notlike '\\server\*'

if ( $needsSecureHomeDrive )
{
    # Do Something
}
```

This just feels much cleaner than the previous example. You also are given an opportunity to use a variable name that explains what it's that you're really checking. This is also and example of self-documenting code that saves unnecessary comments.

Multiple if statements

We can break this up into multiple statements and check them one at a time. In this case, we use a flag or a tracking variable to combine the results.

PowerShell

```
$skipUser = $false

if( $null -eq $user )
{
    $skipUser = $true
}

if( $user.Department -ne 'Finance' )
{
    Write-Verbose "isn't in Finance department"
    $skipUser = $true
```

```
}

if( $user.Title -match 'Senior' )
{
    Write-Verbose "Doesn't have Senior title"
    $skipUser = $true
}

if( $user.HomeDrive -like '\\server\*' )
{
    Write-Verbose "Home drive already configured"
    $skipUser = $true
}

if ( -not $skipUser )
{
    # do something
}
```

I did have to invert the logic to make the flag logic work correctly. Each evaluation is an individual `if` statement. The advantage of this is that when you're debugging, you can tell exactly what the logic is doing. I was able to add much better verbosity at the same time.

The obvious downside is that it's so much more code to write. The code is more complex to look at as it takes a single line of logic and explodes it into 25 or more lines.

Using functions

We can also move all that validation logic into a function. Look at how clean this looks at a glance.

PowerShell

```
if ( Test-SecureDriveConfiguration -ADUser $user )
{
    # do something
}
```

You still have to create the function to do the validation, but it makes this code much easier to work with. It makes this code easier to test. In your tests, you can mock the call to `Test-ADDriveConfiguration` and you only need two tests for this function. One where it returns `$true` and one where it returns `$false`. Testing the other function is simpler because it's so small.

The body of that function could still be that one-liner we started with or the exploded logic that we used in the last section. This works well for both scenarios and allows you to easily change that implementation later.

Error handling

One important use of the `if` statement is to check for error conditions before you run into errors. A good example is to check if a folder already exists before you try to create it.

PowerShell

```
if ( -not (Test-Path -Path $folder) )
{
    New-Item -Type Directory -Path $folder
}
```

I like to say that if you expect an exception to happen, then it's not really an exception. So check your values and validate your conditions where you can.

If you want to dive a little more into actual exception handling, I have an article on everything you ever wanted to know about exceptions.

Final words

The `if` statement is such a simple statement but is a fundamental piece of PowerShell. You will find yourself using this multiple times in almost every script you write. I hope you have a better understanding than you had before.

Everything you ever wanted to know about the switch statement

Article • 11/17/2022

Like many other languages, PowerShell has commands for controlling the flow of execution within your scripts. One of those statements is the switch statement and in PowerShell, it offers features that aren't found in other languages. Today, we take a deep dive into working with the PowerShell `switch`.

> **Note**
>
> The **original version** of this article appeared on the blog written by **@KevinMarquette**. The PowerShell team thanks Kevin for sharing this content with us. Please check out his blog at **PowerShellExplained.com**.

The `if` statement

One of the first statements that you learn is the `if` statement. It lets you execute a script block if a statement is `$true`.

PowerShell

```
if ( Test-Path $Path )
{
    Remove-Item $Path
}
```

You can have much more complicated logic using `elseif` and `else` statements. Here is an example where I have a numeric value for day of the week and I want to get the name as a string.

PowerShell

```
$day = 3

if ( $day -eq 0 ) { $result = 'Sunday'    }
elseif ( $day -eq 1 ) { $result = 'Monday'    }
elseif ( $day -eq 2 ) { $result = 'Tuesday'   }
elseif ( $day -eq 3 ) { $result = 'Wednesday' }
elseif ( $day -eq 4 ) { $result = 'Thursday'  }
elseif ( $day -eq 5 ) { $result = 'Friday'    }
```

```
elseif ( $day -eq 6 ) { $result = 'Saturday'  }

$result
```

Output

```
Wednesday
```

It turns out that this is a common pattern and there are many ways to deal with this. One of them is with a `switch`.

Switch statement

The `switch` statement allows you to provide a variable and a list of possible values. If the value matches the variable, then its scriptblock is executed.

PowerShell

```
$day = 3

switch ( $day )
{
    0 { $result = 'Sunday'    }
    1 { $result = 'Monday'    }
    2 { $result = 'Tuesday'   }
    3 { $result = 'Wednesday' }
    4 { $result = 'Thursday'  }
    5 { $result = 'Friday'    }
    6 { $result = 'Saturday'  }
}

$result
```

Output

```
'Wednesday'
```

For this example, the value of `$day` matches one of the numeric values, then the correct name is assigned to `$result`. We're only doing a variable assignment in this example, but any PowerShell can be executed in those script blocks.

Assign to a variable

We can write that last example in another way.

PowerShell

```
$result = switch ( $day )
{
    0 { 'Sunday'    }
    1 { 'Monday'    }
    2 { 'Tuesday'   }
    3 { 'Wednesday' }
    4 { 'Thursday'  }
    5 { 'Friday'    }
    6 { 'Saturday'  }
}
```

We're placing the value on the PowerShell pipeline and assigning it to the `$result`. You can do this same thing with the `if` and `foreach` statements.

Default

We can use the `default` keyword to identify the what should happen if there is no match.

PowerShell

```
$result = switch ( $day )
{
    0 { 'Sunday' }
    # ...
    6 { 'Saturday' }
    default { 'Unknown' }
}
```

Here we return the value `Unknown` in the default case.

Strings

I was matching numbers in those last examples, but you can also match strings.

PowerShell

```
$item = 'Role'

switch ( $item )
{
    Component
    {
        'is a component'
    }
```

```
    Role
    {
        'is a role'
    }
    Location
    {
        'is a location'
    }
}
```

Output

```
is a role
```

I decided not to wrap the `Component`,`Role` and `Location` matches in quotes here to highlight that they're optional. The `switch` treats those as a string in most cases.

Arrays

One of the cool features of the PowerShell `switch` is the way it handles arrays. If you give a `switch` an array, it processes each element in that collection.

PowerShell

```
$roles = @('WEB','Database')

switch ( $roles ) {
    'Database'   { 'Configure SQL' }
    'WEB'        { 'Configure IIS' }
    'FileServer' { 'Configure Share' }
}
```

Output

```
Configure IIS
Configure SQL
```

If you have repeated items in your array, then they're matched multiple times by the appropriate section.

PSItem

You can use the `$PSItem` or `$_` to reference the current item that was processed. When we do a simple match, `$PSItem` is the value that we're matching. I'll be performing some

advanced matches in the next section where this variable is used.

Parameters

A unique feature of the PowerShell `switch` is that it has a number of switch parameters that change how it performs.

-CaseSensitive

The matches aren't case-sensitive by default. If you need to be case-sensitive, you can use `-CaseSensitive`. This can be used in combination with the other switch parameters.

-Wildcard

We can enable wildcard support with the `-wildcard` switch. This uses the same wildcard logic as the `-like` operator to do each match.

PowerShell

```
$Message = 'Warning, out of disk space'

switch -Wildcard ( $message )
{
    'Error*'
    {
        Write-Error -Message $Message
    }
    'Warning*'
    {
        Write-Warning -Message $Message
    }
    default
    {
        Write-Information $message
    }
}
```

Output

```
WARNING: Warning, out of disk space
```

Here we're processing a message and then outputting it on different streams based on the contents.

-Regex

The switch statement supports regex matches just like it does wildcards.

PowerShell

```powershell
switch -Regex ( $message )
{
    '^Error'
    {
        Write-Error -Message $Message
    }
    '^Warning'
    {
        Write-Warning -Message $Message
    }
    default
    {
        Write-Information $message
    }
}
```

I have more examples of using regex in another article I wrote: The many ways to use regex.

-File

A little known feature of the switch statement is that it can process a file with the `-File` parameter. You use `-file` with a path to a file instead of giving it a variable expression.

PowerShell

```powershell
switch -Wildcard -File $path
{
    'Error*'
    {
        Write-Error -Message $PSItem
    }
    'Warning*'
    {
        Write-Warning -Message $PSItem
    }
    default
    {
        Write-Output $PSItem
    }
}
```

It works just like processing an array. In this example, I combine it with wildcard matching and make use of the `$PSItem`. This would process a log file and convert it to warning and error messages depending on the regex matches.

Advanced details

Now that you're aware of all these documented features, we can use them in the context of more advanced processing.

Expressions

The `switch` can be on an expression instead of a variable.

PowerShell

```
switch ( ( Get-Service | Where status -eq 'running' ).name ) {...}
```

Whatever the expression evaluates to is the value used for the match.

Multiple matches

You may have already picked up on this, but a `switch` can match to multiple conditions. This is especially true when using `-wildcard` or `-regex` matches. You can add the same condition multiple times and all are triggered.

PowerShell

```
switch ( 'Word' )
{
    'word' { 'lower case word match' }
    'Word' { 'mixed case word match' }
    'WORD' { 'upper case word match' }
}
```

Output

```
lower case word match
mixed case word match
upper case word match
```

All three of these statements are fired. This shows that every condition is checked (in order). This holds true for processing arrays where each item checks each condition.

Continue

Normally, this is where I would introduce the `break` statement, but it's better that we learn how to use `continue` first. Just like with a `foreach` loop, `continue` continues onto the next item in the collection or exits the `switch` if there are no more items. We can rewrite that last example with continue statements so that only one statement executes.

PowerShell

```
switch ( 'Word' )
{
    'word'
    {
        'lower case word match'
        continue
    }
    'Word'
    {
        'mixed case word match'
        continue
    }
    'WORD'
    {
        'upper case word match'
        continue
    }
}
```

Output

```
lower case word match
```

Instead of matching all three items, the first one is matched and the switch continues to the next value. Because there are no values left to process, the switch exits. This next example is showing how a wildcard could match multiple items.

PowerShell

```
switch -Wildcard -File $path
{
    '*Error*'
    {
        Write-Error -Message $PSItem
        continue
    }
    '*Warning*'
    {
        Write-Warning -Message $PSItem
```

```
        continue
    }
    default
    {
        Write-Output $PSItem
    }
}
```

Because a line in the input file could contain both the word `Error` and `Warning`, we only want the first one to execute and then continue processing the file.

Break

A `break` statement exits the switch. This is the same behavior that `continue` presents for single values. The difference is shown when processing an array. `break` stops all processing in the switch and `continue` moves onto the next item.

PowerShell

```
$Messages = @(
    'Downloading update'
    'Ran into errors downloading file'
    'Error: out of disk space'
    'Sending email'
    '...'
)

switch -Wildcard ($Messages)
{
    'Error*'
    {
        Write-Error -Message $PSItem
        break
    }
    '*Error*'
    {
        Write-Warning -Message $PSItem
        continue
    }
    '*Warning*'
    {
        Write-Warning -Message $PSItem
        continue
    }
    default
    {
        Write-Output $PSItem
    }
}
```

Output

```
Downloading update
WARNING: Ran into errors downloading file
write-error -message $PSItem : Error: out of disk space
+ CategoryInfo          : NotSpecified: (:) [Write-Error],
WriteErrorException
+ FullyQualifiedErrorId : Microsoft.PowerShell.Commands.WriteErrorException
```

In this case, if we hit any lines that start with `Error` then we get an error and the switch stops. This is what that `break` statement is doing for us. If we find `Error` inside the string and not just at the beginning, we write it as a warning. We do the same thing for `Warning`. It's possible that a line could have both the word `Error` and `Warning`, but we only need one to process. This is what the `continue` statement is doing for us.

Break labels

The `switch` statement supports `break/continue` labels just like `foreach`.

PowerShell

```
:filelist foreach($path in $logs)
{
    :logFile switch -Wildcard -File $path
    {
        'Error*'
        {
            Write-Error -Message $PSItem
            break filelist
        }
        'Warning*'
        {
            Write-Error -Message $PSItem
            break logFile
        }
        default
        {
            Write-Output $PSItem
        }
    }
}
```

I personally don't like the use of break labels but I wanted to point them out because they're confusing if you've never seen them before. When you have multiple `switch` or `foreach` statements that are nested, you may want to break out of more than the inner most item. You can place a label on a `switch` that can be the target of your `break`.

Enum

PowerShell 5.0 gave us enums and we can use them in a switch.

PowerShell

```
enum Context {
    Component
    Role
    Location
}

$item = [Context]::Role

switch ( $item )
{
    Component
    {
        'is a component'
    }
    Role
    {
        'is a role'
    }
    Location
    {
        'is a location'
    }
}
```

Output

```
is a role
```

If you want to keep everything as strongly typed enums, then you can place them in parentheses.

PowerShell

```
switch ($item )
{
    ([Context]::Component)
    {
        'is a component'
    }
    ([Context]::Role)
    {
        'is a role'
    }
    ([Context]::Location)
```

```
    {
        'is a location'
    }
}
```

The parentheses are needed here so that the switch doesn't treat the value `[Context]::Location` as a literal string.

ScriptBlock

We can use a scriptblock to perform the evaluation for a match if needed.

PowerShell

```
$age = 37

switch ( $age )
{
    {$PSItem -le 18}
    {
        'child'
    }
    {$PSItem -gt 18}
    {
        'adult'
    }
}
```

Output

```
'adult'
```

This adds complexity and can make your `switch` hard to read. In most cases where you would use something like this it would be better to use `if` and `elseif` statements. I would consider using this if I already had a large switch in place and I needed two items to hit the same evaluation block.

One thing that I think helps with legibility is to place the scriptblock in parentheses.

PowerShell

```
switch ( $age )
{
    ({$PSItem -le 18})
    {
        'child'
    }
```

```
    ({$PSItem -gt 18})
    {
        'adult'
    }
}
```

It still executes the same way and gives a better visual break when quickly looking at it.

Regex $matches

We need to revisit regex to touch on something that isn't immediately obvious. The use of regex populates the `$matches` variable. I do go into the use of `$matches` more when I talk about The many ways to use regex. Here is a quick sample to show it in action with named matches.

PowerShell

```
$message = 'my ssn is 123-23-3456 and credit card: 1234-5678-1234-5678'

switch -regex ($message)
{
    '(?<SSN>\d\d\d-\d\d-\d\d\d\d)'
    {
        Write-Warning "message contains a SSN: $($matches.SSN)"
    }
    '(?<CC>\d\d\d\d-\d\d\d\d-\d\d\d\d-\d\d\d\d)'
    {
        Write-Warning "message contains a credit card number:
$($matches.CC)"
    }
    '(?<Phone>\d\d\d-\d\d\d-\d\d\d\d)'
    {
        Write-Warning "message contains a phone number: $($matches.Phone)"
    }
}
```

Output

```
WARNING: message may contain a SSN: 123-23-3456
WARNING: message may contain a credit card number: 1234-5678-1234-5678
```

$null

You can match a `$null` value that doesn't have to be the default.

PowerShell

```
$values = '', 5, $null
switch ( $values )
{
    $null          { "Value '$_' is `$null" }
    { '' -eq $_ }  { "Value '$_' is an empty string" }
    default        { "Value [$_] isn't an empty string or `$null" }
}
```

Output

```
Value '' is an empty string
Value [5] isn't an empty string or $null
Value '' is $null
```

When testing for an empty string in a `switch` statement, it's important to use the comparison statement as shown in this example instead of the raw value `''`. In a `switch` statement, the raw value `''` also matches `$null`. For example:

PowerShell

```
$values = '', 5, $null
switch ( $values )
{
    $null          { "Value '$_' is `$null" }
    ''             { "Value '$_' is an empty string" }
    default        { "Value [$_] isn't an empty string or `$null" }
}
```

Output

```
Value '' is an empty string
Value [5] isn't an empty string or $null
Value '' is $null
Value '' is an empty string
```

Also, be careful with empty returns from cmdlets. Cmdlets or pipelines that have no output are treated as an empty array that doesn't match anything, including the `default` case.

PowerShell

```
$file = Get-ChildItem NonExistantFile*
switch ( $file )
{
    $null   { '$file is $null' }
    default { "`$file is type $($file.GetType().Name)" }
```

```
}
# No matches
```

Constant expression

Lee Dailey pointed out that we can use a constant `$true` expression to evaluate `[bool]` items. Imagine if we have several boolean checks that need to happen.

PowerShell

```powershell
$isVisible = $false
$isEnabled = $true
$isSecure = $true

switch ( $true )
{
    $isEnabled
    {
        'Do-Action'
    }
    $isVisible
    {
        'Show-Animation'
    }
    $isSecure
    {
        'Enable-AdminMenu'
    }
}
```

Output

```
Do-Action
Enabled-AdminMenu
```

This is a clean way to evaluate and take action on the status of several boolean fields. The cool thing about this is that you can have one match flip the status of a value that hasn't been evaluated yet.

PowerShell

```powershell
$isVisible = $false
$isEnabled = $true
$isAdmin = $false

switch ( $true )
{
    $isEnabled
```

```
    {
        'Do-Action'
        $isVisible = $true
    }
    $isVisible
    {
        'Show-Animation'
    }
    $isAdmin
    {
        'Enable-AdminMenu'
    }
}
```

Output

```
Do-Action
Show-Animation
```

Setting `$isEnabled` to `$true` in this example makes sure that `$isVisible` is also set to `$true`. Then when `$isVisible` gets evaluated, its scriptblock is invoked. This is a bit counter-intuitive but is a clever use of the mechanics.

$switch automatic variable

When the `switch` is processing its values, it creates an enumerator and calls it `$switch`. This is an automatic variable created by PowerShell and you can manipulate it directly.

PowerShell

```
$a = 1, 2, 3, 4

switch($a) {
    1 { [void]$switch.MoveNext(); $switch.Current }
    3 { [void]$switch.MoveNext(); $switch.Current }
}
```

This gives you the results of:

Output

```
2
4
```

By moving the enumerator forward, the next item doesn't get processed by the `switch` but you can access that value directly. I would call it madness.

Other patterns

Hashtables

One of my most popular posts is the one I did on hashtables. One of the use cases for a `hashtable` is to be a lookup table. That's an alternate approach to a common pattern that a `switch` statement is often addressing.

PowerShell

```
$day = 3

$lookup = @{
    0 = 'Sunday'
    1 = 'Monday'
    2 = 'Tuesday'
    3 = 'Wednesday'
    4 = 'Thursday'
    5 = 'Friday'
    6 = 'Saturday'
}

$lookup[$day]
```

Output

```
Wednesday
```

If I'm only using a `switch` as a lookup, I often use a `hashtable` instead.

Enum

PowerShell 5.0 introduced the `Enum` and it's also an option in this case.

PowerShell

```
$day = 3

enum DayOfTheWeek {
    Sunday
    Monday
    Tuesday
    Wednesday
    Thursday
    Friday
    Saturday
```

```
}

[DayOfTheWeek]$day
```

Output

```
Wednesday
```

We could go all day looking at different ways to solve this problem. I just wanted to make sure you knew you had options.

Final words

The switch statement is simple on the surface but it offers some advanced features that most people don't realize are available. Stringing those features together makes this a powerful feature. I hope you learned something that you had not realized before.

Everything you wanted to know about exceptions

Article • 11/17/2022

Error handling is just part of life when it comes to writing code. We can often check and validate conditions for expected behavior. When the unexpected happens, we turn to exception handling. You can easily handle exceptions generated by other people's code or you can generate your own exceptions for others to handle.

> **Note**
>
> The **original version** of this article appeared on the blog written by **@KevinMarquette**. The PowerShell team thanks Kevin for sharing this content with us. Please check out his blog at **PowerShellExplained.com**.

Basic terminology

We need to cover some basic terms before we jump into this one.

Exception

An Exception is like an event that is created when normal error handling can't deal with the issue. Trying to divide a number by zero or running out of memory are examples of something that creates an exception. Sometimes the author of the code you're using creates exceptions for certain issues when they happen.

Throw and Catch

When an exception happens, we say that an exception is thrown. To handle a thrown exception, you need to catch it. If an exception is thrown and it isn't caught by something, the script stops executing.

The call stack

The call stack is the list of functions that have called each other. When a function is called, it gets added to the stack or the top of the list. When the function exits or returns, it is removed from the stack.

When an exception is thrown, that call stack is checked in order for an exception handler to catch it.

Terminating and non-terminating errors

An exception is generally a terminating error. A thrown exception is either be caught or it terminates the current execution. By default, a non-terminating error is generated by `Write-Error` and it adds an error to the output stream without throwing an exception.

I point this out because `Write-Error` and other non-terminating errors do not trigger the `catch`.

Swallowing an exception

This is when you catch an error just to suppress it. Do this with caution because it can make troubleshooting issues very difficult.

Basic command syntax

Here is a quick overview of the basic exception handling syntax used in PowerShell.

Throw

To create our own exception event, we throw an exception with the `throw` keyword.

PowerShell

```
function Start-Something
{
    throw "Bad thing happened"
}
```

This creates a runtime exception that is a terminating error. It's handled by a `catch` in a calling function or exits the script with a message like this.

PowerShell

```
PS> Start-Something

Bad thing happened
At line:1 char:1
+ throw "Bad thing happened"
+ ~~~~~~~~~~~~~~~~~~~~~~~~~~
```

```
    + CategoryInfo          : OperationStopped: (Bad thing happened:String)
[], RuntimeException
    + FullyQualifiedErrorId : Bad thing happened
```

Write-Error -ErrorAction Stop

I mentioned that `Write-Error` doesn't throw a terminating error by default. If you specify `-ErrorAction Stop`, `Write-Error` generates a terminating error that can be handled with a `catch`.

PowerShell

```
Write-Error -Message "Houston, we have a problem." -ErrorAction Stop
```

Thank you to Lee Dailey for reminding about using `-ErrorAction Stop` this way.

Cmdlet -ErrorAction Stop

If you specify `-ErrorAction Stop` on any advanced function or cmdlet, it turns all `Write-Error` statements into terminating errors that stop execution or that can be handled by a `catch`.

PowerShell

```
Start-Something -ErrorAction Stop
```

Try/Catch

The way exception handling works in PowerShell (and many other languages) is that you first `try` a section of code and if it throws an error, you can `catch` it. Here is a quick sample.

PowerShell

```
try
{
    Start-Something
}
catch
{
    Write-Output "Something threw an exception"
    Write-Output $_
}
```

```
try
{
    Start-Something -ErrorAction Stop
}
catch
{
    Write-Output "Something threw an exception or used Write-Error"
    Write-Output $_
}
```

The `catch` script only runs if there's a terminating error. If the `try` executes correctly, then it skips over the `catch`. You can access the exception information in the `catch` block using the `$_` variable.

Try/Finally

Sometimes you don't need to handle an error but still need some code to execute if an exception happens or not. A `finally` script does exactly that.

Take a look at this example:

PowerShell

```
$command = [System.Data.SqlClient.SqlCommand]::New(queryString, connection)
$command.Connection.Open()
$command.ExecuteNonQuery()
$command.Connection.Close()
```

Anytime you open or connect to a resource, you should close it. If the `ExecuteNonQuery()` throws an exception, the connection isn't closed. Here is the same code inside a `try/finally` block.

PowerShell

```
$command = [System.Data.SqlClient.SqlCommand]::New(queryString, connection)
try
{
    $command.Connection.Open()
    $command.ExecuteNonQuery()
}
finally
{
    $command.Connection.Close()
}
```

In this example, the connection is closed if there's an error. It also is closed if there's no error. The `finally` script runs every time.

Because you're not catching the exception, it still gets propagated up the call stack.

Try/Catch/Finally

It's perfectly valid to use `catch` and `finally` together. Most of the time you'll use one or the other, but you may find scenarios where you use both.

$PSItem

Now that we got the basics out of the way, we can dig a little deeper.

Inside the `catch` block, there's an automatic variable (`$PSItem` or `$_`) of type `ErrorRecord` that contains the details about the exception. Here is a quick overview of some of the key properties.

For these examples, I used an invalid path in `ReadAllText` to generate this exception.

PowerShell

```
[System.IO.File]::ReadAllText( '\\test\no\filefound.log')
```

PSItem.ToString()

This gives you the cleanest message to use in logging and general output. `ToString()` is automatically called if `$PSItem` is placed inside a string.

PowerShell

```
catch
{
    Write-Output "Ran into an issue: $($PSItem.ToString())"
}

catch
{
    Write-Output "Ran into an issue: $PSItem"
}
```

$PSItem.InvocationInfo

This property contains additional information collected by PowerShell about the function or script where the exception was thrown. Here is the `InvocationInfo` from the sample exception that I created.

PowerShell

```
PS> $PSItem.InvocationInfo | Format-List *

MyCommand             : Get-Resource
BoundParameters       : {}
UnboundArguments      : {}
ScriptLineNumber      : 5
OffsetInLine          : 5
ScriptName            : C:\blog\throwerror.ps1
Line                  :     Get-Resource
PositionMessage       : At C:\blog\throwerror.ps1:5 char:5
                        +     Get-Resource
                        +     ~~~~~~~~~~~~
PSScriptRoot          : C:\blog
PSCommandPath         : C:\blog\throwerror.ps1
InvocationName        : Get-Resource
```

The important details here show the `ScriptName`, the `Line` of code and the `ScriptLineNumber` where the invocation started.

$PSItem.ScriptStackTrace

This property shows the order of function calls that got you to the code where the exception was generated.

PowerShell

```
PS> $PSItem.ScriptStackTrace
at Get-Resource, C:\blog\throwerror.ps1: line 13
at Start-Something, C:\blog\throwerror.ps1: line 5
at <ScriptBlock>, C:\blog\throwerror.ps1: line 18
```

I'm only making calls to functions in the same script but this would track the calls if multiple scripts were involved.

$PSItem.Exception

This is the actual exception that was thrown.

$PSItem.Exception.Message

This is the general message that describes the exception and is a good starting point when troubleshooting. Most exceptions have a default message but can also be set to something custom when the exception is thrown.

PowerShell

```
PS> $PSItem.Exception.Message

Exception calling "ReadAllText" with "1" argument(s): "The network path was
not found."
```

This is also the message returned when calling `$PSItem.ToString()` if there was not one set on the `ErrorRecord`.

$PSItem.Exception.InnerException

Exceptions can contain inner exceptions. This is often the case when the code you're calling catches an exception and throws a different exception. The original exception is placed inside the new exception.

PowerShell

```
PS> $PSItem.Exception.InnerExceptionMessage
The network path was not found.
```

I will revisit this later when I talk about re-throwing exceptions.

$PSItem.Exception.StackTrace

This is the `StackTrace` for the exception. I showed a `ScriptStackTrace` above, but this one is for the calls to managed code.

Output

```
at System.IO.FileStream.Init(String path, FileMode mode, FileAccess access,
Int32 rights, Boolean
 useRights, FileShare share, Int32 bufferSize, FileOptions options,
SECURITY_ATTRIBUTES secAttrs,
 String msgPath, Boolean bFromProxy, Boolean useLongPath, Boolean checkHost)
at System.IO.FileStream..ctor(String path, FileMode mode, FileAccess access,
FileShare share, Int32
 bufferSize, FileOptions options, String msgPath, Boolean bFromProxy,
Boolean useLongPath, Boolean
 checkHost)
at System.IO.StreamReader..ctor(String path, Encoding encoding, Boolean
```

```
detectEncodingFromByteOrderMarks,
 Int32 bufferSize, Boolean checkHost)
at System.IO.File.InternalReadAllText(String path, Encoding encoding,
Boolean checkHost)
at CallSite.Target(Closure , CallSite , Type , String )
```

You only get this stack trace when the event is thrown from managed code. I'm calling a .NET framework function directly so that is all we can see in this example. Generally when you're looking at a stack trace, you're looking for where your code stops and the system calls begin.

Working with exceptions

There is more to exceptions than the basic syntax and exception properties.

Catching typed exceptions

You can be selective with the exceptions that you catch. Exceptions have a type and you can specify the type of exception you want to catch.

PowerShell

```powershell
try
{
    Start-Something -Path $path
}
catch [System.IO.FileNotFoundException]
{
    Write-Output "Could not find $path"
}
catch [System.IO.IOException]
{
        Write-Output "IO error with the file: $path"
}
```

The exception type is checked for each `catch` block until one is found that matches your exception. It's important to realize that exceptions can inherit from other exceptions. In the example above, `FileNotFoundException` inherits from `IOException`. So if the `IOException` was first, then it would get called instead. Only one catch block is invoked even if there are multiple matches.

If we had a `System.IO.PathTooLongException`, the `IOException` would match but if we had a `InsufficientMemoryException` then nothing would catch it and it would propagate up the stack.

Catch multiple types at once

It's possible to catch multiple exception types with the same `catch` statement.

PowerShell

```
try
{
    Start-Something -Path $path -ErrorAction Stop
}
catch [System.IO.DirectoryNotFoundException],
[System.IO.FileNotFoundException]
{
    Write-Output "The path or file was not found: [$path]"
}
catch [System.IO.IOException]
{
    Write-Output "IO error with the file: [$path]"
}
```

Thank you `/u/Sheppard_Ra` for suggesting this addition.

Throwing typed exceptions

You can throw typed exceptions in PowerShell. Instead of calling `throw` with a string:

PowerShell

```
throw "Could not find: $path"
```

Use an exception accelerator like this:

PowerShell

```
throw [System.IO.FileNotFoundException] "Could not find: $path"
```

But you have to specify a message when you do it that way.

You can also create a new instance of an exception to be thrown. The message is optional when you do this because the system has default messages for all built-in exceptions.

PowerShell

```
throw [System.IO.FileNotFoundException]::new()
throw [System.IO.FileNotFoundException]::new("Could not find path: $path")
```

If you're not using PowerShell 5.0 or higher, you must use the older `New-Object` approach.

PowerShell

```
throw (New-Object -TypeName System.IO.FileNotFoundException )
throw (New-Object -TypeName System.IO.FileNotFoundException -ArgumentList
"Could not find path: $path")
```

By using a typed exception, you (or others) can catch the exception by the type as mentioned in the previous section.

Write-Error -Exception

We can add these typed exceptions to `Write-Error` and we can still `catch` the errors by exception type. Use `Write-Error` like in these examples:

PowerShell

```
# with normal message
Write-Error -Message "Could not find path: $path" -Exception
([System.IO.FileNotFoundException]::new()) -ErrorAction Stop

# With message inside new exception
Write-Error -Exception ([System.IO.FileNotFoundException]::new("Could not
find path: $path")) -ErrorAction Stop

# Pre PS 5.0
Write-Error -Exception ([System.IO.FileNotFoundException]"Could not find
path: $path") -ErrorAction Stop

Write-Error -Message "Could not find path: $path" -Exception ( New-Object -
TypeName System.IO.FileNotFoundException ) -ErrorAction Stop
```

Then we can catch it like this:

PowerShell

```
catch [System.IO.FileNotFoundException]
{
    Write-Log $PSItem.ToString()
}
```

The big list of .NET exceptions

I compiled a master list with the help of the Reddit/r/PowerShell community that contains hundreds of .NET exceptions to complement this post.

- The big list of .NET exceptions

I start by searching that list for exceptions that feel like they would be a good fit for my situation. You should try to use exceptions in the base `System` namespace.

Exceptions are objects

If you start using a lot of typed exceptions, remember that they are objects. Different exceptions have different constructors and properties. If we look at the FileNotFoundException documentation for `System.IO.FileNotFoundException`, we see that we can pass in a message and a file path.

PowerShell

```
[System.IO.FileNotFoundException]::new("Could not find file", $path)
```

And it has a `FileName` property that exposes that file path.

PowerShell

```
catch [System.IO.FileNotFoundException]
{
    Write-Output $PSItem.Exception.FileName
}
```

You should consult the .NET documentation for other constructors and object properties.

Re-throwing an exception

If all you're going to do in your `catch` block is `throw` the same exception, then don't `catch` it. You should only `catch` an exception that you plan to handle or perform some action when it happens.

There are times where you want to perform an action on an exception but re-throw the exception so something downstream can deal with it. We could write a message or log the problem close to where we discover it but handle the issue further up the stack.

PowerShell

```
catch
{
    Write-Log $PSItem.ToString()
    throw $PSItem
}
```

Interestingly enough, we can call `throw` from within the `catch` and it re-throws the current exception.

PowerShell

```
catch
{
    Write-Log $PSItem.ToString()
    throw
}
```

We want to re-throw the exception to preserve the original execution information like source script and line number. If we throw a new exception at this point, it hides where the exception started.

Re-throwing a new exception

If you catch an exception but you want to throw a different one, then you should nest the original exception inside the new one. This allows someone down the stack to access it as the `$PSItem.Exception.InnerException`.

PowerShell

```
catch
{
    throw [System.MissingFieldException]::new('Could not access
field',$PSItem.Exception)
}
```

$PSCmdlet.ThrowTerminatingError()

The one thing that I don't like about using `throw` for raw exceptions is that the error message points at the `throw` statement and indicates that line is where the problem is.

Output

```
Unable to find the specified file.
At line:31 char:9
```

```
+         throw [System.IO.FileNotFoundException]::new()
+         ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
    + CategoryInfo          : OperationStopped: (:) [],
FileNotFoundException
    + FullyQualifiedErrorId : Unable to find the specified file.
```

Having the error message tell me that my script is broken because I called `throw` on line 31 is a bad message for users of your script to see. It doesn't tell them anything useful.

Dexter Dhami pointed out that I can use `ThrowTerminatingError()` to correct that.

PowerShell

```
$PSCmdlet.ThrowTerminatingError(
    [System.Management.Automation.ErrorRecord]::new(
        ([System.IO.FileNotFoundException]"Could not find $Path"),
        'My.ID',
        [System.Management.Automation.ErrorCategory]::OpenError,
        $MyObject
    )
)
```

If we assume that `ThrowTerminatingError()` was called inside a function called `Get-Resource`, then this is the error that we would see.

Output

```
Get-Resource : Could not find C:\Program Files (x86)\Reference
Assemblies\Microsoft\Framework\.NETPortable\v4.6\System.IO.xml
At line:6 char:5
+     Get-Resource -Path $Path
+     ~~~~~~~~~~~~
    + CategoryInfo          : OpenError: (:) [Get-Resource],
FileNotFoundException
    + FullyQualifiedErrorId : My.ID,Get-Resource
```

Do you see how it points to the `Get-Resource` function as the source of the problem? That tells the user something useful.

Because `$PSItem` is an `ErrorRecord`, we can also use `ThrowTerminatingError` this way to re-throw.

PowerShell

```
catch
{
    $PSCmdlet.ThrowTerminatingError($PSItem)
}
```

This changes the source of the error to the Cmdlet and hide the internals of your function from the users of your Cmdlet.

Try can create terminating errors

Kirk Munro points out that some exceptions are only terminating errors when executed inside a `try/catch` block. Here is the example he gave me that generates a divide by zero runtime exception.

PowerShell

```
function Start-Something { 1/(1-1) }
```

Then invoke it like this to see it generate the error and still output the message.

PowerShell

```
&{ Start-Something; Write-Output "We did it. Send Email" }
```

But by placing that same code inside a `try/catch`, we see something else happen.

PowerShell

```
try
{
    &{ Start-Something; Write-Output "We did it. Send Email" }
}
catch
{
    Write-Output "Notify Admin to fix error and send email"
}
```

We see the error become a terminating error and not output the first message. What I don't like about this one is that you can have this code in a function and it acts differently if someone is using a `try/catch`.

I have not ran into issues with this myself but it is corner case to be aware of.

$PSCmdlet.ThrowTerminatingError() inside try/catch

One nuance of `$PSCmdlet.ThrowTerminatingError()` is that it creates a terminating error within your Cmdlet but it turns into a non-terminating error after it leaves your Cmdlet.

This leaves the burden on the caller of your function to decide how to handle the error. They can turn it back into a terminating error by using `-ErrorAction Stop` or calling it from within a `try{...}catch{...}`.

Public function templates

One last take a way I had with my conversation with Kirk Munro was that he places a `try{...}catch{...}` around every `begin`, `process` and `end` block in all of his advanced functions. In those generic catch blocks, he has a single line using `$PSCmdlet.ThrowTerminatingError($PSItem)` to deal with all exceptions leaving his functions.

PowerShell

```
function Start-Something
{
    [CmdletBinding()]
    param()

    process
    {
        try
        {
            ...
        }
        catch
        {
            $PSCmdlet.ThrowTerminatingError($PSItem)
        }
    }
}
```

Because everything is in a `try` statement within his functions, everything acts consistently. This also gives clean errors to the end user that hides the internal code from the generated error.

Trap

I focused on the `try/catch` aspect of exceptions. But there's one legacy feature I need to mention before we wrap this up.

A `trap` is placed in a script or function to catch all exceptions that happen in that scope. When an exception happens, the code in the `trap` is executed and then the normal code continues. If multiple exceptions happen, then the trap is called over and over.

PowerShell

```powershell
trap
{
    Write-Log $PSItem.ToString()
}

throw [System.Exception]::new('first')
throw [System.Exception]::new('second')
throw [System.Exception]::new('third')
```

I personally never adopted this approach but I can see the value in admin or controller scripts that log any and all exceptions, then still continue to execute.

Closing remarks

Adding proper exception handling to your scripts not only make them more stable, but also makes it easier for you to troubleshoot those exceptions.

I spent a lot of time talking `throw` because it is a core concept when talking about exception handling. PowerShell also gave us `Write-Error` that handles all the situations where you would use `throw`. So don't think that you need to be using `throw` after reading this.

Now that I have taken the time to write about exception handling in this detail, I'm going to switch over to using `Write-Error -Stop` to generate errors in my code. I'm also going to take Kirk's advice and make `ThrowTerminatingError` my goto exception handler for every function.

Everything you wanted to know about $null

Article • 11/17/2022

The PowerShell `$null` often appears to be simple but it has a lot of nuances. Let's take a close look at `$null` so you know what happens when you unexpectedly run into a `$null` value.

> **Note**
>
> The **original version** of this article appeared on the blog written by **@KevinMarquette**. The PowerShell team thanks Kevin for sharing this content with us. Please check out his blog at **PowerShellExplained.com**.

What is NULL?

You can think of NULL as an unknown or empty value. A variable is NULL until you assign a value or an object to it. This can be important because there are some commands that require a value and generate errors if the value is NULL.

PowerShell $null

`$null` is an automatic variable in PowerShell used to represent NULL. You can assign it to variables, use it in comparisons and use it as a place holder for NULL in a collection.

PowerShell treats `$null` as an object with a value of NULL. This is different than what you may expect if you come from another language.

Examples of $null

Anytime you try to use a variable that you have not initialized, the value is `$null`. This is one of the most common ways that `$null` values sneak into your code.

PowerShell

```
PS> $null -eq $undefinedVariable
True
```

If you happen to mistype a variable name then PowerShell sees it as a different variable and the value is `$null`.

The other way you find `$null` values is when they come from other commands that don't give you any results.

PowerShell

```
PS> function Get-Nothing {}
PS> $value = Get-Nothing
PS> $null -eq $value
True
```

Impact of $null

`$null` values impact your code differently depending on where they show up.

In strings

If you use `$null` in a string, then it's a blank value (or empty string).

PowerShell

```
PS> $value = $null
PS> Write-Output "The value is $value"
The value is
```

This is one of the reasons that I like to place brackets around variables when using them in log messages. It's even more important to identify the edges of your variable values when the value is at the end of the string.

PowerShell

```
PS> $value = $null
PS> Write-Output "The value is [$value]"
The value is []
```

This makes empty strings and `$null` values easy to spot.

In numeric equation

When a `$null` value is used in a numeric equation then your results are invalid if they don't give an error. Sometimes the `$null` evaluates to `0` and other times it makes the whole result `$null`. Here is an example with multiplication that gives 0 or `$null` depending on the order of the values.

PowerShell

```
PS> $null * 5
PS> $null -eq ( $null * 5 )
True

PS> 5 * $null
0
PS> $null -eq ( 5 * $null )
False
```

In place of a collection

A collection allows you use an index to access values. If you try to index into a collection that is actually `null`, you get this error: `Cannot index into a null array`.

PowerShell

```
PS> $value = $null
PS> $value[10]
Cannot index into a null array.
At line:1 char:1
+ $value[10]
+ ~~~~~~~~~~
    + CategoryInfo          : InvalidOperation: (:) [], RuntimeException
    + FullyQualifiedErrorId : NullArray
```

If you have a collection but try to access an element that is not in the collection, you get a `$null` result.

PowerShell

```
$array = @( 'one','two','three' )
$null -eq $array[100]
True
```

In place of an object

If you try to access a property or sub property of an object that doesn't have the specified property, you get a `$null` value like you would for an undefined variable. It doesn't matter if the variable is `$null` or an actual object in this case.

PowerShell

```
PS> $null -eq $undefined.some.fake.property
True

PS> $date = Get-Date
PS> $null -eq $date.some.fake.property
True
```

Method on a null-valued expression

Calling a method on a `$null` object throws a `RuntimeException`.

PowerShell

```
PS> $value = $null
PS> $value.toString()
You cannot call a method on a null-valued expression.
At line:1 char:1
+ $value.tostring()
+ ~~~~~~~~~~~~~~~~
    + CategoryInfo          : InvalidOperation: (:) [], RuntimeException
    + FullyQualifiedErrorId : InvokeMethodOnNull
```

Whenever I see the phrase `You cannot call a method on a null-valued expression` then the first thing I look for are places where I am calling a method on a variable without first checking it for `$null`.

Checking for $null

You may have noticed that I always place the `$null` on the left when checking for `$null` in my examples. This is intentional and accepted as a PowerShell best practice. There are some scenarios where placing it on the right doesn't give you the expected result.

Look at this next example and try to predict the results:

PowerShell

```
if ( $value -eq $null )
{
    'The array is $null'
```

```
}
if ( $value -ne $null )
{
    'The array is not $null'
}
```

If I do not define `$value`, the first one evaluates to `$true` and our message is `The array is $null`. The trap here is that it's possible to create a `$value` that allows both of them to be `$false`

PowerShell

```
$value = @( $null )
```

In this case, the `$value` is an array that contains a `$null`. The `-eq` checks every value in the array and returns the `$null` that is matched. This evaluates to `$false`. The `-ne` returns everything that doesn't match `$null` and in this case there are no results (This also evaluates to `$false`). Neither one is `$true` even though it looks like one of them should be.

Not only can we create a value that makes both of them evaluate to `$false`, it's possible to create a value where they both evaluate to `$true`. Mathias Jessen (@IISResetMe) has a good post that dives into that scenario.

PSScriptAnalyzer and VSCode

The PSScriptAnalyzer module has a rule that checks for this issue called `PSPossibleIncorrectComparisonWithNull`.

PowerShell

```
PS> Invoke-ScriptAnalyzer ./myscript.ps1

RuleName                                Message
--------                                -------
PSPossibleIncorrectComparisonWithNull $null should be on the left side of
equality comparisons.
```

Because VS Code uses the PSScriptAnalyser rules too, it also highlights or identifies this as a problem in your script.

Simple if check

A common way that people check for a non-$null value is to use a simple `if()` statement without the comparison.

PowerShell

```
if ( $value )
{
    Do-Something
}
```

If the value is `$null`, this evaluates to `$false`. This is easy to read, but be careful that it's looking for exactly what you're expecting it to look for. I read that line of code as:

> If `$value` has a value.

But that's not the whole story. That line is actually saying:

> If `$value` is not `$null` or `0` or `$false` or an empty string or an empty array.

Here is a more complete sample of that statement.

PowerShell

```
if ( $null -ne $value -and
        $value -ne 0 -and
        $value -ne '' -and
        ($value -isnot [array] -or $value.Length -ne 0) -and
        $value -ne $false )
{
    Do-Something
}
```

It's perfectly OK to use a basic `if` check as long as you remember those other values count as `$false` and not just that a variable has a value.

I ran into this issue when refactoring some code a few days ago. It had a basic property check like this.

PowerShell

```
if ( $object.property )
{
    $object.property = $value
}
```

I wanted to assign a value to the object property only if it existed. In most cases, the original object had a value that would evaluate to `$true` in the `if` statement. But I ran into an issue where the value was occasionally not getting set. I debugged the code and found that the object had the property but it was a blank string value. This prevented it from ever getting updated with the previous logic. So I added a proper `$null` check and everything worked.

PowerShell

```
if ( $null -ne $object.property )
{
    $object.property = $value
}
```

It's little bugs like these that are hard to spot and make me aggressively check values for `$null`.

$null.Count

If you try to access a property on a `$null` value, that the property is also `$null`. The `count` property is the exception to this rule.

PowerShell

```
PS> $value = $null
PS> $value.count
0
```

When you have a `$null` value, then the `count` is `0`. This special property is added by PowerShell.

[PSCustomObject] Count

Almost all objects in PowerShell have that count property. One important exception is the `[PSCustomObject]` in Windows PowerShell 5.1 (This is fixed in PowerShell 6.0). It doesn't have a count property so you get a `$null` value if you try to use it. I call this out here so that you don't try to use `.Count` instead of a `$null` check.

Running this example on Windows PowerShell 5.1 and PowerShell 6.0 gives you different results.

PowerShell

```
$value = [PSCustomObject]@{Name='MyObject'}
if ( $value.count -eq 1 )
{
    "We have a value"
}
```

Empty null

There is one special type of `$null` that acts differently than the others. I am going to call it the empty `$null` but it's really a System.Management.Automation.Internal.AutomationNull. This empty `$null` is the one you get as the result of a function or script block that returns nothing (a void result).

PowerShell

```
PS> function Get-Nothing {}
PS> $nothing = Get-Nothing
PS> $null -eq $nothing
True
```

If you compare it with `$null`, you get a `$null` value. When used in an evaluation where a value is required, the value is always `$null`. But if you place it inside an array, it's treated the same as an empty array.

PowerShell

```
PS> $containempty = @( @() )
PS> $containnothing = @($nothing)
PS> $containnull = @($null)

PS> $containempty.count
0
PS> $containnothing.count
0
PS> $containnull.count
1
```

You can have an array that contains one `$null` value and its `count` is `1`. But if you place an empty result inside an array then it's not counted as an item. The count is `0`.

If you treat the empty `$null` like a collection, then it's empty.

If you pass in an empty value to a function parameter that isn't strongly typed, PowerShell coerces the nothing value into a `$null` value by default. This means inside

the function, the value will be treated as `$null` instead of the **System.Management.Automation.Internal.AutomationNull** type.

Pipeline

The primary place you see the difference is when using the pipeline. You can pipe a `$null` value but not an empty `$null` value.

PowerShell

```
PS> $null | ForEach-Object{ Write-Output 'NULL Value' }
'NULL Value'
PS> $nothing | ForEach-Object{ Write-Output 'No Value' }
```

Depending on your code, you should account for the `$null` in your logic.

Either check for `$null` first

- Filter out null on the pipeline (`... | Where {$null -ne $_} | ...`)
- Handle it in the pipeline function

foreach

One of my favorite features of `foreach` is that it doesn't enumerate over a `$null` collection.

PowerShell

```
foreach ( $node in $null )
{
    #skipped
}
```

This saves me from having to `$null` check the collection before I enumerate it. If you have a collection of `$null` values, the `$node` can still be `$null`.

The foreach started working this way with PowerShell 3.0. If you happen to be on an older version, then this is not the case. This is one of the important changes to be aware of when back-porting code for 2.0 compatibility.

Value types

Technically, only reference types can be `$null`. But PowerShell is very generous and allows for variables to be any type. If you decide to strongly type a value type, it cannot be `$null`. PowerShell converts `$null` to a default value for many types.

PowerShell

```
PS> [int]$number = $null
PS> $number
0

PS> [bool]$boolean = $null
PS> $boolean
False

PS> [string]$string = $null
PS> $string -eq ''
True
```

There are some types that do not have a valid conversion from `$null`. These types generate a `Cannot convert null to type` error.

PowerShell

```
PS> [datetime]$date = $null
Cannot convert null to type "System.DateTime".
At line:1 char:1
+ [datetime]$date = $null
+ ~~~~~~~~~~~~~~~~~~~~~~
    + CategoryInfo          : MetadataError: (:) [],
ArgumentTransformationMetadataException
    + FullyQualifiedErrorId : RuntimeException
```

Function parameters

Using a strongly typed values in function parameters is very common. We generally learn to define the types of our parameters even if we tend not to define the types of other variables in our scripts. You may already have some strongly typed variables in your functions and not even realize it.

PowerShell

```
function Do-Something
{
    param(
        [String] $Value
    )
}
```

As soon as you set the type of the parameter as a `string`, the value can never be `$null`. It's common to check if a value is `$null` to see if the user provided a value or not.

PowerShell

```
if ( $null -ne $Value ){...}
```

`$Value` is an empty string `''` when no value is provided. Use the automatic variable `$PSBoundParameters.Value` instead.

PowerShell

```
if ( $null -ne $PSBoundParameters.Value ){...}
```

`$PSBoundParameters` only contains the parameters that were specified when the function was called. You can also use the `ContainsKey` method to check for the property.

PowerShell

```
if ( $PSBoundParameters.ContainsKey('Value') ){...}
```

IsNotNullOrEmpty

If the value is a string, you can use a static string function to check if the value is `$null` or an empty string at the same time.

PowerShell

```
if ( -not [string]::IsNullOrEmpty( $value ) ){...}
```

I find myself using this often when I know the value type should be a string.

When I $null check

I am a defensive scripter. Anytime I call a function and assign it to a variable, I check it for `$null`.

PowerShell

```
$userList = Get-ADUser kevmar
if ($null -ne $userList){...}
```

I much prefer using `if` or `foreach` over using `try/catch`. Don't get me wrong, I still use `try/catch` a lot. But if I can test for an error condition or an empty set of results, I can allow my exception handling be for true exceptions.

I also tend to check for `$null` before I index into a value or call methods on an object. These two actions fail for a `$null` object so I find it important to validate them first. I already covered those scenarios earlier in this post.

No results scenario

It's important to know that different functions and commands handle the no results scenario differently. Many PowerShell commands return the empty `$null` and an error in the error stream. But others throw exceptions or give you a status object. It's still up to you to know how the commands you use deal with the no results and error scenarios.

Initializing to $null

One habit that I have picked up is initializing all my variables before I use them. You are required to do this in other languages. At the top of my function or as I enter a foreach loop, I define all the values that I'm using.

Here is a scenario that I want you to take a close look at. It's an example of a bug I had to chase down before.

PowerShell

```
function Do-Something
{
    foreach ( $node in 1..6 )
    {
        try
        {
            $result = Get-Something -ID $node
        }
        catch
        {
            Write-Verbose "[$result] not valid"
        }

        if ( $null -ne $result )
        {
            Update-Something $result
        }
    }
}
```

The expectation here is that `Get-Something` returns either a result or an empty `$null`. If there is an error, we log it. Then we check to make sure we got a valid result before processing it.

The bug hiding in this code is when `Get-Something` throws an exception and doesn't assign a value to `$result`. It fails before the assignment so we don't even assign `$null` to the `$result` variable. `$result` still contains the previous valid `$result` from other iterations. `Update-Something` to execute multiple times on the same object in this example.

I set `$result` to `$null` right inside the foreach loop before I use it to mitigate this issue.

PowerShell

```
foreach ( $node in 1..6 )
{
    $result = $null
    try
    {
        ...
```

Scope issues

This also helps mitigate scoping issues. In that example, we assign values to `$result` over and over in a loop. But because PowerShell allows variable values from outside the function to bleed into the scope of the current function, initializing them inside your function mitigates bugs that can be introduced that way.

An uninitialized variable in your function is not `$null` if it's set to a value in a parent scope. The parent scope could be another function that calls your function and uses the same variable names.

If I take that same `Do-something` example and remove the loop, I would end up with something that looks like this example:

PowerShell

```
function Invoke-Something
{
    $result = 'ParentScope'
    Do-Something
}

function Do-Something
```

```
{
    try
    {
        $result = Get-Something -ID $node
    }
    catch
    {
        Write-Verbose "[$result] not valid"
    }

    if ( $null -ne $result )
    {
        Update-Something $result
    }
}
```

If the call to `Get-Something` throws an exception, then my `$null` check finds the `$result` from `Invoke-Something`. Initializing the value inside your function mitigates this issue.

Naming variables is hard and it's common for an author to use the same variable names in multiple functions. I know I use `$node`, `$result`, `$data` all the time. So it would be very easy for values from different scopes to show up in places where they should not be.

Redirect output to $null

I have been talking about `$null` values for this entire article but the topic is not complete if I didn't mention redirecting output to `$null`. There are times when you have commands that output information or objects that you want to suppress. Redirecting output to `$null` does that.

Out-Null

The Out-Null command is the built-in way to redirect pipeline data to `$null`.

PowerShell

```
New-Item -Type Directory -Path $path | Out-Null
```

Assign to $null

You can assign the results of a command to `$null` for the same effect as using `Out-Null`.

```
```

PowerShell

```
$null = New-Item -Type Directory -Path $path
```

Because `$null` is a constant value, you can never overwrite it. I don't like the way it looks in my code but it often performs faster than `Out-Null`.

Redirect to $null

You can also use the redirection operator to send output to `$null`.

PowerShell

```
New-Item -Type Directory -Path $path > $null
```

If you're dealing with command-line executables that output on the different streams. You can redirect all output streams to `$null` like this:

PowerShell

```
git status *> $null
```

Summary

I covered a lot of ground on this one and I know this article is more fragmented than most of my deep dives. That is because `$null` values can pop up in many different places in PowerShell and all the nuances are specific to where you find it. I hope you walk away from this with a better understanding of `$null` and an awareness of the more obscure scenarios you may run into.

Everything you wanted to know about ShouldProcess

Article • 11/17/2022

PowerShell functions have several features that greatly improve the way users interact with them. One important feature that is often overlooked is `-WhatIf` and `-Confirm` support and it's easy to add to your functions. In this article, we dive deep into how to implement this feature.

> **Note**
>
> The **original version** of this article appeared on the blog written by **@KevinMarquette**. The PowerShell team thanks Kevin for sharing this content with us. Please check out his blog at **PowerShellExplained.com**.

This is a simple feature you can enable in your functions to provide a safety net for the users that need it. There's nothing scarier than running a command that you know can be dangerous for the first time. The option to run it with `-WhatIf` can make a big difference.

CommonParameters

Before we look at implementing these common parameters, I want to take a quick look at how they're used.

Using -WhatIf

When a command supports the `-WhatIf` parameter, it allows you to see what the command would have done instead of making changes. it's a good way to test out the impact of a command, especially before you do something destructive.

PowerShell

```
PS C:\temp> Get-ChildItem
    Directory: C:\temp
Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a----         4/19/2021   8:59 AM              0 importantfile.txt
-a----         4/19/2021   8:58 AM              0 myfile1.txt
-a----         4/19/2021   8:59 AM              0 myfile2.txt
```

```
PS C:\temp> Remove-Item -Path .\myfile1.txt -WhatIf
What if: Performing the operation "Remove File" on target
"C:\Temp\myfile1.txt".
```

If the command correctly implements `ShouldProcess`, it should show you all the changes that it would have made. Here is an example using a wildcard to delete multiple files.

PowerShell

```
PS C:\temp> Remove-Item -Path * -WhatIf
What if: Performing the operation "Remove File" on target
"C:\Temp\myfile1.txt".
What if: Performing the operation "Remove File" on target
"C:\Temp\myfile2.txt".
What if: Performing the operation "Remove File" on target
"C:\Temp\importantfile.txt".
```

Using -Confirm

Commands that support `-WhatIf` also support `-Confirm`. This gives you a chance confirm an action before performing it.

PowerShell

```
PS C:\temp> Remove-Item .\myfile1.txt -Confirm

Confirm
Are you sure you want to perform this action?
Performing the operation "Remove File" on target "C:\Temp\myfile1.txt".
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
(default is "Y"):
```

In this case, you have multiple options that allow you to continue, skip a change, or stop the script. The help prompt describes each of those options like this.

Output

```
Y - Continue with only the next step of the operation.
A - Continue with all the steps of the operation.
N - Skip this operation and proceed with the next operation.
L - Skip this operation and all subsequent operations.
S - Pause the current pipeline and return to the command prompt. Type "exit"
to resume the pipeline.
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
(default is "Y"):
```

Localization

This prompt is localized in PowerShell so the language changes based on the language of your operating system. This is one more thing that PowerShell manages for you.

Switch parameters

Let's take quick moment to look at ways to pass a value to a switch parameter. The main reason I call this out is that you often want to pass parameter values to functions you call.

The first approach is a specific parameter syntax that can be used for all parameters but you mostly see it used for switch parameters. You specify a colon to attach a value to the parameter.

PowerShell

```
Remove-Item -Path:* -WhatIf:$true
```

You can do the same with a variable.

PowerShell

```
$DoWhatIf = $true
Remove-Item -Path * -WhatIf:$DoWhatIf
```

The second approach is to use a hashtable to splat the value.

PowerShell

```
$RemoveSplat = @{
    Path = '*'
    WhatIf = $true
}
Remove-Item @RemoveSplat
```

If you're new to hashtables or splatting, I have another article on that covers everything you wanted to know about hashtables.

SupportsShouldProcess

The first step to enable `-WhatIf` and `-Confirm` support is to specify `SupportsShouldProcess` in the `CmdletBinding` of your function.

PowerShell

```
function Test-ShouldProcess {
    [CmdletBinding(SupportsShouldProcess)]
    param()
    Remove-Item .\myfile1.txt
}
```

By specifying `SupportsShouldProcess` in this way, we can now call our function with `-WhatIf` (or `-Confirm`).

PowerShell

```
PS> Test-ShouldProcess -WhatIf
What if: Performing the operation "Remove File" on target
"C:\Temp\myfile1.txt".
```

Notice that I did not create a parameter called `-WhatIf`. Specifying `SupportsShouldProcess` automatically creates it for us. When we specify the `-WhatIf` parameter on `Test-ShouldProcess`, some things we call also perform `-WhatIf` processing.

Trust but verify

There's some danger here trusting that everything you call inherits `-WhatIf` values. For the rest of the examples, I'm going to assume that it doesn't work and be very explicit when making calls to other commands. I recommend that you do the same.

PowerShell

```
function Test-ShouldProcess {
    [CmdletBinding(SupportsShouldProcess)]
    param()
    Remove-Item .\myfile1.txt -WhatIf:$WhatIfPreference
}
```

I will revisit the nuances much later once you have a better understanding of all the pieces in play.

$PSCmdlet.ShouldProcess

The method that allows you to implement `SupportsShouldProcess` is `$PSCmdlet.ShouldProcess`. You call `$PSCmdlet.ShouldProcess(...)` to see if you should

process some logic and PowerShell takes care of the rest. Let's start with an example:

PowerShell

```
function Test-ShouldProcess {
    [CmdletBinding(SupportsShouldProcess)]
    param()

    $file = Get-ChildItem './myfile1.txt'
    if($PSCmdlet.ShouldProcess($file.Name)){
        $file.Delete()
    }
}
```

The call to `$PSCmdlet.ShouldProcess($file.name)` checks for the `-WhatIf` (and `-Confirm` parameter) then handles it accordingly. The `-WhatIf` causes `ShouldProcess` to output a description of the change and return `$false`:

PowerShell

```
PS> Test-ShouldProcess -WhatIf
What if: Performing the operation "Test-ShouldProcess" on target
"myfile1.txt".
```

A call using `-Confirm` pauses the script and prompts the user with the option to continue. It returns `$true` if the user selected `Y`.

PowerShell

```
PS> Test-ShouldProcess -Confirm
Confirm
Are you sure you want to perform this action?
Performing the operation "Test-ShouldProcess" on target "myfile1.txt".
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
(default is "Y"):
```

An awesome feature of `$PSCmdlet.ShouldProcess` is that it doubles as verbose output. I depend on this often when implementing `ShouldProcess`.

PowerShell

```
PS> Test-ShouldProcess -Verbose
VERBOSE: Performing the operation "Test-ShouldProcess" on target
"myfile1.txt".
```

Overloads

There are a few different overloads for `$PSCmdlet.ShouldProcess` with different parameters for customizing the messaging. We already saw the first one in the example above. Let's take a closer look at it.

PowerShell

```
function Test-ShouldProcess {
    [CmdletBinding(SupportsShouldProcess)]
    param()

    if($PSCmdlet.ShouldProcess('TARGET')){
        # ...
    }
}
```

This produces output that includes both the function name and the target (value of the parameter).

PowerShell

```
What if: Performing the operation "Test-ShouldProcess" on target "TARGET".
```

Specifying a second parameter as the operation uses the operation value instead of the function name in the message.

PowerShell

```
## $PSCmdlet.ShouldProcess('TARGET','OPERATION')
What if: Performing the operation "OPERATION" on target "TARGET".
```

The next option is to specify three parameters to fully customize the message. When three parameters are used, the first one is the entire message. The second two parameters are still used in the `-Confirm` message output.

PowerShell

```
## $PSCmdlet.ShouldProcess('MESSAGE','TARGET','OPERATION')
What if: MESSAGE
```

Quick parameter reference

Just in case you came here only to figure out what parameters you should use, here is a quick reference showing how the parameters change the message in the different `-WhatIf` scenarios.

PowerShell

```
## $PSCmdlet.ShouldProcess('TARGET')
What if: Performing the operation "FUNCTION_NAME" on target "TARGET".

## $PSCmdlet.ShouldProcess('TARGET','OPERATION')
What if: Performing the operation "OPERATION" on target "TARGET".

## $PSCmdlet.ShouldProcess('MESSAGE','TARGET','OPERATION')
What if: MESSAGE
```

I tend to use the one with two parameters.

ShouldProcessReason

We have a fourth overload that's more advanced than the others. It allows you to get the reason `ShouldProcess` was executed. I'm only adding this here for completeness because we can just check if `$WhatIfPreference` is `$true` instead.

PowerShell

```
$reason = ''
if($PSCmdlet.ShouldProcess('MESSAGE','TARGET','OPERATION',[ref]$reason)){
    Write-Output "Some Action"
}
$reason
```

We have to pass the `$reason` variable into the fourth parameter as a reference variable with `[ref]`. `ShouldProcess` populates `$reason` with the value `None` or `WhatIf`. I didn't say this was useful and I have had no reason to ever use it.

Where to place it

You use `ShouldProcess` to make your scripts safer. So you use it when your scripts are making changes. I like to place the `$PSCmdlet.ShouldProcess` call as close to the change as possible.

PowerShell

```
## general logic and variable work
if ($PSCmdlet.ShouldProcess('TARGET','OPERATION')){
    # Change goes here
}
```

If I'm processing a collection of items, I call it for each item. So the call gets placed inside the foreach loop.

PowerShell

```
foreach ($node in $collection){
    # general logic and variable work
    if ($PSCmdlet.ShouldProcess($node,'OPERATION')){
        # Change goes here
    }
}
```

The reason why I place `ShouldProcess` tightly around the change, is that I want as much code to execute as possible when `-WhatIf` is specified. I want the setup and validation to run if possible so the user gets to see those errors.

I also like to use this in my Pester tests that validate my projects. If I have a piece of logic that is hard to mock in pester, I can often wrap it in `ShouldProcess` and call it with `-WhatIf` in my tests. It's better to test some of your code than none of it.

$WhatIfPreference

The first preference variable we have is `$WhatIfPreference`. This is `$false` by default. If you set it to `$true` then your function executes as if you specified `-WhatIf`. If you set this in your session, all commands perform `-WhatIf` execution.

When you call a function with `-WhatIf`, the value of `$WhatIfPreference` gets set to `$true` inside the scope of your function.

ConfirmImpact

Most of my examples are for `-WhatIf` but everything so far also works with `-Confirm` to prompt the user. You can set the `ConfirmImpact` of the function to high and it prompts the user as if it was called with `-Confirm`.

PowerShell

```
function Test-ShouldProcess {
    [CmdletBinding(
        SupportsShouldProcess,
        ConfirmImpact = 'High'
    )]
    param()

    if ($PSCmdlet.ShouldProcess('TARGET')){
        Write-Output "Some Action"
    }
}
```

This call to `Test-ShouldProcess` is performing the `-Confirm` action because of the `High` impact.

PowerShell

```
PS> Test-ShouldProcess

Confirm
Are you sure you want to perform this action?
Performing the operation "Test-ShouldProcess" on target "TARGET".
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
(default is "Y"): y
Some Action
```

The obvious issue is that now it's harder to use in other scripts without prompting the user. In this case, we can pass a `$false` to `-Confirm` to suppress the prompt.

PowerShell

```
PS> Test-ShouldProcess -Confirm:$false
Some Action
```

I'll cover how to add `-Force` support in a later section.

$ConfirmPreference

`$ConfirmPreference` is an automatic variable that controls when `ConfirmImpact` asks you to confirm execution. Here are the possible values for both `$ConfirmPreference` and `ConfirmImpact`.

- `High`
- `Medium`
- `Low`

- `None`

With these values, you can specify different levels of impact for each function. If you have `$ConfirmPreference` set to a value higher than `ConfirmImpact`, then you aren't prompted to confirm execution.

By default, `$ConfirmPreference` is set to `High` and `ConfirmImpact` is `Medium`. If you want your function to automatically prompt the user, set your `ConfirmImpact` to `High`. Otherwise set it to `Medium` if its destructive and use `Low` if the command is always safe run in production. If you set it to `none`, it doesn't prompt even if `-Confirm` was specified (but it still gives you `-WhatIf` support).

When calling a function with `-Confirm`, the value of `$ConfirmPreference` gets set to `Low` inside the scope of your function.

Suppressing nested confirm prompts

The `$ConfirmPreference` can get picked up by functions that you call. This can create scenarios where you add a confirm prompt and the function you call also prompts the user.

What I tend to do is specify `-Confirm:$false` on the commands that I call when I have already handled the prompting.

PowerShell

```
function Test-ShouldProcess {
    [CmdletBinding(SupportsShouldProcess)]
    param()

    $file = Get-ChildItem './myfile1.txt'
    if($PSCmdlet.ShouldProcess($file.Name)){
        Remove-Item -Path $file.FullName -Confirm:$false
    }
}
```

This brings us back to an earlier warning: There are nuances as to when `-WhatIf` is not passed to a function and when `-Confirm` passes to a function. I promise I'll get back to this later.

$PSCmdlet.ShouldContinue

If you need more control than `ShouldProcess` provides, you can trigger the prompt directly with `ShouldContinue`. `ShouldContinue` ignores `$ConfirmPreference`, `ConfirmImpact`, `-Confirm`, `$WhatIfPreference`, and `-WhatIf` because it prompts every time it's executed.

At a quick glance, it's easy to confuse `ShouldProcess` and `ShouldContinue`. I tend to remember to use `ShouldProcess` because the parameter is called `SupportsShouldProcess` in the `CmdletBinding`. You should use `ShouldProcess` in almost every scenario. That is why I covered that method first.

Let's take a look at `ShouldContinue` in action.

PowerShell

```
function Test-ShouldContinue {
    [CmdletBinding()]
    param()

    if($PSCmdlet.ShouldContinue('TARGET','OPERATION')){
        Write-Output "Some Action"
    }
}
```

This provides us a simpler prompt with fewer options.

PowerShell

```
Test-ShouldContinue

Second
TARGET
[Y] Yes  [N] No  [S] Suspend  [?] Help (default is "Y"):
```

The biggest issue with `ShouldContinue` is that it requires the user to run it interactively because it always prompts the user. You should always be building tools that can be used by other scripts. The way you do this is by implementing `-Force`. I'll revisit this idea later.

Yes to all

This is automatically handled with `ShouldProcess` but we have to do a little more work for `ShouldContinue`. There's a second method overload where we have to pass in a few values by reference to control the logic.

PowerShell

```
function Test-ShouldContinue {
    [CmdletBinding()]
    param()

    $collection = 1..5
    $yesToAll = $false
    $noToAll = $false

    foreach($target in $collection) {

        $continue = $PSCmdlet.ShouldContinue(
                "TARGET_$target",
                'OPERATION',
                [ref]$yesToAll,
                [ref]$noToAll
            )

        if ($continue){
            Write-Output "Some Action [$target]"
        }
    }
}
```

I added a `foreach` loop and a collection to show it in action. I pulled the `ShouldContinue` call out of the `if` statement to make it easier to read. Calling a method with four parameters starts to get a little ugly, but I tried to make it look as clean as I could.

Implementing -Force

`ShouldProcess` and `ShouldContinue` need to implement `-Force` in different ways. The trick to these implementations is that `ShouldProcess` should always get executed, but `ShouldContinue` should not get executed if `-Force` is specified.

ShouldProcess -Force

If you set your `ConfirmImpact` to `high`, the first thing your users are going to try is to suppress it with `-Force`. That's the first thing I do anyway.

PowerShell

```
Test-ShouldProcess -Force
Error: Test-ShouldProcess: A parameter cannot be found that matches
parameter name 'force'.
```

If you recall from the `ConfirmImpact` section, they actually need to call it like this:

PowerShell

```
Test-ShouldProcess -Confirm:$false
```

Not everyone realizes they need to do that and `-Force` doesn't suppress `ShouldContinue`. So we should implement `-Force` for the sanity of our users. Take a look at this full example here:

PowerShell

```
function Test-ShouldProcess {
    [CmdletBinding(
        SupportsShouldProcess,
        ConfirmImpact = 'High'
    )]
    param(
        [Switch]$Force
    )

    if ($Force -and -not $Confirm){
        $ConfirmPreference = 'None'
    }

    if ($PSCmdlet.ShouldProcess('TARGET')){
        Write-Output "Some Action"
    }
}
```

We add our own `-Force` switch as a parameter. The `-Confirm` parameter is automatically added when using `SupportsShouldProcess` in the `CmdletBinding`.

PowerShell

```
[CmdletBinding(
    SupportsShouldProcess,
    ConfirmImpact = 'High'
)]
param(
    [Switch]$Force
)
```

Focusing in on the `-Force` logic here:

PowerShell

```
if ($Force -and -not $Confirm){
    $ConfirmPreference = 'None'
}
```

If the user specifies `-Force`, we want to suppress the confirm prompt unless they also specify `-Confirm`. This allows a user to force a change but still confirm the change. Then we set `$ConfirmPreference` in the local scope. Now, using the `-Force` parameter temporarily sets the `$ConfirmPreference` to none, disabling prompt for confirmation.

PowerShell

```
if ($PSCmdlet.ShouldProcess('TARGET')){
        Write-Output "Some Action"
    }
```

If someone specifies both `-Force` and `-WhatIf`, then `-WhatIf` needs to take priority. This approach preserves `-WhatIf` processing because `ShouldProcess` always gets executed.

Do not add a check for the `$Force` value inside the `if` statement with the `ShouldProcess`. That is an anti-pattern for this specific scenario even though that's what I show you in the next section for `ShouldContinue`.

ShouldContinue -Force

This is the correct way to implement `-Force` with `ShouldContinue`.

PowerShell

```
function Test-ShouldContinue {
    [CmdletBinding()]
    param(
        [Switch]$Force
    )

    if($Force -or $PSCmdlet.ShouldContinue('TARGET','OPERATION')){
        Write-Output "Some Action"
    }
}
```

By placing the `$Force` to the left of the `-or` operator, it gets evaluated first. Writing it this way short circuits the execution of the `if` statement. If `$force` is `$true`, then the `ShouldContinue` is not executed.

```
```

```PowerShell
PS> Test-ShouldContinue -Force
Some Action
```

We don't have to worry about `-Confirm` or `-WhatIf` in this scenario because they're not supported by `ShouldContinue`. This is why it needs to be handled differently than `ShouldProcess`.

Scope issues

Using `-WhatIf` and `-Confirm` are supposed to apply to everything inside your functions and everything they call. They do this by setting `$WhatIfPreference` to `$true` or setting `$ConfirmPreference` to `Low` in the local scope of the function. When you call another function, calls to `ShouldProcess` use those values.

This actually works correctly most of the time. Anytime you call built-in cmdlet or a function in your same scope, it works. It also works when you call a script or a function in a script module from the console.

The one specific place where it doesn't work is when a script or a script module calls a function in another script module. This may not sound like a big problem, but most of the modules you create or pull from the PSGallery are script modules.

The core issue is that script modules do not inherit the values for `$WhatIfPreference` or `$ConfirmPreference` (and several others) when called from functions in other script modules.

The best way to summarize this as a general rule is that this works correctly for binary modules and never trust it to work for script modules. If you aren't sure, either test it or just assume it doesn't work correctly.

I personally feel this is very dangerous because it creates scenarios where you add `-WhatIf` support to multiple modules that work correctly in isolation, but fail to work correctly when they call each other.

We do have a GitHub RFC working to get this issue fixed. See Propagate execution preferences beyond script module scope for more details.

In closing

I have to look up how to use `ShouldProcess` every time I need to use it. It took me a long time to distinguish `ShouldProcess` from `ShouldContinue`. I almost always need to look up what parameters to use. So don't worry if you still get confused from time to time. This article will be here when you need it. I'm sure I will reference it often myself.

If you liked this post, please share your thoughts with me on Twitter using the link below. I always like hearing from people that get value from my content.

Writing Progress across multiple threads with Foreach Parallel

Article • 11/17/2022

Starting in PowerShell 7.0, the ability to work in multiple threads simultaneously is possible using the **Parallel** parameter in the Foreach-Object cmdlet. Monitoring the progress of these threads can be a challenge though. Normally, you can monitor the progress of a process using Write-Progress. However, since PowerShell uses a separate runspace for each thread when using **Parallel**, reporting the progress back to the host isn't as straight forward as normal use of `Write-Progress`.

Using a synced hashtable to track progress

When writing the progress from multiple threads, tracking becomes difficult because when running parallel processes in PowerShell, each process has it's own runspace. To get around this, you can use a synchronized hashtable. A synced hashtable is a thread safe data structure that can be modified by multiple threads simultaneously without throwing an error.

Set up

One of the downsides to this approach is it takes a, somewhat, complex set up to ensure everything runs without error.

PowerShell

```
$dataset = @(
    @{
        Id   = 1
        Wait = 3..10 | get-random | Foreach-Object {$_*100}
    }
    @{
        Id   = 2
        Wait = 3..10 | get-random | Foreach-Object {$_*100}
    }
    @{
        Id   = 3
        Wait = 3..10 | get-random | Foreach-Object {$_*100}
    }
    @{
        Id   = 4
        Wait = 3..10 | get-random | Foreach-Object {$_*100}
    }
```

```
    @{
        Id   = 5
        Wait = 3..10 | get-random | Foreach-Object {$_*100}
    }
)

# Create a hashtable for process.
# Keys should be ID's of the processes
$origin = @{}
$dataset | Foreach-Object {$origin.($_.id) = @{}}

# Create synced hashtable
$sync = [System.Collections.Hashtable]::Synchronized($origin)
```

This section creates three different data structures, for three different purposes.

The `$dataSet` variable stores an array of hashtables that is used to coordinate the next steps without the risk of being modified. If an object collection is modified while iterating through the collection, PowerShell throws an error. You must keep the object collection in the loop separate from the objects being modified. The `Id` key in each hashtable is the identifier for a mock process. The `Wait` key simulates the workload of each mock process being tracked.

The `$origin` variable stores a nested hashtable with each key being one of the mock process id's. Then, it is used to hydrate the synchronized hashtable stored in the `$sync` variable. The `$sync` variable is responsible for reporting the progress back to the parent runspace, which displays the progress.

Running the processes

This section runs the multi-threaded processes and creates some of the output used to display progress.

PowerShell

```
$job = $dataset | Foreach-Object -ThrottleLimit 3 -AsJob -Parallel {
    $syncCopy = $using:sync
    $process = $syncCopy.$($PSItem.Id)

    $process.Id = $PSItem.Id
    $process.Activity = "Id $($PSItem.Id) starting"
    $process.Status = "Processing"

    # Fake workload start up that takes x amount of time to complete
    start-sleep -Milliseconds ($PSItem.wait*5)

    # Process. update activity
    $process.Activity = "Id $($PSItem.id) processing"
```

```
    foreach ($percent in 1..100)
    {
        # Update process on status
        $process.Status = "Handling $percent/100"
        $process.PercentComplete = (($percent / 100) * 100)

        # Fake workload that takes x amount of time to complete
        Start-Sleep -Milliseconds $PSItem.Wait
    }

    # Mark process as completed
    $process.Completed = $true
}
```

The mock processes are sent to `Foreach-Object` and started as jobs. The **ThrottleLimit** is set to **3** to highlight running multiple processes in a queue. The jobs are stored in the `$job` variable and allows us to know when all the processes have finished later on.

When using the `using:` statement to reference a parent scope variable in PowerShell, you can't use expressions to make it dynamic. For example, if you tried to create the `$process` variable like this, `$process = $using:sync.$($PSItem.id)`, you would get an error stating you can't use expressions there. So, we create the `$syncCopy` variable to be able to reference and modify the `$sync` variable without the risk of it failing.

Next, we build out a hashtable to represent the progress of the process currently in the loop using the `$process` variable by referencing the synchronized hashtable keys. The **Activity** and the **Status** keys are used as parameter values for `Write-Progress` to display the status of a given mock process in the next section.

The `foreach` loop is just a way to simulate the process working and is randomized based on the `$dataSet` **Wait** attribute to set `Start-Sleep` using milliseconds. How you calculate the progress of your process may vary.

Displaying the progress of multiple processes

Now that the mock processes are running as jobs, we can start to write the processes progress to the PowerShell window.

PowerShell

```
while($job.State -eq 'Running')
{
    $sync.Keys | Foreach-Object {
        # If key is not defined, ignore
        if(![string]::IsNullOrEmpty($sync.$_.keys))
        {
```

```
            # Create parameter hashtable to splat
            $param = $sync.$_

            # Execute Write-Progress
            Write-Progress @param
        }
    }

    # Wait to refresh to not overload gui
    Start-Sleep -Seconds 0.1
}
```

The `$job` variable contains the parent **job** and has a child **job** for each of the mock processes. While any of the child jobs are still running, the parent job **State** will remain "Running". This allows us to use the `while` loop to continually update the progress of every process until all processes are finished.

Within the while loop, we loop through each of the keys in the `$sync` variable. Since this is a synchronized hashtable, it is constantly updated but can still be accessed without throwing any errors.

There is a check to ensure that the process being reported is actually running using the `IsNullOrEmpty()` method. If the process hasn't been started, the loop won't report on it and move on to the next until it gets to a process that has been started. If the process is started, the hashtable from the current key is used to splat the parameters to `Write-Progress`.

Full example

PowerShell

```
# Example workload
$dataset = @(
    @{
        Id   = 1
        Wait = 3..10 | get-random | Foreach-Object {$_*100}
    }
    @{
        Id   = 2
        Wait = 3..10 | get-random | Foreach-Object {$_*100}
    }
    @{
        Id   = 3
        Wait = 3..10 | get-random | Foreach-Object {$_*100}
    }
    @{
        Id   = 4
        Wait = 3..10 | get-random | Foreach-Object {$_*100}
```

```
    }
    @{
        Id   = 5
        Wait = 3..10 | get-random | Foreach-Object {$_*100}
    }
)

# Create a hashtable for process.
# Keys should be ID's of the processes
$origin = @{}
$dataset | Foreach-Object {$origin.($_.id) = @{}}

# Create synced hashtable
$sync = [System.Collections.Hashtable]::Synchronized($origin)

$job = $dataset | Foreach-Object -ThrottleLimit 3 -AsJob -Parallel {
    $syncCopy = $using:sync
    $process = $syncCopy.$($PSItem.Id)

    $process.Id = $PSItem.Id
    $process.Activity = "Id $($PSItem.Id) starting"
    $process.Status = "Processing"

    # Fake workload start up that takes x amount of time to complete
    start-sleep -Milliseconds ($PSItem.wait*5)

    # Process. update activity
    $process.Activity = "Id $($PSItem.id) processing"
    foreach ($percent in 1..100)
    {
        # Update process on status
        $process.Status = "Handling $percent/100"
        $process.PercentComplete = (($percent / 100) * 100)

        # Fake workload that takes x amount of time to complete
        Start-Sleep -Milliseconds $PSItem.Wait
    }

    # Mark process as completed
    $process.Completed = $true
}

while($job.State -eq 'Running')
{
    $sync.Keys | Foreach-Object {
        # If key is not defined, ignore
        if(![string]::IsNullOrEmpty($sync.$_.keys))
        {
            # Create parameter hashtable to splat
            $param = $sync.$_

            # Execute Write-Progress
            Write-Progress @param
        }
    }
```

```
    # Wait to refresh to not overload gui
    Start-Sleep -Seconds 0.1
}
```

Related Links

- about_Jobs
- about_Scopes
- about_Splatting

Add Credential support to PowerShell functions

Article • 11/17/2022

> **Note**
>
> The **original version** of this article appeared on the blog written by **@joshduffney**. This article has been edited for inclusion on this site. The PowerShell team thanks Josh for sharing this content with us. Please check out his blog at **duffney.io**.

This article shows you how to add credential parameters to PowerShell functions and why you'd want to. A credential parameter is to allow you to run the function or cmdlet as a different user. The most common use is to run the function or cmdlet as an elevated user account.

For example, the cmdlet `New-ADUser` has a **Credential** parameter, which you could provide domain admin credentials to create an account in a domain. Assuming your normal account running the PowerShell session doesn't have that access already.

Creating credential object

The PSCredential object represents a set of security credentials such as a user name and password. The object can be passed as a parameter to a function that runs as the user account in that credential object. There are a few ways that you can create a credential object. The first way to create a credential object is to use the PowerShell cmdlet `Get-Credential`. When you run without parameters, it prompts you for a username and password. Or you can call the cmdlet with some optional parameters.

To specify the domain name and username ahead of time you can use either the **Credential** or **UserName** parameters. When you use the **UserName** parameter, you're also required to provide a **Message** value. The code below demonstrates using the cmdlet. You can also store the credential object in a variable so that you can use the credential multiple times. In the example below, the credential object is stored in the variable `$Cred`.

```
PowerShell
```

```
$Cred = Get-Credential
$Cred = Get-Credential -Credential domain\user
$Cred = Get-Credential -UserName domain\user -Message 'Enter Password'
```

Sometimes, you can't use the interactive method of creating credential objects shown in the previous example. Most automation tools require a non-interactive method. To create a credential without user interaction, create a secure string containing the password. Then pass the secure string and user name to the `System.Management.Automation.PSCredential()` method.

Use the following command to create a secure string containing the password:

PowerShell

```
ConvertTo-SecureString "MyPlainTextPassword" -AsPlainText -Force
```

Both the **AsPlainText** and **Force** parameters are required. Without those parameters, you receive a message warning that you shouldn't pass plain text into a secure string. PowerShell returns this warning because the plain text password gets recorded in various logs. Once you have a secure string created, you need to pass it to the `PSCredential()` method to create the credential object. In the following example, the variable `$password` contains the secure string `$Cred` contains the credential object.

PowerShell

```
$password = ConvertTo-SecureString "MyPlainTextPassword" -AsPlainText -Force
$Cred = New-Object System.Management.Automation.PSCredential ("username",
$password)
```

Now that you know how to create credential objects, you can add credential parameters to your PowerShell functions.

Adding a Credential Parameter

Just like any other parameter, you start off by adding it in the `param` block of your function. It's recommended that you name the parameter `$Credential` because that's what existing PowerShell cmdlets use. The type of the parameter should be `[System.Management.Automation.PSCredential]`.

The following example shows the parameter block for a function called `Get-Something`. It has two parameters: `$Name` and `$Credential`.

PowerShell

```
function Get-Something {
    param(
        $Name,
        [System.Management.Automation.PSCredential]$Credential
    )
```

The code in this example is enough to have a working credential parameter, however there are a few things you can add to make it more robust.

- Add the `[ValidateNotNull()]` validation attribute to check that the value being passed to **Credential**. If the parameter value is null, this attribute prevents the function from executing with invalid credentials.
- Add `[System.Management.Automation.Credential()]`. This allows you to pass in a username as a string and have an interactive prompt for the password.
- Set a default value for the `$Credential` parameter to `[System.Management.Automation.PSCredential]::Empty`. Your function you might be passing this `$Credential` object to existing PowerShell cmdlets. Providing a null value to the cmdlet called inside your function causes an error. Providing an empty credential object avoids this error.

> **Tip**
>
> Some cmdlets that accept a credential parameter do not support `[System.Management.Automation.PSCredential]::Empty` as they should. See the **Dealing with Legacy Cmdlets** section for a workaround.

Using credential parameters

The following example demonstrates how to use credential parameters. This example shows a function called `Set-RemoteRegistryValue`, which is out of The Pester Book. This function defines the credential parameter using the techniques describe in the previous section. The function calls `Invoke-Command` using the `$Credential` variable created by the function. This allows you to change the user who's running `Invoke-Command`. Because the default value of `$Credential` is an empty credential, the function can run without providing credentials.

PowerShell

```
function Set-RemoteRegistryValue {
    param(
        $ComputerName,
        $Path,
        $Name,
        $Value,
        [ValidateNotNull()]
        [System.Management.Automation.PSCredential]
        [System.Management.Automation.Credential()]
        $Credential = [System.Management.Automation.PSCredential]::Empty
    )
        $null = Invoke-Command -ComputerName $ComputerName -ScriptBlock {
            Set-ItemProperty -Path $using:Path -Name $using:Name -Value
$using:Value
        } -Credential $Credential
}
```

The following sections show different methods of providing credentials to `Set-RemoteRegistryValue`.

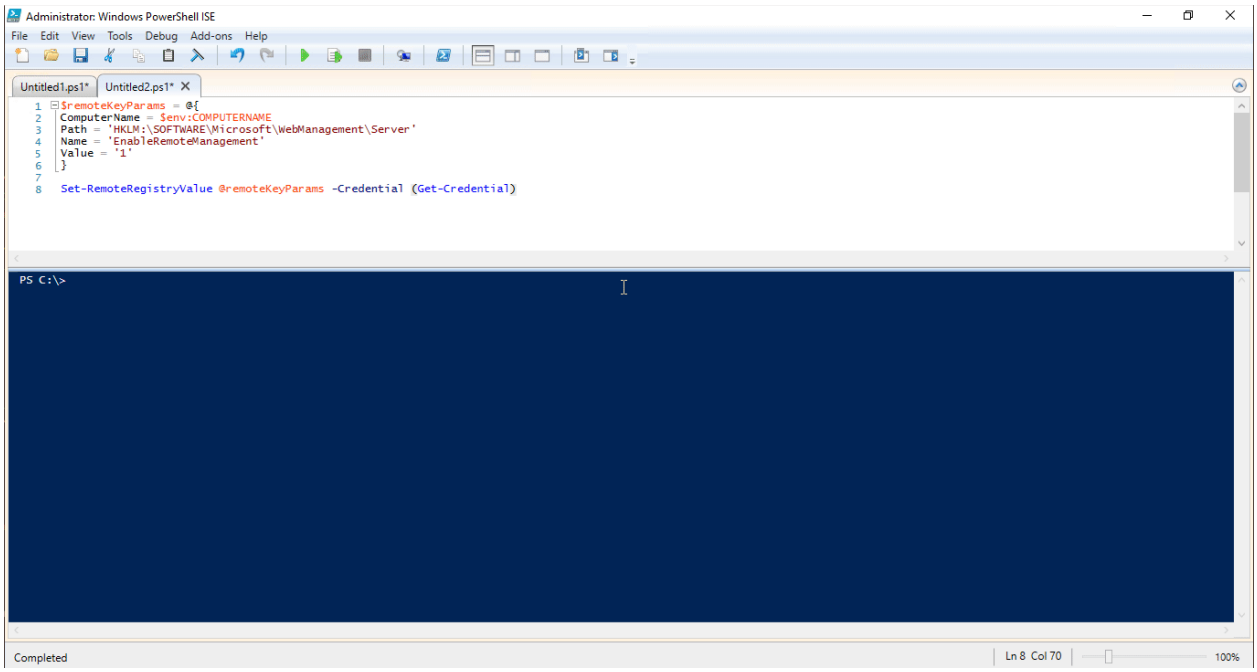
Prompting for credentials

Using `Get-Credential` in parentheses `()` at run time causes the `Get-credential` to run first. You are prompted for a username and password. You could use the **Credential** or **UserName** parameters of `Get-credential` to pre-populate the username and domain. The following example uses a technique called splatting to pass parameters to the `Set-RemoteRegistryValue` function. For more information about splatting, check out the about_Splatting article.

PowerShell

```
$remoteKeyParams = @{
    ComputerName = $env:COMPUTERNAME
    Path = 'HKLM:\SOFTWARE\Microsoft\WebManagement\Server'
    Name = 'EnableRemoteManagement'
    Value = '1'
}

Set-RemoteRegistryValue @remoteKeyParams -Credential (Get-Credential)
```

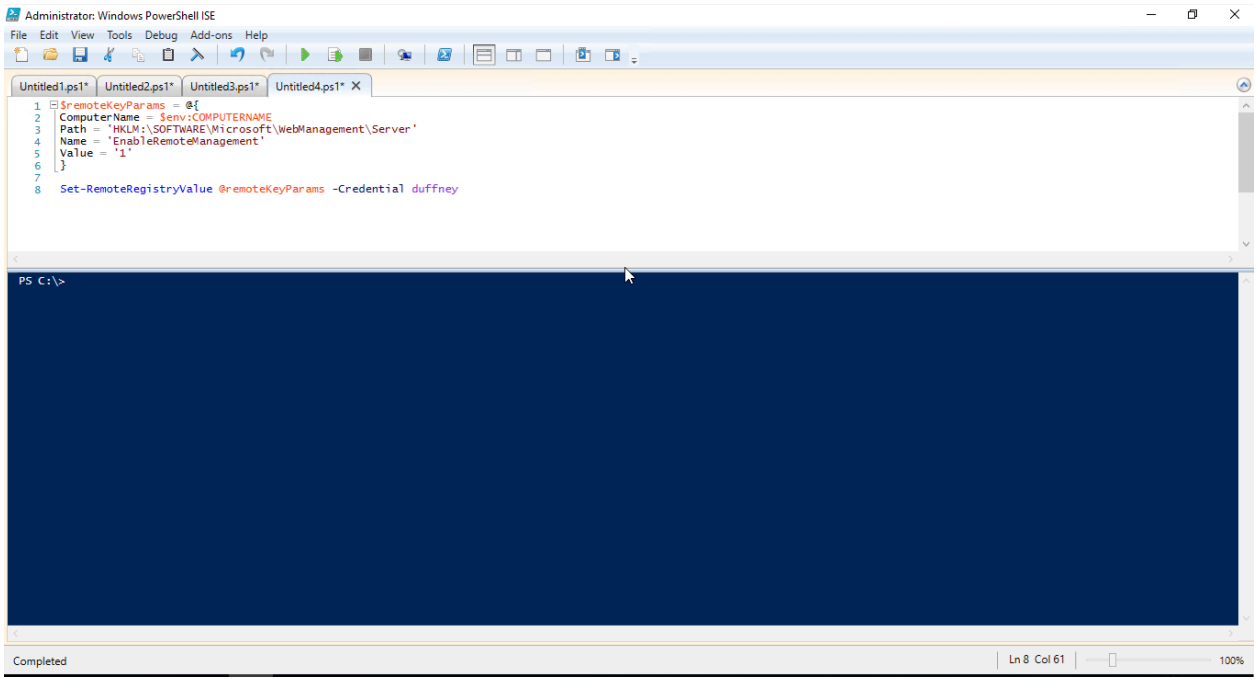


Using `(Get-Credential)` seems cumbersome. Normally, when you use the **Credential** parameter with only a username, the cmdlet automatically prompts for the password. The `[System.Management.Automation.Credential()]` attribute enables this behavior.

PowerShell

```
$remoteKeyParams = @{
    ComputerName = $env:COMPUTERNAME
    Path = 'HKLM:\SOFTWARE\Microsoft\WebManagement\Server'
    Name = 'EnableRemoteManagement'
    Value = '1'
}

Set-RemoteRegistryValue @remoteKeyParams -Credential duffney
```



> **Note**
>
> To set the registry value shown, these examples assume you have the **Web Server** features of Windows installed. Run `Install-WindowsFeature Web-Server` and `Install-WindowsFeature web-mgmt-tools` if required.

Provide credentials in a variable

You can also populate a credential variable ahead of time and pass it to the **Credential** parameter of `Set-RemoteRegistryValue` function. Use this method with Continuous Integration / Continuous Deployment (CI/CD) tools such as Jenkins, TeamCity, and Octopus Deploy. For an example using Jenkins, check out Hodge's blog post Automating with Jenkins and PowerShell on Windows - Part 2.

This example uses the .NET method to create the credential object and a secure string to pass in the password.

PowerShell

```
$password = ConvertTo-SecureString "P@ssw0rd" -AsPlainText -Force
$Cred = New-Object System.Management.Automation.PSCredential ("duffney",
$password)

$remoteKeyParams = @{
    ComputerName = $env:COMPUTERNAME
    Path = 'HKLM:\SOFTWARE\Microsoft\WebManagement\Server'
    Name = 'EnableRemoteManagement'
    Value = '1'
}

Set-RemoteRegistryValue @remoteKeyParams -Credential $Cred
```

For this example, the secure string is created using a clear text password. All of the previously mentioned CI/CD have a secure method of providing that password at run time. When using those tools, replace the plain text password with the variable defined within the CI/CD tool you use.

Run without credentials

Since `$Credential` defaults to an empty credential object, you can run the command without credentials, as shown in this example:

PowerShell

```
$remoteKeyParams = @{
    ComputerName = $env:COMPUTERNAME
    Path = 'HKLM:\SOFTWARE\Microsoft\WebManagement\Server'
    Name = 'EnableRemoteManagement'
    Value = '1'
}

Set-RemoteRegistryValue @remoteKeyParams
```

Dealing with legacy cmdlets

Not all cmdlets support credential objects or allow empty credentials. Instead, the cmdlet wants username and password parameters as strings. There are a few ways to work around this limitation.

Using if-else to handle empty credentials

In this scenario, the cmdlet you want to run doesn't accept an empty credential object. This example adds the **Credential** parameter to `Invoke-Command` only if it's not empty. Otherwise, it runs the `Invoke-Command` without the **Credential** parameter.

PowerShell

```
function Set-RemoteRegistryValue {
    param(
        $ComputerName,
        $Path,
        $Name,
        $Value,
        [ValidateNotNull()]
        [System.Management.Automation.PSCredential]
        [System.Management.Automation.Credential()]
        $Credential = [System.Management.Automation.PSCredential]::Empty
    )

    if($Credential -ne [System.Management.Automation.PSCredential]::Empty) {
        Invoke-Command -ComputerName:$ComputerName -Credential:$Credential
{
            Set-ItemProperty -Path $using:Path -Name $using:Name -Value
$using:Value
        }
    } else {
        Invoke-Command -ComputerName:$ComputerName {
            Set-ItemProperty -Path $using:Path -Name $using:Name -Value
$using:Value
        }
    }
}
```

Using splatting to handle empty credentials

This example uses parameter splatting to call the legacy cmdlet. The `$Credential` object is conditionally added to the hash table for splatting and avoids the need to repeat the `Invoke-Command` script block. To learn more about splatting inside functions, see the Splatting Parameters Inside Advanced Functions blog post.

PowerShell

```
function Set-RemoteRegistryValue {
    param(
        $ComputerName,
        $Path,
        $Name,
        $Value,
        [ValidateNotNull()]
        [System.Management.Automation.PSCredential]
        [System.Management.Automation.Credential()]
        $Credential = [System.Management.Automation.PSCredential]::Empty
    )

        $Splat = @{
            ComputerName = $ComputerName
        }

        if ($Credential -ne
[System.Management.Automation.PSCredential]::Empty) {
            $Splat['Credential'] = $Credential
        }

        $null = Invoke-Command -ScriptBlock {
            Set-ItemProperty -Path $using:Path -Name $using:Name -Value
$using:Value
        } @splat
}
```

Working with string passwords

The `Invoke-Sqlcmd` cmdlet is an example of a cmdlet that accepts a string as a password. `Invoke-Sqlcmd` allows you to run simple SQL insert, update, and delete statements. `Invoke-Sqlcmd` requires a clear-text username and password rather than a more secure credential object. This example shows how to extract the username and password from a credential object.

The `Get-AllSQLDatabases` function in this example calls the `Invoke-Sqlcmd` cmdlet to query a SQL server for all its databases. The function defines a **Credential** parameter

with the same attribute used in the previous examples. Since the username and password exist within the `$Credential` variable, you can extract those values for use with `Invoke-Sqlcmd`.

The user name is available from the **UserName** property of the `$Credential` variable. To obtain the password, you have to use the `GetNetworkCredential()` method of the `$Credential` object. The values are extracted into variables that are added to a hash table used for splatting parameters to `Invoke-Sqlcmd`.

PowerShell

```
function Get-AllSQLDatabases {
    param(
        $SQLServer,
        [ValidateNotNull()]
        [System.Management.Automation.PSCredential]
        [System.Management.Automation.Credential()]
        $Credential = [System.Management.Automation.PSCredential]::Empty
    )

        $UserName = $Credential.UserName
        $Password = $Credential.GetNetworkCredential().Password

        $splat = @{
            UserName = $UserName
            Password = $Password
            ServerInstance = 'SQLServer'
            Query = "Select * from Sys.Databases"
        }

        Invoke-Sqlcmd @splat
}

$credSplat = @{
    TypeName = 'System.Management.Automation.PSCredential'
    ArgumentList = 'duffney',('P@ssw0rd' | ConvertTo-SecureString -
AsPlainText -Force)
}
$Credential = New-Object @credSplat

Get-AllSQLDatabases -SQLServer SQL01 -Credential $Credential
```

Continued learning credential management

Creating and storing credential objects securely can be difficult. The following resources can help you maintain PowerShell credentials.

- BetterCredentials

- Azure Key Vault
- Vault Project
- SecretManagement module

Avoid assigning variables in expressions

Article • 11/17/2022

PowerShell allows you to use assignments within expressions by enclosing the assignment in parentheses `()`. PowerShell passes the assigned value through. For example:

PowerShell

```
# In an `if` conditional
if ($foo = Get-Item $PROFILE) { "$foo exists" }

# Property access
($profileFile = Get-Item $PROFILE).LastWriteTime

# You can even *assign* to such expressions.
($profileFile = Get-Item $PROFILE).LastWriteTime = Get-Date
```

> **Note**
>
> While this syntax is allowed, its use is discouraged. There are cases where this does not work and the intent of the code author can be confusing to other code reviewers.

Limitations

The assignment case doesn't always work. When it doesn't work, the assignment is discarded. If you create an instance of a *mutable* value type and attempt to both save the instance in a variable and modify one of its properties in the same expression, the property assignment is discarded.

PowerShell

```
# create mutable value type
PS> Add-Type 'public struct Foo { public int x; }'

# Create an instance, store it in a variable, and try to modify its
property.
# This assignment is effectively IGNORED.
PS> ($var = [Foo]::new()).x = 1
PS> $var.x
0
```

The difference is that you can't return a reference to the value. Essentially, `($var = [Foo]::new())` is equivalent to `$($var = [Foo]::new(); $var)`. You're no longer performing a member access on the variable you're performing a member access on the variable's output, which is a copy.

The workaround is to create the instance and save it in a variable first, and then assign to the property via the variable:

PowerShell

```
# create mutable value type
PS> Add-Type 'public struct Foo { public int x; }'

# Create an instance and store it in a variable first
# and then modify its property via the variable.
PS> $var = [Foo]::new()
PS> $var.x = 1
PS> $var.x
1
```

Avoid using Invoke-Expression

Article • 11/17/2022

The `Invoke-Expression` cmdlet should only be used as a *last resort*. In most scenarios, safer and more robust alternatives are available. Forums like Stack Overflow are filled with examples of `Invoke-Expression` misuse. Also note that **PSScriptAnalyzer** has a rule for this. For more information, see AvoidUsingInvokeExpression.

Carefully consider the security implications. When a string from an untrusted source such as user input is passed directly to `Invoke-Expression`, arbitrary commands can be executed. Always consider a different, more robust and secure solution first.

Common scenarios

Consider the following usage scenarios:

- **It's simpler to redirect PowerShell to execute something naturally.** For example:

  PowerShell

  ```
  Get-Content ./file.ps1 | Invoke-Expression
  ```

  These cases are trivially avoidable. The script or code already exists in file or AST form, so you should write a script with parameters and invoke it directly instead of using `Invoke-Expression` on a string.

- **Running a script from a trusted source.** For example, running the install script from the PowerShell repository:

  PowerShell

  ```
  Invoke-WebRequest https://aka.ms/install-powershell.ps1 | Invoke-
  Expression
  ```

  You should only use this interactively. And, while this does make life simpler, this practice should be discouraged.

- **Testing for parsing errors.** The PowerShell team tests for parse errors in the source code using `Invoke-Expression` because that's the only way to turn a parse-time error into a runtime one.

Conclusion

Most other scripting languages have a way to evaluate a string as code, and as an interpreted language, PowerShell must have a way to dynamically run itself. But there's no good reason to use `Invoke-Expression` in a production environment.

References

- Stack Overflow discussion - In what scenario was Invoke-Expression designed to be used?
- PowerShell Blog post - Invoke-Expression Considered Harmful

Limitations of PowerShell transcripts

Article • 11/17/2022

Mixing `Write-Host` output with the output objects, strings, and PowerShell transcription is complicated. There is a subtle interaction between the script and how transcription works with PowerShell pipelines that can have unexpected results.

When you emit objects from your script the formatting of those objects is handled by `Out-Default`. But the formatting can occur after the script has completed and transcription has stopped. This means that the output doesn't get transcribed. Strings are handled differently. Sometimes string output is passed through formatting, but not always. `Write-Host` makes an immediate write to the host process. `Write-Object` is sent through the formatting system. Combining the output of complex objects with writes to the host makes it difficult to predict what gets logged in the transcript.

Scenario 1 - Output of a structured object at the end of all of the other operations

Consider the following script and its output:

PowerShell

```
PS> Get-Content scenario1.ps1
Start-Transcript scenario1.log -UseMinimalHeader
Write-Host '1'
Write-Output '2'
Get-Location
Write-Host '4'
Write-Output '5'
Stop-Transcript

PS> ./scenario1.ps1
Transcript started, output file is scenario1.log
1
2

4
Path
----
/Users/user1/src/projects/transcript
5
Transcript stopped, output file is
/Users/user1/src/projects/transcript/scenario1.log
```

The output to the console shows the output you expect, but not in the order you expect it. `Write-Host 4` is visible before `Get-Location` because `Write-Host` is optimized to write directly to the host. There's code in transcription that copies the output to the transcript file and the console. Then we have the regular output of `Get-Location` and `Write-Output 5` sent as output of the script.

PowerShell

```
PS> Get-Content scenario1.log
**********************
PowerShell transcript start
Start time: 20191106114858
**********************
Transcript started, output file is s2
1
2

4
**********************
PowerShell transcript end
End time: 20191106114858
**********************
```

Since transcription is turned off before the script exits, it's not rendered in the transcript. The objects were sent to the next consumer in the pipeline. In this case, it's `Out-Default`, which PowerShell inserted automatically. To complicate things further, the output of strings is also optimized in the formatting system. The first `Write-Output 2` gets emitted and captured by the transcript. But the insertion of the `Get-Location` object causes its output to be pushed into the stack of things that need actual formatting, which sets a bit of state for any remaining objects that also may need formatting. This is why the second `Write-Output 5` doesn't get added to the transcript.

Scenario 2 - Move the object emission to the beginning

Consider the following script and its output:

PowerShell

```
PS> Get-Content scenario2.ps1
Start-Transcript scenario2.log -UseMinimalHeader
Get-Location
Write-Host '1'
Write-Output '2'
Get-Location
```

```
Write-Host '4'
Write-Output '5'
Stop-Transcript

PS> ./scenario2.ps1
Transcript started, output file is scenario2.log

1
4
Path
----
/Users/user1/src/projects/transcript
2
5
Transcript stopped, output file is
/Users/user1/src/projects/transcript/scenario2.log
```

We can see that the `Write-Host` commands happen before anything, and then the objects start to come out. The `Write-Output` of a string forces the object to be rendered to the screen, but notice that the transcript contains only the output of `Write-Host`. That's because those string objects are piped to `Out-Default` for formatting after the script turned off transcription.

PowerShell

```
PS> Get-Content scenario2.log
**********************
PowerShell transcript start
Start time: 20220606094609
**********************
Transcript started, output file is s3

1
4
**********************
PowerShell transcript end
End time: 20220606094609
**********************
```

Scenario 3 - Object emitted at the end of the script

For this scenario, the output of the complex object is at the end of the script.

PowerShell

```
PS> Get-Content scenario3.ps1
Start-Transcript scenario3.log -UseMinimalHeader
Write-Host '1'
Write-Output '2'
Write-Host '4'
Write-Output '5'
Get-Location
Stop-Transcript

PS> ./scenario3.ps1
Transcript started, output file is scenario3.log
1
2
4
5

Path
----
/Users/user1/src/projects/transcript
Transcript stopped, output file is
/Users/user1/src/projects/transcript/scenario3.log
```

The string output from both `Write-Host` and `Write-Object` makes it into the transcript. However, the output from `Get-Location` occurs after transcription has stopped.

```
**********************
PowerShell transcript start
Start time: 20220606100342
**********************
Transcript started, output file is scenario3.log
1
2
4
5

**********************
PowerShell transcript end
End time: 20220606100342
**********************
```

A way to ensure full transcription

This example is a slight variation on the original scenario, but now everything is logged to the transcript. The original code is wrapped in a script block and the formatter explicitly invoked via `Out-Default`.

PowerShell

```
PS> Get-Content scenario4.ps1
Start-Transcript scenario4.log -UseMinimalHeader
. {
    Write-Host '1'
    Write-Output '2'
    Get-Location
    Write-Host '4'
    Write-Output '5'
} | Out-Default
Stop-Transcript

PS> ./scenario4.ps1
Transcript started, output file is scenario4.log
1
2

4
Path
----
/Users/user1/src/projects/transcript
5

Transcript stopped, output file is
/Users/user1/src/projects/transcript/scenario4.log
```

Notice that the last `Write-Host` call is still out of order, that's because of the optimization in `Write-Host` that doesn't go into the output stream.

PowerShell

```
PS> Get-Content scenario4.log
**********************
PowerShell transcript start
Start time: 20220606101038
**********************
Transcript started, output file is s5
1
2

4
Path
----
/Users/user1/src/projects/transcript
5

**********************
PowerShell transcript end
End time: 20220606101038
**********************
```

Sample scripts for system administration

A collection of examples walks through scenarios for administering systems with PowerShell.

Working with objects

HOW-TO GUIDE

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Selecting parts of objects

Removing objects from the pipeline

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Multiple selection list boxes

Selecting items from a list box

Viewing object structure

Article • 12/09/2022

Because objects play such a central role in PowerShell, there are several native commands designed to work with arbitrary object types. The most important one is the `Get-Member` command.

The simplest technique for analyzing the objects that a command returns is to pipe the output of that command to the `Get-Member` cmdlet. The `Get-Member` cmdlet shows you the formal name of the object type and a complete listing of its members. The number of elements that are returned can sometimes be overwhelming. For example, a process object can have over 100 members.

The following command allows you to see all the members of a **Process** object and page through the output.

PowerShell

```powershell
Get-Process | Get-Member | Out-Host -Paging
```

Output

```
TypeName: System.Diagnostics.Process

Name                           MemberType     Definition
----                           ----------     ----------
Handles                        AliasProperty  Handles = Handlecount
Name                           AliasProperty  Name = ProcessName
NPM                            AliasProperty  NPM = NonpagedSystemMemorySize
PM                             AliasProperty  PM = PagedMemorySize
VM                             AliasProperty  VM = VirtualMemorySize
WS                             AliasProperty  WS = WorkingSet
add_Disposed                   Method         System.Void
add_Disposed(Event...
...
```

We can make this long list of information more usable by filtering for elements we want to see. The `Get-Member` command lets you list only members that are properties. There are several forms of properties. The cmdlet displays properties of a type using the **MemberType** parameter with the value `Properties`. The resulting list is still very long, but a more manageable:

PowerShell

```
Get-Process | Get-Member -MemberType Properties
```

Output

```
   TypeName: System.Diagnostics.Process

Name                       MemberType     Definition
----                       ----------     ----------
Handles                    AliasProperty  Handles = Handlecount
Name                       AliasProperty  Name = ProcessName
...
ExitCode                   Property       System.Int32 ExitCode {get;}
...
Handle                     Property       System.IntPtr Handle {get;}
...
CPU                        ScriptProperty System.Object CPU
{get=$this.Total...
...
Path                       ScriptProperty System.Object Path
{get=$this.Main...
...
```

> **Note**
>
> The allowed values of MemberType are AliasProperty, CodeProperty, Property, NoteProperty, ScriptProperty, Properties, PropertySet, Method, CodeMethod, ScriptMethod, Methods, ParameterizedProperty, MemberSet, and All.

There are more than 60 properties for a process. By default, PowerShell determines how to display an object type using information stored in XML files that have names ending in `.format.ps1xml`. The formatting definition for process objects is stored in `DotNetTypes.format.ps1xml`.

If you need to look at properties other than those that PowerShell displays by default, you can format the output using the `Format-*` cmdlets.

Selecting parts of objects

Article • 12/09/2022

You can use the `Select-Object` cmdlet to create new, custom PowerShell objects that contain properties selected from the objects you use to create them. Type the following command to create a new object that includes only the **Name** and **FreeSpace** properties of the **Win32_LogicalDisk** WMI class:

PowerShell

```powershell
Get-CimInstance -Class Win32_LogicalDisk |
    Select-Object -Property Name, FreeSpace
```

Output

```
Name      FreeSpace
----      ---------
C:      50664845312
```

With `Select-Object` you can create calculated properties to display **FreeSpace** in gigabytes rather than bytes.

PowerShell

```powershell
Get-CimInstance -Class Win32_LogicalDisk |
    Select-Object -Property Name, @{
        label='FreeSpace'
        expression={($_.FreeSpace/1GB).ToString('F2')}
    }
```

Output

```
Name    FreeSpace
----    ---------
C:      47.18
```

Removing objects from the pipeline

Article • 12/09/2022

In PowerShell, you often generate and pass along more objects to a pipeline than you want. You can specify the properties of particular objects to display using the `Format-*` cmdlets, but this doesn't help with the problem of removing entire objects from the display. You may want to filter objects before the end of a pipeline, so you can perform actions on only a subset of the initially generated objects.

PowerShell includes a `Where-Object` cmdlet that allows you to test each object in the pipeline and only pass it along the pipeline if it meets a particular test condition. Objects that don't pass the test are removed from the pipeline. You supply the test condition as the value of the **FilterScript** parameter.

Performing simple tests with Where-Object

The value of **FilterScript** is a *script block* - one or more PowerShell commands surrounded by braces (`{}`) - that evaluates to true or false. These script blocks can be simple, but creating them requires knowing about another PowerShell concept, comparison operators. A comparison operator compares the items that appear on each side of it. Comparison operators begin with a hyphen character (`-`) and are followed by a name. Basic comparison operators work on almost any kind of object. The more advanced comparison operators might only work on text or arrays.

> **Note**
>
> By default, PowerShell comparison operators are case-insensitive.

Due to parsing considerations, symbols such as `<`, `>`, and `=` aren't used as comparison operators. Instead, comparison operators are comprised of letters. The basic comparison operators are listed in the following table.

Comparison Operator	Meaning	Example (returns true)
-eq	is equal to	1 -eq 1
-ne	isn't equal to	1 -ne 2
-lt	Is less than	1 -lt 2
-le	Is less than or equal to	1 -le 2

Comparison Operator	Meaning	Example (returns true)
-gt	Is greater than	2 -gt 1
-ge	Is greater than or equal to	2 -ge 1
-like	Is like (wildcard comparison for text)	"file.doc" -like "f*.do?"
-notlike	isn't like (wildcard comparison for text)	"file.doc" -notlike "p*.doc"
-contains	Contains	1,2,3 -contains 1
-notcontains	doesn't contain	1,2,3 -notcontains 4

`Where-Object` script blocks use the special variable `$_` to refer to the current object in the pipeline. Here is an example of how it works. If you have a list of numbers, and only want to return the ones that are less than 3, you can use `Where-Object` to filter the numbers by typing:

```
1,2,3,4 | Where-Object {$_ -lt 3}
1
2
```

Filtering based on object properties

Since `$_` refers to the current pipeline object, we can access its properties for our tests.

As an example, we can look at the **Win32_SystemDriver** class in WMI. There might be hundreds of system drivers on a particular system, but you might only be interested in a particular set of the system drivers, such as those that are running. For the **Win32_SystemDriver** class the relevant property is **State**. You can filter the system drivers, selecting only the running ones by typing:

PowerShell

```
Get-CimInstance -Class Win32_SystemDriver |
    Where-Object {$_.State -eq 'Running'}
```

This still produces a long list. You may want to filter to only select the drivers set to start automatically by testing the **StartMode** value as well:

PowerShell

```powershell
Get-CimInstance -Class Win32_SystemDriver |
    Where-Object {$_.State -eq "Running"} |
    Where-Object {$_.StartMode -eq "Auto"}
```

Output

```
DisplayName : RAS Asynchronous Media Driver
Name        : AsyncMac
State       : Running
Status      : OK
Started     : True

DisplayName : Audio Stub Driver
Name        : audstub
State       : Running
Status      : OK
Started     : True
...
```

This gives us a lot of information we no longer need because we know that the drivers are running. In fact, the only information we probably need at this point are the name and the display name. The following command includes only those two properties, resulting in much simpler output:

PowerShell

```powershell
Get-CimInstance -Class Win32_SystemDriver |
    Where-Object {$_.State -eq "Running"} |
    Where-Object {$_.StartMode -eq "Manual"} |
    Format-Table -Property Name,DisplayName
```

Output

```
Name              DisplayName
----              -----------
AsyncMac               RAS Asynchronous Media Driver
bindflt                Windows Bind Filter Driver
bowser                 Browser
CompositeBus           Composite Bus Enumerator Driver
condrv                 Console Driver
HdAudAddService        Microsoft 1.1 UAA Function Driver for High Definition
Audio Service
HDAudBus               Microsoft UAA Bus Driver for High Definition Audio
HidUsb                 Microsoft HID Class Driver
HTTP                   HTTP Service
igfx                   igfx
IntcDAud               Intel(R) Display Audio
```

```
intelppm               Intel Processor Driver
...
```

There are two `Where-Object` elements in the above command, but they can be expressed in a single `Where-Object` element using the `-and` logical operator, like this:

PowerShell

```
Get-CimInstance -Class Win32_SystemDriver |
    Where-Object {($_.State -eq 'Running') -and ($_.StartMode -eq 'Manual')}
|
    Format-Table -Property Name,DisplayName
```

The standard logical operators are listed in the following table.

Logical Operator	Meaning	Example (returns true)
`-and`	Logical and; true if both sides are true	`(1 -eq 1) -and (2 -eq 2)`
`-or`	Logical or; true if either side is true	`(1 -eq 1) -or (1 -eq 2)`
`-not`	Logical not; reverses true and false	`-not (1 -eq 2)`
`!`	Logical not; reverses true and false	`!(1 -eq 2)`

Sorting objects

Article • 12/09/2022

We can organize displayed data to make it easier to scan using the `Sort-Object` cmdlet. `Sort-Object` takes the name of one or more properties to sort on, and returns data sorted by the values of those properties.

Basic sorting

Consider the problem of listing subdirectories and files in the current directory. If we want to sort by **LastWriteTime** and then by **Name**, we can do it by typing:

PowerShell

```
Get-ChildItem |
    Sort-Object -Property LastWriteTime, Name |
    Format-Table -Property LastWriteTime, Name
```

Output

```
LastWriteTime          Name
-------------          ----
11/6/2017 10:10:11 AM  .localization-config
11/6/2017 10:10:11 AM  .openpublishing.build.ps1
11/6/2017 10:10:11 AM  appveyor.yml
11/6/2017 10:10:11 AM  LICENSE
11/6/2017 10:10:11 AM  LICENSE-CODE
11/6/2017 10:10:11 AM  ThirdPartyNotices
11/6/2017 10:10:15 AM  tests
6/6/2018 7:58:59 PM    CONTRIBUTING.md
6/6/2018 7:58:59 PM    README.md
...
```

You can also sort the objects in reverse order by specifying the **Descending** switch parameter.

PowerShell

```
Get-ChildItem |
  Sort-Object -Property LastWriteTime, Name -Descending |
  Format-Table -Property LastWriteTime, Name
```

Output

```
LastWriteTime          Name
-------------          ----
12/1/2018 10:13:50 PM  reference
12/1/2018 10:13:50 PM  dsc
...
6/6/2018 7:58:59 PM    README.md
6/6/2018 7:58:59 PM    CONTRIBUTING.md
11/6/2017 10:10:15 AM  tests
11/6/2017 10:10:11 AM  ThirdPartyNotices
11/6/2017 10:10:11 AM  LICENSE-CODE
11/6/2017 10:10:11 AM  LICENSE
11/6/2017 10:10:11 AM  appveyor.yml
11/6/2017 10:10:11 AM  .openpublishing.build.ps1
11/6/2017 10:10:11 AM  .localization-config
```

Using hash tables

You can sort different properties in different orders using hash tables in an array. Each hash table uses an **Expression** key to specify the property name as string and an **Ascending** or **Descending** key to specify the sort order by `$true` or `$false`. The **Expression** key is mandatory. The **Ascending** or **Descending** key is optional.

The following example sorts objects in descending **LastWriteTime** order and ascending **Name** order.

PowerShell

```powershell
Get-ChildItem |
  Sort-Object -Property @{ Expression = 'LastWriteTime'; Descending = $true
},
                        @{ Expression = 'Name'; Ascending = $true } |
  Format-Table -Property LastWriteTime, Name
```

Output

```
LastWriteTime          Name
-------------          ----
12/1/2018 10:13:50 PM  dsc
12/1/2018 10:13:50 PM  reference
11/29/2018 6:56:01 PM  .openpublishing.redirection.json
11/29/2018 6:56:01 PM  gallery
11/24/2018 10:33:22 AM developer
11/20/2018 7:22:19 PM  .markdownlint.json
...
```

You can also set a scriptblock to the **Expression** key. When running the `Sort-Object` cmdlet, the scriptblock is executed and the result is used for sorting.

The following example sorts objects in descending order by the time span between **CreationTime** and **LastWriteTime**.

PowerShell

```
Get-ChildItem |
    Sort-Object -Property @{ Exp = { $_.LastWriteTime - $_.CreationTime };
Desc = $true } |
    Format-Table -Property LastWriteTime, CreationTime
```

Output

```
LastWriteTime          CreationTime
-------------          ------------
12/1/2018 10:13:50 PM  11/6/2017 10:10:11 AM
12/1/2018 10:13:50 PM  11/6/2017 10:10:11 AM
11/7/2018 6:52:24 PM   11/6/2017 10:10:11 AM
11/7/2018 6:52:24 PM   11/6/2017 10:10:15 AM
11/3/2018 9:58:17 AM   11/6/2017 10:10:11 AM
10/26/2018 4:50:21 PM  11/6/2017 10:10:11 AM
11/17/2018 1:10:57 PM  11/29/2017 5:48:30 PM
11/12/2018 6:29:53 PM  12/7/2017 7:57:07 PM
...
```

Tips

You can omit the **Property** parameter name as following:

PowerShell

```
Sort-Object LastWriteTime, Name
```

Besides, you can refer to `Sort-Object` by its built-in alias, `sort`:

PowerShell

```
sort LastWriteTime, Name
```

The keys in the hash tables for sorting can be abbreviated as following:

PowerShell

```
Sort-Object @{ e = 'LastWriteTime'; d = $true }, @{ e = 'Name'; a = $true }
```

In this example, the **e** stands for **Expression**, the **d** stands for **Descending**, and the **a** stands for **Ascending**.

To improve readability, you can place the hash tables into a separate variable:

PowerShell

```
$order = @(
  @{ Expression = 'LastWriteTime'; Descending = $true }
  @{ Expression = 'Name'; Ascending = $true }
)

Get-ChildItem |
    Sort-Object $order |
    Format-Table LastWriteTime, Name
```

Creating .NET and COM objects

Article • 12/09/2022

> This sample only runs on Windows platforms.

There are software components with .NET Framework and COM interfaces that enable you to perform many system administration tasks. PowerShell lets you use these components, so you aren't limited to the tasks that can be performed by using cmdlets. Many of the cmdlets in the initial release of PowerShell don't work against remote computers. We will demonstrate how to get around this limitation when managing event logs by using the .NET Framework **System.Diagnostics.EventLog** class directly from PowerShell.

Using New-Object for event log access

The .NET Framework Class Library includes a class named **System.Diagnostics.EventLog** that can be used to manage event logs. You can create a new instance of a .NET Framework class by using the `New-Object` cmdlet with the **TypeName** parameter. For example, the following command creates an event log reference:

PowerShell

```
New-Object -TypeName System.Diagnostics.EventLog
```

Output

```
  Max(K) Retain OverflowAction       Entries Name
  ------ ------ --------------       ------- ----
```

Although the command has created an instance of the **EventLog** class, the instance doesn't include any data. that's because we didn't specify a particular event log. How do you get a real event log?

Using constructors with New-Object

To refer to a specific event log, you need to specify the name of the log. `New-Object` has an **ArgumentList** parameter. The arguments you pass as values to this parameter are used by a special startup method of the object. The method is called a **constructor**

because it's used to construct the object. For example, to get a reference to the Application log, you specify the string 'Application' as an argument:

PowerShell

```
New-Object -TypeName System.Diagnostics.EventLog -ArgumentList Application
```

Output

```
Max(K) Retain OverflowAction       Entries Name
------ ------ --------------       ------- ----
16,384      7 OverwriteOlder           2,160 Application
```

> **Note**
>
> Since most of the .NET classes are contained in the **System** namespace, PowerShell automatically attempts to find classes you specify in the **System** namespace if it can't find a match for the typename you specify. This means that you can specify `Diagnostics.EventLog` instead of `System.Diagnostics.EventLog`.

Storing Objects in Variables

You might want to store a reference to an object, so you can use it in the current shell. Although PowerShell lets you do a lot of work with pipelines, lessening the need for variables, sometimes storing references to objects in variables makes it more convenient to manipulate those objects.

The output from any valid PowerShell command can be stored in a variable. Variable names always begin with `$`. If you want to store the Application log reference in a variable named `$AppLog`, type the name of the variable, followed by an equal sign and then type the command used to create the Application log object:

PowerShell

```
$AppLog = New-Object -TypeName System.Diagnostics.EventLog -ArgumentList
Application
```

If you then type `$AppLog`, you can see that it contains the Application log:

PowerShell

```
$AppLog
```

Output

```
  Max(K) Retain OverflowAction       Entries Name
  ------ ------ --------------       ------- ----
  16,384      7 OverwriteOlder           2,160 Application
```

Accessing a remote event log with New-Object

The commands used in the preceding section target the local computer; the `Get-EventLog` cmdlet can do that. To access the Application log on a remote computer, you must supply both the log name and a computer name (or IP address) as arguments.

PowerShell

```
$RemoteAppLog = New-Object -TypeName System.Diagnostics.EventLog
Application, 192.168.1.81
$RemoteAppLog
```

Output

```
  Max(K) Retain OverflowAction       Entries Name
  ------ ------ --------------       ------- ----
     512      7 OverwriteOlder            262 Application
```

Now that we have a reference to an event log stored in the `$RemoteAppLog` variable, what tasks can we perform on it?

Clearing an event log with object methods

Objects often have methods that can be called to perform tasks. You can use `Get-Member` to display the methods associated with an object. The following command and selected output show some the methods of the **EventLog** class:

PowerShell

```
$RemoteAppLog | Get-Member -MemberType Method
```

Output

```
   TypeName: System.Diagnostics.EventLog

Name                      MemberType Definition
```

```
----                        ---------- ----------
...
Clear                       Method     System.Void Clear()
Close                       Method     System.Void Close()
...
GetType                     Method     System.Type GetType()
...
ModifyOverflowPolicy        Method     System.Void
ModifyOverflowPolicy(Overfl...
RegisterDisplayName         Method     System.Void RegisterDisplayName(String
...
...
ToString                    Method     System.String ToString()
WriteEntry                  Method     System.Void WriteEntry(String
message),...
WriteEvent                  Method     System.Void WriteEvent(EventInstance
in...
```

The `Clear()` method can be used to clear the event log. When calling a method, you must always follow the method name by parentheses, even if the method doesn't require arguments. This lets PowerShell distinguish between the method and a potential property with the same name. Type the following to call the **Clear** method:

PowerShell

```
$RemoteAppLog.Clear()
$RemoteAppLog
```

Output

```
  Max(K) Retain OverflowAction        Entries Name
  ------ ------ --------------        ------- ----
     512      7 OverwriteOlder              0 Application
```

Notice that the event log was cleared and now has 0 entries instead of 262.

Creating COM objects with New-Object

You can use `New-Object` to work with Component Object Model (COM) components. Components range from the various libraries included with Windows Script Host (WSH) to ActiveX applications such as Internet Explorer that are installed on most systems.

`New-Object` uses .NET Framework Runtime-Callable Wrappers to create COM objects, so it has the same limitations that .NET Framework does when calling COM objects. To create a COM object, you need to specify the **ComObject** parameter with the Programmatic Identifier or **ProgId** of the COM class you want to use. A complete

discussion of the limitations of COM use and determining what ProgIds are available on a system is beyond the scope of this user's guide, but most well-known objects from environments such as WSH can be used within PowerShell.

You can create the WSH objects by specifying these progids: **WScript.Shell**, **WScript.Network**, **Scripting.Dictionary**, and **Scripting.FileSystemObject**. The following commands create these objects:

PowerShell

```
New-Object -ComObject WScript.Shell
New-Object -ComObject WScript.Network
New-Object -ComObject Scripting.Dictionary
New-Object -ComObject Scripting.FileSystemObject
```

Although most of the functionality of these classes is made available in other ways in Windows PowerShell, a few tasks such as shortcut creation are still easier to do using the WSH classes.

Creating a desktop shortcut with WScript.Shell

One task that can be performed quickly with a COM object is creating a shortcut. Suppose you want to create a shortcut on your desktop that links to the home folder for PowerShell. You first need to create a reference to **WScript.Shell**, which we will store in a variable named `$WshShell`:

PowerShell

```
$WshShell = New-Object -ComObject WScript.Shell
```

`Get-Member` works with COM objects, so you can explore the members of the object by typing:

PowerShell

```
$WshShell | Get-Member
```

Output

```
   TypeName: System.__ComObject#{41904400-be18-11d3-a28b-00104bd35090}

Name                      MemberType            Definition
----                      ----------            ----------
AppActivate               Method                bool AppActivate (Variant,
```

```
Va...
CreateShortcut           Method               IDispatch CreateShortcut
(str...
...
```

`Get-Member` has an optional **InputObject** parameter you can use instead of piping to provide input to `Get-Member`. You would get the same output as shown above if you instead used the command **Get-Member -InputObject $WshShell**. If you use **InputObject**, it treats its argument as a single item. This means that if you have several objects in a variable, `Get-Member` treats them as an array of objects. For example:

PowerShell

```
$a = 1,2,"three"
Get-Member -InputObject $a
```

Output

```
TypeName: System.Object[]
Name                MemberType    Definition
----                ----------    ----------
Count               AliasProperty Count = Length
...
```

The **WScript.Shell CreateShortcut** method accepts a single argument, the path to the shortcut file to create. We could type in the full path to the desktop, but there is an easier way. The desktop is normally represented by a folder named Desktop inside the home folder of the current user. Windows PowerShell has a variable `$HOME` that contains the path to this folder. We can specify the path to the home folder by using this variable, and then add the name of the Desktop folder and the name for the shortcut to create by typing:

PowerShell

```
$lnk = $WshShell.CreateShortcut("$HOME\Desktop\PSHome.lnk")
```

When you use something that looks like a variable name inside double-quotes, PowerShell tries to substitute a matching value. If you use single-quotes, PowerShell doesn't try to substitute the variable value. For example, try typing the following commands:

PowerShell

```
"$HOME\Desktop\PSHome.lnk"
```

Output

```
C:\Documents and Settings\aka\Desktop\PSHome.lnk
```

PowerShell

```
'$HOME\Desktop\PSHome.lnk'
```

Output

```
$HOME\Desktop\PSHome.lnk
```

We now have a variable named `$lnk` that contains a new shortcut reference. If you want to see its members, you can pipe it to `Get-Member`. The output below shows the members we need to use to finish creating our shortcut:

PowerShell

```
$lnk | Get-Member
```

Output

```
TypeName: System.__ComObject#{f935dc23-1cf0-11d0-adb9-00c04fd58a0b}
Name             MemberType   Definition
----             ----------   ----------
...
Save             Method       void Save ()
...
TargetPath       Property     string TargetPath () {get} {set}
```

We need to specify the **TargetPath**, which is the application folder for PowerShell, and then save the shortcut by calling the `Save` method. The PowerShell application folder path is stored in the variable `$PSHome`, so we can do this by typing:

PowerShell

```
$lnk.TargetPath = $PSHome
$lnk.Save()
```

Using Internet Explorer from PowerShell

Many applications, including the Microsoft Office family of applications and Internet Explorer, can be automated by using COM. The following examples illustrate some of the typical techniques and issues involved in working with COM-based applications.

You create an Internet Explorer instance by specifying the Internet Explorer ProgId, **InternetExplorer.Application**:

```
PowerShell
```

```
$ie = New-Object -ComObject InternetExplorer.Application
```

This command starts Internet Explorer, but doesn't make it visible. If you type `Get-Process`, you can see that a process named `iexplore` is running. In fact, if you exit PowerShell, the process will continue to run. You must reboot the computer or use a tool like Task Manager to end the `iexplore` process.

> **Note**
>
> COM objects that start as separate processes, commonly called *ActiveX executables*, may or may not display a user interface window when they start up. If they create a window but don't make it visible, like Internet Explorer, the focus usually moves to the Windows desktop. You must make the window visible to interact with it.

By typing `$ie | Get-Member`, you can view properties and methods for Internet Explorer. To see the Internet Explorer window, set the **Visible** property to `$true` by typing:

```
PowerShell
```

```
$ie.Visible = $true
```

You can then navigate to a specific Web address using the `Navigate` method:

```
PowerShell
```

```
$ie.Navigate("https://devblogs.microsoft.com/scripting/")
```

Using other members of the Internet Explorer object model, it's possible to retrieve text content from the Web page. The following command displays the HTML text in the body of the current Web page:

```
PowerShell
```

```
$ie.Document.Body.InnerText
```

To close Internet Explorer from within PowerShell, call its `Quit()` method:

PowerShell

```
$ie.Quit()
```

The `$ie` variable no longer contains a valid reference even though it still appears to be a COM object. If you attempt to use it, PowerShell returns an automation error:

PowerShell

```
$ie | Get-Member
```

Output

```
Get-Member : Exception retrieving the string representation for property
"Appli
cation" : "The object invoked has disconnected from its clients. (Exception
fro
m HRESULT: 0x80010108 (RPC_E_DISCONNECTED))"
At line:1 char:16
+ $ie | Get-Member <<<<
```

You can either remove the remaining reference with a command like `$ie = $null`, or completely remove the variable by typing:

PowerShell

```
Remove-Variable ie
```

> **Note**
>
> There is no common standard for whether ActiveX executables exit or continue to run when you remove a reference to one. Depending on circumstances, such as whether the application is visible, whether an edited document is running in it, and even whether PowerShell is still running, the application may or may not exit. For this reason, you should test termination behavior for each ActiveX executable you want to use in PowerShell.

Getting warnings about .NET Framework-wrapped COM objects

In some cases, a COM object might have an associated .NET Framework **Runtime-Callable Wrapper** (RCW) that's used by `New-Object`. Since the behavior of the RCW may be different from the behavior of the normal COM object, `New-Object` has a **Strict** parameter to warn you about RCW access. If you specify the **Strict** parameter and then create a COM object that uses an RCW, you get a warning message:

PowerShell

```
$xl = New-Object -ComObject Excel.Application -Strict
```

Output

```
New-Object : The object written to the pipeline is an instance of the type
"Mic
rosoft.Office.Interop.Excel.ApplicationClass" from the component's primary
interop assembly. If
this type exposes different members than the IDispatch members , scripts
written to work with this
object might not work if the primary interop assembly isn't installed. At
line:1 char:17 + $xl =
New-Object <<<< -ComObject Excel.Application -Strict
```

Although the object is still created, you are warned that it isn't a standard COM object.

Using static classes and methods

Article • 12/09/2022

Not all .NET Framework classes can be created using `New-Object`. For example, if you try to create a **System.Environment** or a **System.Math** object with `New-Object`, you will get the following error messages:

PowerShell

```
New-Object System.Environment
```

Output

```
New-Object : Constructor not found. Cannot find an appropriate constructor
for
type System.Environment.
At line:1 char:11
+ New-Object  <<<< System.Environment
```

PowerShell

```
New-Object System.Math
```

Output

```
New-Object : Constructor not found. Cannot find an appropriate constructor
for
type System.Math.
At line:1 char:11
+ New-Object  <<<< System.Math
```

These errors occur because there is no way to create a new object from these classes. These classes are reference libraries of methods and properties that don't change state. You don't need to create them, you simply use them. Classes and methods such as these are called *static classes* because they're not created, destroyed, or changed. To make this clear we will provide examples that use static classes.

Getting environment data with System.Environment

Usually, the first step in working with an object in Windows PowerShell is to use Get-Member to find out what members it contains. With static classes, the process is a little different because the actual class isn't an object.

Referring to the static System.Environment class

You can refer to a static class by surrounding the class name with square brackets. For example, you can refer to **System.Environment** by typing the name within brackets. Doing so displays some generic type information:

PowerShell

```
[System.Environment]
```

Output

```
IsPublic IsSerial Name                                     BaseType
-------- -------- ----                                     --------
True     False    Environment                              System.Object
```

> **Note**
>
> As we mentioned previously, Windows PowerShell automatically prepends '**System.**' to type names when you use `New-Object`. The same thing happens when using a bracketed type name, so you can specify **[System.Environment]** as **[Environment]**.

The **System.Environment** class contains general information about the working environment for the current process, which is `powershell.exe` when working within Windows PowerShell.

If you try to view details of this class by typing **[System.Environment] | Get-Member**, the object type is reported as being **System.RuntimeType** , not **System.Environment**:

PowerShell

```
[System.Environment] | Get-Member
```

Output

```
   TypeName: System.RuntimeType
```

To view static members with Get-Member, specify the **Static** parameter:

PowerShell

```
[System.Environment] | Get-Member -Static
```

Output

```
   TypeName: System.Environment

Name                      MemberType Definition
----                      ---------- ----------
Equals                    Method     static System.Boolean Equals(Object
ob...
Exit                      Method     static System.Void Exit(Int32
exitCode)
...
CommandLine               Property   static System.String CommandLine
{get;}
CurrentDirectory          Property   static System.String CurrentDirectory
...
ExitCode                  Property   static System.Int32 ExitCode
{get;set;}
HasShutdownStarted        Property   static System.Boolean
HasShutdownStart...
MachineName               Property   static System.String MachineName
{get;}
NewLine                   Property   static System.String NewLine {get;}
OSVersion                 Property   static System.OperatingSystem
OSVersio...
ProcessorCount            Property   static System.Int32 ProcessorCount
{get;}
StackTrace                Property   static System.String StackTrace {get;}
SystemDirectory           Property   static System.String SystemDirectory
{...
TickCount                 Property   static System.Int32 TickCount {get;}
UserDomainName            Property   static System.String UserDomainName
{g...
UserInteractive           Property   static System.Boolean UserInteractive
...
UserName                  Property   static System.String UserName {get;}
Version                   Property   static System.Version Version {get;}
WorkingSet                Property   static System.Int64 WorkingSet {get;}
TickCount                              ExitCode
```

We can now select properties to view from System.Environment.

Displaying static properties of System.Environment

The properties of System.Environment are also static, and must be specified in a different way than normal properties. We use `::` to indicate to Windows PowerShell that we want to work with a static method or property. To see the command that was used to launch Windows PowerShell, we check the **CommandLine** property by typing:

PowerShell

```
[System.Environment]::Commandline
```

Output

```
"C:\Program Files\Windows PowerShell\v1.0\powershell.exe"
```

To check the operating system version, display the OSVersion property by typing:

PowerShell

```
[System.Environment]::OSVersion
```

Output

```
           Platform ServicePack         Version             VersionString
           -------- -----------         -------             -------------
            Win32NT Service Pack 2      5.1.2600.131072     Microsoft
Windows...
```

We can check whether the computer is in the process of shutting down by displaying the **HasShutdownStarted** property:

PowerShell

```
[System.Environment]::HasShutdownStarted
```

Output

```
False
```

Doing math with System.Math

The **System.Math** static class is useful for performing some mathematical operations. The class includes several useful methods, which we can display using `Get-Member`.

> ⓘ Note
>
> **System.Math** has several methods with the same name, but they're distinguished by the type of their parameters.

Type the following command to list the methods of the **System.Math** class.

PowerShell

```
[System.Math] | Get-Member -Static -MemberType Methods
```

Output

```
   TypeName: System.Math

Name            MemberType Definition
----            ---------- ----------
Abs             Method     static System.Single Abs(Single value), static
Sy...
Acos            Method     static System.Double Acos(Double d)
Asin            Method     static System.Double Asin(Double d)
Atan            Method     static System.Double Atan(Double d)
Atan2           Method     static System.Double Atan2(Double y, Double x)
BigMul          Method     static System.Int64 BigMul(Int32 a, Int32 b)
Ceiling         Method     static System.Double Ceiling(Double a), static
Sy...
Cos             Method     static System.Double Cos(Double d)
Cosh            Method     static System.Double Cosh(Double value)
DivRem          Method     static System.Int32 DivRem(Int32 a, Int32 b,
Int3...
Equals          Method     static System.Boolean Equals(Object objA, Object
...
Exp             Method     static System.Double Exp(Double d)
Floor           Method     static System.Double Floor(Double d), static
Syst...
IEEERemainder   Method     static System.Double IEEERemainder(Double x,
Doub...
Log             Method     static System.Double Log(Double d), static
System...
Log10           Method     static System.Double Log10(Double d)
Max             Method     static System.SByte Max(SByte val1, SByte val2),
...
Min             Method     static System.SByte Min(SByte val1, SByte val2),
...
Pow             Method     static System.Double Pow(Double x, Double y)
ReferenceEquals Method     static System.Boolean ReferenceEquals(Object
objA...
Round           Method     static System.Double Round(Double a), static
Syst...
Sign            Method     static System.Int32 Sign(SByte value), static
Sys...
```

```
Sin             Method     static System.Double Sin(Double a)
Sinh            Method     static System.Double Sinh(Double value)
Sqrt            Method     static System.Double Sqrt(Double d)
Tan             Method     static System.Double Tan(Double a)
Tanh            Method     static System.Double Tanh(Double value)
Truncate        Method     static System.Decimal Truncate(Decimal d),
static...
```

This displays several mathematical methods. Here is a list of commands that demonstrate how some of the common methods work:

PowerShell

```
[System.Math]::Sqrt(9)
3
[System.Math]::Pow(2,3)
8
[System.Math]::Floor(3.3)
3
[System.Math]::Floor(-3.3)
-4
[System.Math]::Ceiling(3.3)
4
[System.Math]::Ceiling(-3.3)
-3
[System.Math]::Max(2,7)
7
[System.Math]::Min(2,7)
2
[System.Math]::Truncate(9.3)
9
[System.Math]::Truncate(-9.3)
-9
```

Getting WMI objects with Get-CimInstance

Article • 12/09/2022

> This sample only applies to Windows plaforms.

Windows Management Instrumentation (WMI) is a core technology for Windows system administration because it exposes a wide range of information in a uniform manner. Because of how much WMI makes possible, the PowerShell cmdlet for accessing WMI objects, `Get-CimInstance`, is one of the most useful for doing real work. We're going to discuss how to use the CIM cmdlets to access WMI objects and then how to use WMI objects to do specific things.

Listing WMI classes

The first problem most WMI users face is trying to find out what can be done with WMI. WMI classes describe the resources that can be managed. There are hundreds of WMI classes, some of which contain dozens of properties.

`Get-CimClass` addresses this problem by making WMI discoverable. You can get a list of the WMI classes available on the local computer by typing:

PowerShell

```powershell
Get-CimClass -Namespace root/CIMV2 |
  Where-Object CimClassName -like Win32* |
    Select-Object CimClassName
```

Output

```
CimClassName
------------
Win32_DeviceChangeEvent
Win32_SystemConfigurationChangeEvent
Win32_VolumeChangeEvent
Win32_SystemTrace
Win32_ProcessTrace
Win32_ProcessStartTrace
Win32_ProcessStopTrace
Win32_ThreadTrace
Win32_ThreadStartTrace
Win32_ThreadStopTrace
...
```

You can retrieve the same information from a remote computer using the **ComputerName** parameter, specifying a computer name or IP address:

PowerShell

```
Get-CimClass -Namespace root/CIMV2 -ComputerName 192.168.1.29
```

The class listing returned by remote computers may vary due to the specific operating system the computer is running and the particular WMI extensions added by installed applications.

> **Note**
>
> When using CIM cmdlets to connect to a remote computer, the remote computer must be running WMI and the account you are using must be in the local administrators group on the remote computer. The remote system doesn't need to have PowerShell installed. This allows you to administer operating systems that aren't running PowerShell, but do have WMI available.

Displaying WMI class details

If you already know the name of a WMI class, you can use it to get information immediately. For example, one of the WMI classes commonly used for retrieving information about a computer is **Win32_OperatingSystem**.

PowerShell

```
Get-CimInstance -Class Win32_OperatingSystem
```

Output

```
SystemDirectory     Organization BuildNumber RegisteredUser SerialNumber
Version
---------------     ------------ ----------- -------------- ------------
-------
C:\WINDOWS\system32 Microsoft    18362       USER1          00330-80000-
00000-AA175 10.0.18362
```

Although we're showing all of the parameters, the command can be expressed in a more succinct way. The **ComputerName** parameter isn't necessary when connecting to

the local system. We show it to demonstrate the most general case and remind you about the parameter. The **Namespace** defaults to `root/CIMV2`, and can be omitted as well. Finally, most cmdlets allow you to omit the name of common parameters. With `Get-CimInstance`, if no name is specified for the first parameter, PowerShell treats it as the **Class** parameter. This means the last command could have been issued by typing:

PowerShell

```
Get-CimInstance Win32_OperatingSystem
```

The **Win32_OperatingSystem** class has many more properties than those displayed here. You can use Get-Member to see all the properties. The properties of a WMI class are automatically available like other object properties:

PowerShell

```
Get-CimInstance -Class Win32_OperatingSystem | Get-Member -MemberType
Property
```

Output

```
   TypeName:
Microsoft.Management.Infrastructure.CimInstance#root/cimv2/Win32_OperatingSy
stem
Name                                       MemberType Definition
----                                       ---------- ----------
BootDevice                                 Property   string BootDevice
{get;}
BuildNumber                                Property   string BuildNumber
{get;}
BuildType                                  Property   string BuildType {get;}
Caption                                    Property   string Caption {get;}
CodeSet                                    Property   string CodeSet {get;}
CountryCode                                Property   string CountryCode
{get;}
CreationClassName                          Property   string
CreationClassName {get;}
CSCreationClassName                        Property   string
CSCreationClassName {get;}
CSDVersion                                 Property   string CSDVersion
{get;}
CSName                                     Property   string CSName {get;}
CurrentTimeZone                            Property   short CurrentTimeZone
{get;}
DataExecutionPrevention_32BitApplications Property   bool
DataExecutionPrevention_32BitApplications {get;}
DataExecutionPrevention_Available          Property   bool
DataExecutionPrevention_Available {get;}
...
```

Displaying non-default properties with Format cmdlets

If you want information contained in the **Win32_OperatingSystem** class that isn't displayed by default, you can display it by using the **Format** cmdlets. For example, if you want to display available memory data, type:

PowerShell

```
Get-CimInstance -Class Win32_OperatingSystem |
  Format-Table -Property TotalVirtualMemorySize, TotalVisibleMemorySize,
    FreePhysicalMemory, FreeVirtualMemory, FreeSpaceInPagingFiles
```

Output

```
TotalVirtualMemorySize TotalVisibleMemorySize FreePhysicalMemory
FreeVirtualMemory FreeSpaceInPagingFiles
---------------------- ---------------------- ----------------- -----------
------ ----------------------
              33449088               16671872            6451868
18424496               16285032
```

> **Note**
>
> Wildcards work with property names in `Format-Table`, so the final pipeline element can be reduced to `Format-Table -Property Total*Memory*, Free*`

The memory data might be more readable if you format it as a list by typing:

PowerShell

```
Get-CimInstance -Class Win32_OperatingSystem | Format-List Total*Memory*,
Free*
```

Output

```
TotalVirtualMemorySize : 33449088
TotalVisibleMemorySize : 16671872
FreePhysicalMemory     : 6524456
FreeSpaceInPagingFiles : 16285808
FreeVirtualMemory      : 18393668
```

```
Name                   : Microsoft Windows 10
Pro|C:\WINDOWS|\Device\Harddisk0\Partition2
```

Manipulating items directly

Article • 12/09/2022

The elements that you see in PowerShell drives, such as the files and folders or registry keys, are called *Items* in PowerShell. The cmdlets for working with them item have the noun **Item** in their names.

The output of the `Get-Command -Noun Item` command shows that there are nine PowerShell item cmdlets.

PowerShell

```powershell
Get-Command -Noun Item
```

Output

```
CommandType     Name                                Definition
-----------     ----                                ----------
Cmdlet          Clear-Item                          Clear-Item [-Path]
<String[]...
Cmdlet          Copy-Item                           Copy-Item [-Path]
<String[]>...
Cmdlet          Get-Item                            Get-Item [-Path] <String[]>
...
Cmdlet          Invoke-Item                         Invoke-Item [-Path]
<String[...
Cmdlet          Move-Item                           Move-Item [-Path]
<String[]>...
Cmdlet          New-Item                            New-Item [-Path] <String[]>
...
Cmdlet          Remove-Item                         Remove-Item [-Path]
<String[...
Cmdlet          Rename-Item                         Rename-Item [-Path]
<String>...
Cmdlet          Set-Item                            Set-Item [-Path] <String[]>
...
```

Creating new items

To create a new item in the filesystem, use the `New-Item` cmdlet. Include the **Path** parameter with path to the item, and the **ItemType** parameter with a value of `file` or `directory`.

For example, to create a new directory named `New.Directory` in the `C:\Temp` directory, type:

PowerShell

```
New-Item -Path c:\temp\New.Directory -ItemType Directory
```

Output

```
    Directory: Microsoft.PowerShell.Core\FileSystem::C:\temp

Mode                 LastWriteTime     Length Name
----                 -------------     ------ ----
d----         2006-05-18  11:29 AM            New.Directory
```

To create a file, change the value of the **ItemType** parameter to `file`. For example, to create a file named `file1.txt` in the `New.Directory` directory, type:

PowerShell

```
New-Item -Path C:\temp\New.Directory\file1.txt -ItemType file
```

Output

```
    Directory: Microsoft.PowerShell.Core\FileSystem::C:\temp\New.Directory

Mode                 LastWriteTime     Length Name
----                 -------------     ------ ----
-a---         2006-05-18  11:44 AM          0 file1
```

You can use the same technique to create a new registry key. In fact, a registry key is easier to create because the only item type in the Windows registry is a key. (Registry entries are item *properties*.) For example, to create a key named `_Test` in the `CurrentVersion` subkey, type:

PowerShell

```
New-Item -Path HKLM:\SOFTWARE\Microsoft\Windows\CurrentVersion\_Test
```

Output

```
   Hive:
Microsoft.PowerShell.Core\Registry::HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Wi
ndows\CurrentVersion
```

```
SKC  VC Name                           Property
---  -- ----                           --------
  0   0 _Test                         {}
```

When typing a registry path, be sure to include the colon (`:`) in the PowerShell drive names, `HKLM:` and `HKCU:`. Without the colon, PowerShell doesn't recognize the drive name in the path.

Why registry values aren't items

When you use the `Get-ChildItem` cmdlet to find the items in a registry key, you will never see actual registry entries or their values.

For example, the registry key `HKEY_LOCAL_MACHINE\Software\Microsoft\Windows\CurrentVersion\Run` usually contains several registry entries that represent applications that run when the system starts.

However, when you use `Get-ChildItem` to look for child items in the key, all you will see is the `OptionalComponents` subkey of the key:

PowerShell

```powershell
Get-ChildItem HKLM:\Software\Microsoft\Windows\CurrentVersion\Run
```

Output

```
   Hive:
Microsoft.PowerShell.Core\Registry::HKEY_LOCAL_MACHINE\Software\Microsoft\Wi
ndows\CurrentVersion\Run
SKC  VC Name                           Property
---  -- ----                           --------
  3   0 OptionalComponents            {}
```

Although it would be convenient to treat registry entries as items, you can't specify a path to a registry entry in a way that ensures that it's unique. The path notation doesn't distinguish between the registry subkey named **Run** and the **(Default)** registry entry in the **Run** subkey. Furthermore, because registry entry names can contain the backslash character (`\`), if registry entries were items, then you couldn't use the path notation to distinguish a registry entry named `Windows\CurrentVersion\Run` from the subkey that's located in that path.

Renaming existing items

To change the name of a file or folder, use the `Rename-Item` cmdlet. The following command changes the name of the `file1.txt` file to `fileOne.txt`.

PowerShell

```
Rename-Item -Path C:\temp\New.Directory\file1.txt fileOne.txt
```

The `Rename-Item` cmdlet can change the name of a file or a folder, but it can't move an item. The following command fails because it attempts to move the file from the `New.Directory` directory to the Temp directory.

PowerShell

```
Rename-Item -Path C:\temp\New.Directory\fileOne.txt c:\temp\fileOne.txt
```

Output

```
Rename-Item : can't rename because the target specified isn't a path.
At line:1 char:12
+ Rename-Item  <<<< -Path C:\temp\New.Directory\fileOne c:\temp\fileOne.txt
```

Moving items

To move a file or folder, use the `Move-Item` cmdlet.

For example, the following command moves the New.Directory directory from the `C:\temp` directory to the root of the `C:` drive. To verify that the item was moved, include the **PassThru** parameter of the `Move-Item` cmdlet. Without **PassThru**, the `Move-Item` cmdlet doesn't display any results.

PowerShell

```
Move-Item -Path C:\temp\New.Directory -Destination C:\ -PassThru
```

Output

```
    Directory: Microsoft.PowerShell.Core\FileSystem::C:\

Mode                 LastWriteTime     Length Name
----                 -------------     ------ ----
d----         2006-05-18  12:14 PM            New.Directory
```

Copying items

If you are familiar with the copy operations in other shells, you might find the behavior of the `Copy-Item` cmdlet in PowerShell to be unusual. When you copy an item from one location to another, `Copy-Item` doesn't copy its contents by default.

For example, if you copy the `New.Directory` directory from the C: drive to the `C:\temp` directory, the command succeeds, but the files in the New.Directory directory aren't copied.

PowerShell

```
Copy-Item -Path C:\New.Directory -Destination C:\temp
```

If you display the contents of `C:\temp\New.Directory`, you will find that it contains no files:

```
PS> Get-ChildItem -Path C:\temp\New.Directory
PS>
```

Why doesn't the `Copy-Item` cmdlet copy the contents to the new location?

The `Copy-Item` cmdlet was designed to be generic; it isn't just for copying files and folders. Also, even when copying files and folders, you might want to copy only the container and not the items within it.

To copy all of the contents of a folder, include the **Recurse** parameter of the `Copy-Item` cmdlet in the command. If you have already copied the directory without its contents, add the **Force** parameter, which allows you to overwrite the empty folder.

PowerShell

```
Copy-Item -Path C:\New.Directory -Destination C:\temp -Recurse -Force -
Passthru
```

Output

```
    Directory: Microsoft.PowerShell.Core\FileSystem::C:\temp

Mode                 LastWriteTime     Length Name
```

```
----                 -------------     ------ ----
d----         2006-05-18   1:53 PM            New.Directory

    Directory: Microsoft.PowerShell.Core\FileSystem::C:\temp\New.Directory

Mode                 LastWriteTime     Length Name
----                 -------------     ------ ----
-a---         2006-05-18  11:44 AM          0 file1
```

Deleting items

To delete files and folders, use the `Remove-Item` cmdlet. PowerShell cmdlets, such as `Remove-Item`, that can make significant, irreversible changes will often prompt for confirmation when you enter its commands. For example, if you try to remove the `New.Directory` folder, you will be prompted to confirm the command, because the folder contains files:

PowerShell

```
Remove-Item C:\temp\New.Directory
```

Output

```
Confirm
The item at C:\temp\New.Directory has children and the -recurse parameter
was not
specified. If you continue, all children will be removed with the item. Are
you
 sure you want to continue?
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
(default is "Y"):
```

Because `Yes` is the default response, to delete the folder and its files, press the `Enter` key. To remove the folder without confirming, use the **Recurse** parameter.

PowerShell

```
Remove-Item C:\temp\New.Directory -Recurse
```

Executing items

PowerShell uses the `Invoke-Item` cmdlet to perform a default action for a file or folder. This default action is determined by the default application handler in the registry; the

effect is the same as if you double-click the item in File Explorer.

For example, suppose you run the following command:

```
PowerShell

Invoke-Item C:\WINDOWS
```

An Explorer window that's located in `C:\Windows` appears, just as if you had double-clicked the `C:\Windows` folder.

If you invoke the `Boot.ini` file on a system prior to Windows Vista:

```
PowerShell

Invoke-Item C:\boot.ini
```

If the `.ini` file type is associated with Notepad, the `boot.ini` file opens in Notepad.

Changing computer state

Article • 12/09/2022

> This sample only applies to Windows platforms.

To reset a computer in PowerShell, use either a standard command-line tool, WMI, or a CIM class. Although you are using PowerShell only to run the tool, learning how to change a computer's power state in PowerShell illustrates some of the important details about working with external tools in PowerShell.

Locking a computer

The only way to lock a computer directly with the standard available tools is to call the **LockWorkstation()** function in **user32.dll**:

PowerShell

```
rundll32.exe user32.dll,LockWorkStation
```

This command immediately locks the workstation. It uses `rundll32.exe` to call the `LockWorkStation` function in `user32.dll`.

When you lock a workstation while Fast User Switching is enabled, such as on Windows XP, the computer displays the user logon screen rather than starting the current user's screensaver.

To shut down particular sessions on a Terminal Server, use the **tsshutdn.exe** command-line tool.

Logging off the current session

You can use several different techniques to log off of a session on the local system. The simplest way is to use the Remote Desktop/Terminal Services command-line tool, **logoff.exe** (For details, at the PowerShell prompt, type `logoff /?`). To log off the current active session, type `logoff` with no arguments.

You can also use the **shutdown.exe** tool with its logoff option:

PowerShell

```
shutdown.exe -l
```

Another option is to use WMI. The **Win32_OperatingSystem** class has a **Shutdown** method. Invoking the method with the 0 flag initiates logoff:

For more information, see the Shutdown method of the **Win32_OperatingSystem** class.

PowerShell

```
Get-CimInstance -ClassName Win32_OperatingSystem | Invoke-CimMethod -
MethodName Shutdown
```

Shutting down or restarting a computer

Shutting down and restarting computers are are similar tasks. Most command-line tools support both actions. Windows includes two command-line tools for restarting a computer. Use either `tsshutdn.exe` or `shutdown.exe` with appropriate arguments. You can get detailed usage information from `tsshutdn.exe /?` or `shutdown.exe /?`.

You can also perform shutdown and restart operations directly from PowerShell.

To shut down the computer, use the `Stop-Computer` command

PowerShell

```
Stop-Computer
```

To restart the operating system, use the Restart-Computer command

PowerShell

```
Restart-Computer
```

To force an immediate restart of the computer, use the -Force parameter.

PowerShell

```
Restart-Computer -Force
```

Collecting information about computers

Article • 12/09/2022

> This sample only applies to Windows platforms.

Cmdlets from **CimCmdlets** module are the most important cmdlets for general system management tasks. All critical subsystem settings are exposed through WMI. Furthermore, WMI treats data as objects that are in collections of one or more items. Because PowerShell also works with objects and has a pipeline that allows you to treat single or multiple objects in the same way, generic WMI access allows you to perform some advanced tasks with very little work.

Listing desktop settings

We'll begin with a command that collects information about the desktops on the local computer.

PowerShell

```
Get-CimInstance -ClassName Win32_Desktop
```

This returns information for all desktops, whether they're in use or not.

> ⓘ **Note**
>
> Information returned by some WMI classes can be very detailed, and often include metadata about the WMI class.

Because most of these metadata properties have names that begin with **Cim**, you can filter the properties using `Select-Object`. Specify the **-ExcludeProperty** parameter with "Cim*" as the value. For example:

PowerShell

```
Get-CimInstance -ClassName Win32_Desktop | Select-Object -ExcludeProperty
"CIM*"
```

To filter out the metadata, use a pipeline operator (|) to send the results of the `Get-CimInstance` command to `Select-Object -ExcludeProperty "CIM*"`.

Listing BIOS Information

The WMI **Win32_BIOS** class returns fairly compact and complete information about the system BIOS on the local computer:

PowerShell

```
Get-CimInstance -ClassName Win32_BIOS
```

Listing Processor Information

You can retrieve general processor information by using WMI's **Win32_Processor** class, although you will likely want to filter the information:

PowerShell

```
Get-CimInstance -ClassName Win32_Processor | Select-Object -ExcludeProperty
"CIM*"
```

For a generic description string of the processor family, you can just return the **SystemType** property:

PowerShell

```
Get-CimInstance -ClassName Win32_ComputerSystem | Select-Object -Property
SystemType

SystemType
----------
X86-based PC
```

Listing computer manufacturer and model

Computer model information is also available from **Win32_ComputerSystem**. The standard displayed output will not need any filtering to provide OEM data:

PowerShell

```
Get-CimInstance -ClassName Win32_ComputerSystem
```

Output

```
Name PrimaryOwnerName Domain    TotalPhysicalMemory Model
Manufacturer
---- ---------------- ------    ------------------- -----
------------
MyPC Jane Doe         WORKGROUP 804765696           DA243A-ABA 6415cl NA910
Compaq Presario 06
```

Your output from commands such as this, which return information directly from some hardware, is only as good as the data you have. Some information isn't correctly configured by hardware manufacturers and may therefore be unavailable.

Listing installed hotfixes

You can list all installed hotfixes by using **Win32_QuickFixEngineering**:

PowerShell

```
Get-CimInstance -ClassName Win32_QuickFixEngineering
```

This class returns a list of hotfixes that looks like this:

Output

```
Source Description     HotFixID  InstalledBy   InstalledOn PSComputerName
------ -----------     --------  -----------   ----------- --------------
       Security Update KB4048951 Administrator 12/16/2017  .
```

For more succinct output, you may want to exclude some properties. Although you can use the `Get-CimInstance`'s **Property** parameter to choose only the **HotFixID**, doing so will actually return more information, because all the metadata is displayed by default:

PowerShell

```
Get-CimInstance -ClassName Win32_QuickFixEngineering -Property HotFixID
```

Output

```
InstalledOn          :
Caption              :
Description          :
InstallDate          :
Name                 :
Status               :
CSName               :
```

```
FixComments          :
HotFixID             : KB4533002
InstalledBy          :
ServicePackInEffect  :
PSComputerName       :
CimClass             : root/cimv2:Win32_QuickFixEngineering
CimInstanceProperties : {Caption, Description, InstallDate, Name…}
CimSystemProperties  :
Microsoft.Management.Infrastructure.CimSystemProperties
...
```

The additional data is returned, because the **Property** parameter in `Get-CimInstance` restricts the properties returned from WMI class instances, not the object returned to PowerShell. To reduce the output, use `Select-Object`:

PowerShell

```
Get-CimInstance -ClassName Win32_QuickFixEngineering -Property HotFixId |
    Select-Object -Property HotFixId
```

Output

```
HotFixId
--------
KB4048951
```

Listing operating system version information

The **Win32_OperatingSystem** class properties include version and service pack information. You can explicitly select only these properties to get a version information summary from **Win32_OperatingSystem**:

PowerShell

```
Get-CimInstance -ClassName Win32_OperatingSystem |
  Select-Object -Property
BuildNumber,BuildType,OSType,ServicePackMajorVersion,ServicePackMinorVersion
```

You can also use wildcards with the **Property** parameter. Because all the properties beginning with either **Build** or **ServicePack** are important to use here, we can shorten this to the following form:

PowerShell

```powershell
Get-CimInstance -ClassName Win32_OperatingSystem |
    Select-Object -Property Build*,OSType,ServicePack*
```

Output

```
BuildNumber             : 18362
BuildType               : Multiprocessor Free
OSType                  : 18
ServicePackMajorVersion : 0
ServicePackMinorVersion : 0
```

Listing local users and owner

General information about local users can be found with a selection of **Win32_OperatingSystem** class properties. You can explicitly select the properties to display like this:

PowerShell

```powershell
Get-CimInstance -ClassName Win32_OperatingSystem |
    Select-Object -Property NumberOfLicensedUsers, NumberOfUsers,
RegisteredUser
```

A more succinct version using wildcards is:

PowerShell

```powershell
Get-CimInstance -ClassName Win32_OperatingSystem | Select-Object -Property
*user*
```

Getting available disk space

To see the disk space and free space for local drives, you can use the **Win32_LogicalDisk** class. You need to see only instances with a **DriveType** of 3, the value WMI uses for fixed hard disks.

PowerShell

```powershell
Get-CimInstance -ClassName Win32_LogicalDisk -Filter "DriveType=3"
```

Output

```
DeviceID DriveType ProviderName VolumeName Size         FreeSpace
PSComputerName
-------- --------- ------------ ---------- ----         ---------   --------
------
C:       3                     Local Disk 203912880128 65541357568 .
Q:       3                     New Volume 122934034432 44298250240 .
```

PowerShell

```
Get-CimInstance -ClassName Win32_LogicalDisk -Filter "DriveType=3" |
    Measure-Object -Property FreeSpace,Size -Sum |
    Select-Object -Property Property,Sum
```

Output

```
Property           Sum
--------           ---
FreeSpace 109839607808
Size      326846914560
```

Getting logon session information

You can get general information about logon sessions associated with users through the **Win32_LogonSession** WMI class:

PowerShell

```
Get-CimInstance -ClassName Win32_LogonSession
```

Getting the user logged on to a computer

You can display the user logged on to a particular computer system using **Win32_ComputerSystem**. This command returns only the user logged on to the system desktop:

PowerShell

```
Get-CimInstance -ClassName Win32_ComputerSystem -Property UserName
```

Getting local time from a computer

You can retrieve the current local time on a specific computer using the **Win32_LocalTime** WMI class.

PowerShell

```
Get-CimInstance -ClassName Win32_LocalTime
```

Output

```
Day            : 23
DayOfWeek      : 1
Hour           : 8
Milliseconds   :
Minute         : 52
Month          : 12
Quarter        : 4
Second         : 55
WeekInMonth    : 4
Year           : 2019
PSComputerName :
```

Displaying service status

To view the status of all services on a specific computer, you can locally use the `Get-Service` cmdlet. For remote systems, you can use the **Win32_Service** WMI class. If you also use `Select-Object` to filter the results to **Status**, **Name**, and **DisplayName**, the output format is almost identical to that from `Get-Service`:

PowerShell

```
Get-CimInstance -ClassName Win32_Service |
    Select-Object -Property Status,Name,DisplayName
```

To allow the complete display of names for services with long names, use the **AutoSize** and **Wrap** parameters of `Format-Table`. These parameters optimize column width and allow long names to wrap instead of being truncated:

PowerShell

```
Get-CimInstance -ClassName Win32_Service |
    Format-Table -Property Status, Name, DisplayName -AutoSize -Wrap
```

Creating Get-WinEvent queries with FilterHashtable

Article • 06/28/2023

> This sample only applies to Windows platforms.

To read the original June 3, 2014 **Scripting Guy** blog post, see Use FilterHashTable to Filter Event Log with PowerShell.

This article is an excerpt of the original blog post and explains how to use the `Get-WinEvent` cmdlet's **FilterHashtable** parameter to filter event logs. PowerShell's `Get-WinEvent` cmdlet is a powerful method to filter Windows event and diagnostic logs. Performance improves when a `Get-WinEvent` query uses the **FilterHashtable** parameter.

When you work with large event logs, it's not efficient to send objects down the pipeline to a `Where-Object` command. Prior to PowerShell 6, the `Get-EventLog` cmdlet was another option to get log data. For example, the following commands are inefficient to filter the **Microsoft-Windows-Defrag** logs:

PowerShell

```
Get-EventLog -LogName Application | Where-Object Source -Match defrag

Get-WinEvent -LogName Application | Where-Object { $_.ProviderName -Match
'defrag' }
```

The following command uses a hash table that improves the performance:

PowerShell

```
Get-WinEvent -FilterHashtable @{
   LogName='Application'
   ProviderName='*defrag'
}
```

Blog posts about enumeration

This article presents information about how to use enumerated values in a hash table. For more information about enumeration, read these **Scripting Guy** blog posts. To

create a function that returns the enumerated values, see Enumerations and Values. For more information, see the Scripting Guy series of blog posts about enumeration.

Hash table key-value pairs

To build efficient queries, use the `Get-WinEvent` cmdlet with the **FilterHashtable** parameter. **FilterHashtable** accepts a hash table as a filter to get specific information from Windows event logs. A hash table uses **key-value** pairs. For more information about hash tables, see about_Hash_Tables.

If the **key-value** pairs are on the same line, they must be separated by a semicolon. If each **key-value** pair is on a separate line, the semicolon isn't needed. For example, this article places **key-value** pairs on separate lines and doesn't use semicolons.

This sample uses several of the **FilterHashtable** parameter's **key-value** pairs. The completed query includes **LogName**, **ProviderName**, **Keywords**, **ID**, and **Level**.

The accepted **key-value** pairs are shown in the following table and are included in the documentation for the Get-WinEvent **FilterHashtable** parameter.

The following table displays the key names, data types, and whether wildcard characters are accepted for a data value.

Key name	Value data type	Accepts wildcard characters?
LogName	`<String[]>`	Yes
ProviderName	`<String[]>`	Yes
Path	`<String[]>`	No
Keywords	`<Long[]>`	No
ID	`<Int32[]>`	No
Level	`<Int32[]>`	No
StartTime	`<DateTime>`	No
EndTime	`<DateTime>`	No
UserID	`<SID>`	No
Data	`<String[]>`	No
`<named-data>`	`<String[]>`	No

The `<named-data>` key represents a named event data field. For example, the Perflib event 1008 can contain the following event data:

XML

```xml
<EventData>
  <Data Name="Service">BITS</Data>
  <Data Name="Library">C:\Windows\System32\bitsperf.dll</Data>
  <Data Name="Win32Error">2</Data>
</EventData>
```

You can query for these events using the following command:

PowerShell

```powershell
Get-WinEvent -FilterHashtable @{LogName='Application'; 'Service'='Bits'}
```

> ⓘ **Note**
>
> The ability to query for `<named-data>` was added in PowerShell 6.

Building a query with a hash table

To verify results and troubleshoot problems, it helps to build the hash table one **key-value** pair at a time. The query gets data from the **Application** log. The hash table is equivalent to `Get-WinEvent -LogName Application`.

To begin, create the `Get-WinEvent` query. Use the **FilterHashtable** parameter's **key-value** pair with the key, **LogName**, and the value, **Application**.

PowerShell

```powershell
Get-WinEvent -FilterHashtable @{
   LogName='Application'
}
```

Continue to build the hash table with the **ProviderName** key. Usually, the **ProviderName** is the name that appears in the **Source** field in the **Windows Event Viewer**. For example, `.NET Runtime` in the following screenshot:

Image of Windows Event Viewer sources

Update the hash table and include the **key-value** pair with the key, **ProviderName**, and the value, `.NET Runtime`.

PowerShell

```
Get-WinEvent -FilterHashtable @{
   LogName='Application'
   ProviderName='.NET Runtime'
}
```

> **Note**
>
> For some event providers, the correct **ProviderName** can be obtained by looking on the **Details** tab in **Event Properties**. For example, events where the **Source** field shows `Defrag`, the correct **ProviderName** is `Microsoft-Windows-Defrag`.

If your query needs to get data from archived event logs, use the **Path** key. The **Path** value specifies the full path to the log file. For more information, see the **Scripting Guy** blog post, Use PowerShell to Parse Saved Event Logs for Errors.

Using enumerated values in a hash table

Keywords is the next key in the hash table. The **Keywords** data type is an array of the `[long]` value type that holds a large number. Use the following command to find the maximum value of `[long]`:

PowerShell

```
[long]::MaxValue
```

Output

```
9223372036854775807
```

For the **Keywords** key, PowerShell uses a number, not a string such as **Security**. **Windows Event Viewer** displays the **Keywords** as strings, but they're enumerated values. In the hash table, if you use the **Keywords** key with a string value, an error message is displayed.

Open the **Windows Event Viewer** and from the **Actions** pane, click on **Filter current log**. The **Keywords** drop-down menu displays the available keywords, as shown in the

following screenshot:

Image of Windows Event Viewer keywords

Use the following command to display the `StandardEventKeywords` property names.

PowerShell

```
[System.Diagnostics.Eventing.Reader.StandardEventKeywords] |
    Get-Member -Static -MemberType Property
```

Output

```
   TypeName: System.Diagnostics.Eventing.Reader.StandardEventKeywords
Name             MemberType Definition
--             ----------- ----------
AuditFailure     Property   static
System.Diagnostics.Eventing.Reader.StandardEventKey…
AuditSuccess     Property   static
System.Diagnostics.Eventing.Reader.StandardEventKey…
CorrelationHint  Property   static
System.Diagnostics.Eventing.Reader.StandardEventKey…
CorrelationHint2 Property   static
System.Diagnostics.Eventing.Reader.StandardEventKey…
EventLogClassic  Property   static
System.Diagnostics.Eventing.Reader.StandardEventKey…
None             Property   static
System.Diagnostics.Eventing.Reader.StandardEventKey…
ResponseTime     Property   static
System.Diagnostics.Eventing.Reader.StandardEventKey…
Sqm              Property   static
System.Diagnostics.Eventing.Reader.StandardEventKey…
WdiContext       Property   static
System.Diagnostics.Eventing.Reader.StandardEventKey…
WdiDiagnostic    Property   static
System.Diagnostics.Eventing.Reader.StandardEventKey…
```

The enumerated values are documented in the **.NET Framework**. For more information, see StandardEventKeywords Enumeration.

The **Keywords** names and enumerated values are as follows:

Name	Value
AuditFailure	4503599627370496
AuditSuccess	9007199254740992
CorrelationHint2	18014398509481984

Name	Value
EventLogClassic	36028797018963968
Sqm	2251799813685248
WdiDiagnostic	1125899906842624
WdiContext	562949953421312
ResponseTime	281474976710656
None	0

Update the hash table and include the **key-value** pair with the key, **Keywords**, and the **EventLogClassic** enumeration value, **36028797018963968**.

PowerShell

```
Get-WinEvent -FilterHashtable @{
   LogName='Application'
   ProviderName='.NET Runtime'
   Keywords=36028797018963968
}
```

Keywords static property value (optional)

The **Keywords** key is enumerated, but you can use a static property name in the hash table query. Rather than using the returned string, the property name must be converted to a value with the **Value__** property.

For example, the following script uses the **Value__** property.

PowerShell

```
$C =
[System.Diagnostics.Eventing.Reader.StandardEventKeywords]::EventLogClassic
Get-WinEvent -FilterHashtable @{
   LogName='Application'
   ProviderName='.NET Runtime'
   Keywords=$C.Value__
}
```

Filtering by Event Id

To get more specific data, the query's results are filtered by **Event Id**. The **Event Id** is referenced in the hash table as the key **ID** and the value is a specific **Event Id**. The **Windows Event Viewer** displays the **Event Id**. This example uses **Event Id 1023**.

Update the hash table and include the **key-value** pair with the key, **ID** and the value, **1023**.

PowerShell

```
Get-WinEvent -FilterHashtable @{
   LogName='Application'
   ProviderName='.NET Runtime'
   Keywords=36028797018963968
   ID=1023
}
```

Filtering by Level

To further refine the results and include only events that are errors, use the **Level** key. **Windows Event Viewer** displays the **Level** as string values, but they're enumerated values. In the hash table, if you use the **Level** key with a string value, an error message is displayed.

Level has values such as **Error**, **Warning**, or **Informational**. Use the following command to display the `StandardEventLevel` property names.

PowerShell

```
[System.Diagnostics.Eventing.Reader.StandardEventLevel] |
    Get-Member -Static -MemberType Property
```

Output

```
   TypeName: System.Diagnostics.Eventing.Reader.StandardEventLevel

Name          MemberType Definition
----          ---------- ----------
Critical      Property   static
System.Diagnostics.Eventing.Reader.StandardEventLevel Critical {get;}
Error         Property   static
System.Diagnostics.Eventing.Reader.StandardEventLevel Error {get;}
Informational Property   static
System.Diagnostics.Eventing.Reader.StandardEventLevel Informational {get;}
LogAlways     Property   static
System.Diagnostics.Eventing.Reader.StandardEventLevel LogAlways {get;}
Verbose       Property   static
```

```
System.Diagnostics.Eventing.Reader.StandardEventLevel Verbose {get;}
Warning       Property   static
System.Diagnostics.Eventing.Reader.StandardEventLevel Warning {get;}
```

The enumerated values are documented in the **.NET Framework**. For more information, see StandardEventLevel Enumeration.

The **Level** key's names and enumerated values are as follows:

Name	Value
Verbose	5
Informational	4
Warning	3
Error	2
Critical	1
LogAlways	0

The hash table for the completed query includes the key, **Level**, and the value, **2**.

PowerShell

```
Get-WinEvent -FilterHashtable @{
   LogName='Application'
   ProviderName='.NET Runtime'
   Keywords=36028797018963968
   ID=1023
   Level=2
}
```

Level static property in enumeration (optional)

The **Level** key is enumerated, but you can use a static property name in the hash table query. Rather than using the returned string, the property name must be converted to a value with the **Value__** property.

For example, the following script uses the **Value__** property.

PowerShell

```
$C = [System.Diagnostics.Eventing.Reader.StandardEventLevel]::Informational
Get-WinEvent -FilterHashtable @{
   LogName='Application'
```

```
    ProviderName='.NET Runtime'
    Keywords=36028797018963968
    ID=1023
    Level=$C.Value__
}
```

Managing processes with Process cmdlets

Article • 12/09/2022

> This sample only applies to Windows PowerShell 5.1.

You can use the Process cmdlets in PowerShell to manage local and remote processes in PowerShell.

Getting processes

To get the processes running on the local computer, run a `Get-Process` with no parameters.

You can get particular processes by specifying their process names or process IDs. The following command gets the Idle process:

PowerShell

```
Get-Process -id 0
```

Output

```
Handles  NPM(K)    PM(K)      WS(K) VM(M)   CPU(s)     Id ProcessName
-------  ------    -----      ----- -----   ------     -- -----------
      0       0        0         16     0               0 Idle
```

Although it's normal for cmdlets to return no data in some situations, when you specify a process by its **ProcessId**, `Get-Process` generates an error if it finds no matches, because the usual intent is to retrieve a known running process. If there is no process with that ID, it's likely that the ID is incorrect or that the process of interest has already exited:

PowerShell

```
Get-Process -Id 99
```

Output

```
Get-Process : No process with process ID 99 was found.
At line:1 char:12
+ Get-Process  <<<< -Id 99
```

You can use the Name parameter of the `Get-Process` cmdlet to specify a subset of processes based on the process name. The Name parameter can take multiple names in a comma-separated list and it supports the use of wildcards, so you can type name patterns.

For example, the following command gets process whose names begin with "ex."

PowerShell

```
Get-Process -Name ex*
```

Output

```
Handles  NPM(K)    PM(K)      WS(K) VM(M)   CPU(s)     Id ProcessName
-------  ------    -----      ----- -----   ------     -- -----------
    234       7     5572      12484   134     2.98   1684 EXCEL
    555      15    34500      12384   134   105.25    728 explorer
```

Because the .NET **System.Diagnostics.Process** class is the foundation for PowerShell processes, it follows some of the conventions used by **System.Diagnostics.Process**. One of those conventions is that the process name for an executable never includes the `.exe` at the end of the executable name.

`Get-Process` also accepts multiple values for the Name parameter.

PowerShell

```
Get-Process -Name exp*,power*
```

Output

```
Handles  NPM(K)    PM(K)      WS(K) VM(M)   CPU(s)     Id ProcessName
-------  ------    -----      ----- -----   ------     -- -----------
    540      15    35172      48148   141    88.44    408 explorer
    605       9    30668      29800   155     7.11   3052 powershell
```

You can use the ComputerName parameter of `Get-Process` to get processes on remote computers. For example, the following command gets the PowerShell processes on the local computer (represented by "localhost") and on two remote computers.

PowerShell

```
Get-Process -Name PowerShell -ComputerName localhost, Server01, Server02
```

Output

```
Handles  NPM(K)    PM(K)      WS(K) VM(M)   CPU(s)     Id ProcessName
-------  ------    -----      ----- -----   ------     -- -----------
    258       8    29772      38636   130             3700 powershell
    398      24    75988      76800   572             5816 powershell
    605       9    30668      29800   155     7.11    3052 powershell
```

The computer names aren't evident in this display, but they're stored in the **MachineName** property of the process objects that `Get-Process` returns. The following command uses the `Format-Table` cmdlet to display the process **ID**, **ProcessName** and **MachineName** (ComputerName) properties of the process objects.

PowerShell

```
Get-Process -Name PowerShell -ComputerName localhost, Server01, Server01 |
    Format-Table -Property ID, ProcessName, MachineName
```

Output

```
  Id ProcessName MachineName
  -- ----------- -----------
3700 powershell  Server01
3052 powershell  Server02
5816 powershell  localhost
```

This more complex command adds the **MachineName** property to the standard `Get-Process` display.

PowerShell

```
Get-Process powershell -ComputerName localhost, Server01, Server02 |
    Format-Table -Property Handles,
        @{Label="NPM(K)";Expression={[int]($_.NPM/1024)}},
        @{Label="PM(K)";Expression={[int]($_.PM/1024)}},
        @{Label="WS(K)";Expression={[int]($_.WS/1024)}},
        @{Label="VM(M)";Expression={[int]($_.VM/1MB)}},
        @{Label="CPU(s)";Expression={if ($_.CPU -ne $())
{$_.CPU.ToString("N")}}},
        Id, ProcessName, MachineName -auto
```

Output

```
Handles  NPM(K)  PM(K) WS(K) VM(M) CPU(s)  Id ProcessName  MachineName
-------  ------  ----- ----- ----- ------  -- -----------  -----------
    258       8  29772 38636   130         3700 powershell Server01
    398      24  75988 76800   572         5816 powershell localhost
    605       9  30668 29800   155 7.11    3052 powershell Server02
```

Stopping processes

PowerShell gives you flexibility for listing processes, but what about stopping a process?

The `Stop-Process` cmdlet takes a **Name** or **Id** to specify a process you want to stop. Your ability to stop processes depends on your permissions. Some processes can't be stopped. For example, if you try to stop the idle process, you get an error:

PowerShell

```
Stop-Process -Name Idle
```

Output

```
Stop-Process : Process 'Idle (0)' cannot be stopped due to the following
error:
 Access is denied
At line:1 char:13
+ Stop-Process  <<<< -Name Idle
```

You can also force prompting with the **Confirm** parameter. This parameter is particularly useful if you use a wildcard when specifying the process name, because you may accidentally match some processes you don't want to stop:

PowerShell

```
Stop-Process -Name t*,e* -Confirm
```

Output

```
Confirm
Are you sure you want to perform this action?
Performing operation "Stop-Process" on Target "explorer (408)".
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
(default is "Y"):n
Confirm
Are you sure you want to perform this action?
```

```
Performing operation "Stop-Process" on Target "taskmgr (4072)".
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
(default is "Y"):n
```

Complex process manipulation is possible by using some of the object filtering cmdlets. Because a Process object has a **Responding** property that's true when it's no longer responding, you can stop all nonresponsive applications with the following command:

PowerShell

```
Get-Process | Where-Object -FilterScript {$_.Responding -eq $false} | Stop-Process
```

You can use the same approach in other situations. For example, suppose a secondary notification area application automatically runs when users start another application. You may find that this doesn't work correctly in Terminal Services sessions, but you still want to keep it in sessions that run on the physical computer console. Sessions connected to the physical computer desktop always have a session ID of 0, so you can stop all instances of the process that are in other sessions by using `Where-Object` and the process, **SessionId**:

PowerShell

```
Get-Process -Name BadApp | Where-Object -FilterScript {$_.SessionId -neq 0} | Stop-Process
```

The `Stop-Process` cmdlet doesn't have a **ComputerName** parameter. Therefore, to run a stop process command on a remote computer, you need to use the `Invoke-Command` cmdlet. For example, to stop the PowerShell process on the Server01 remote computer, type:

PowerShell

```
Invoke-Command -ComputerName Server01 {Stop-Process Powershell}
```

Stopping All Other PowerShell Sessions

It may occasionally be useful to be able to stop all running PowerShell sessions other than the current session. If a session is using too many resources or is inaccessible (it may be running remotely or in another desktop session), you may not be able to directly stop it. If you try to stop all running sessions, however, the current session may be terminated instead.

Each PowerShell session has an environment variable PID that contains the **Id** of the Windows PowerShell process. You can check the $PID against the Id of each session and terminate only Windows PowerShell sessions that have a different Id. The following pipeline command does this and returns the list of terminated sessions (because of the use of the **PassThru** parameter):

PowerShell

```
Get-Process -Name powershell | Where-Object -FilterScript {$_.Id -ne $PID} |
    Stop-Process -PassThru
```

Output

```
Handles  NPM(K)    PM(K)      WS(K) VM(M)   CPU(s)     Id ProcessName
-------  ------    -----      ----- -----   ------     -- -----------
    334       9    23348      29136   143     1.03    388 powershell
    304       9    23152      29040   143     1.03    632 powershell
    302       9    20916      26804   143     1.03   1116 powershell
    335       9    25656      31412   143     1.09   3452 powershell
    303       9    23156      29044   143     1.05   3608 powershell
    287       9    21044      26928   143     1.02   3672 powershell
```

Starting, debugging, and waiting for processes

PowerShell also comes with cmdlets to start (or restart), debug a process, and wait for a process to complete before running a command. For information about these cmdlets, see the cmdlet help topic for each cmdlet.

See also

- Get-Process
- Stop-Process
- Start-Process
- Wait-Process
- Debug-Process
- Invoke-Command

Managing services

Article • 12/09/2022

> This sample only applies to Windows PowerShell 5.1.

There are eight core **Service** cmdlets, designed for a wide range of service tasks . This article only looks at listing and changing running state for services. You can get a list of service cmdlets using `Get-Command *-Service`. You can find information about each cmdlet by using `Get-Help <Cmdlet-Name>`, such as `Get-Help New-Service`.

Getting services

You can get the services on a local or remote computer by using the `Get-Service` cmdlet. As with `Get-Process`, using the `Get-Service` command without parameters returns all services. You can filter by name, even using an asterisk as a wildcard:

PowerShell

```
PS> Get-Service -Name se*

Status   Name               DisplayName
------   ----               -----------
Running  seclogon           Secondary Logon
Running  SENS               System Event Notification
Stopped  ServiceLayer       ServiceLayer
```

Because it isn't always apparent what the real name for the service is, you may find you need to find services by display name. You can search by specific name, use wildcards, or provide a list of display names:

PowerShell

```
PS> Get-Service -DisplayName se*

Status   Name               DisplayName
------   ----               -----------
Running  lanmanserver       Server
Running  SamSs              Security Accounts Manager
Running  seclogon           Secondary Logon
Stopped  ServiceLayer       ServiceLayer
Running  wscsvc             Security Center

PS> Get-Service -DisplayName ServiceLayer, Server
```

```
Status   Name               DisplayName
------   ----               -----------
Running  lanmanserver       Server
Stopped  ServiceLayer       ServiceLayer
```

Getting remote services

With Windows PowerShell, you can use the **ComputerName** parameter of the `Get-Service` cmdlet to get the services on remote computers. The **ComputerName** parameter accepts multiple values and wildcard characters, so you can get the services on multiple computers with a single command. For example, the following command gets the services on the Server01 remote computer.

PowerShell

```
Get-Service -ComputerName Server01
```

Starting in PowerShell 6.0, the `*-Service` cmdlets don't have the **ComputerName** parameter. You can still get services on remote computers with PowerShell remoting. For example, the following command gets the services on the Server02 remote computer.

PowerShell

```
Invoke-Command -ComputerName Server02 -ScriptBlock { Get-Service }
```

You can also manage services with the other `*-Service` cmdlets. For more information on PowerShell remoting, see about_Remote.

Getting required and dependent services

The Get-Service cmdlet has two parameters that are very useful in service administration. The DependentServices parameter gets services that depend on the service.

The **RequiredServices** parameter gets services upon which the LanmanWorkstation service depends.

PowerShell

```
PS> Get-Service -Name LanmanWorkstation -RequiredServices

Status   Name               DisplayName
```

```
------   ----               -----------
Running  MRxSmb20           SMB 2.0 MiniRedirector
Running  bowser             Bowser
Running  MRxSmb10           SMB 1.x MiniRedirector
Running  NSI                Network Store Interface Service
```

The **DependentServices** parameter gets that require the LanmanWorkstation service.

PowerShell

```
PS> Get-Service -Name LanmanWorkstation -DependentServices

Status   Name               DisplayName
------   ----               -----------
Running  SessionEnv         Terminal Services Configuration
Running  Netlogon           Netlogon
Stopped  Browser            Computer Browser
Running  BITS               Background Intelligent Transfer Ser...
```

The following command gets all services that have dependencies. The `Format-Table` cmdlet to display the **Status**, **Name**, **RequiredServices**, and **DependentServices** properties of the services.

PowerShell

```
Get-Service -Name * | Where-Object {$_.RequiredServices -or
$_.DependentServices} |
  Format-Table -Property Status, Name, RequiredServices, DependentServices -
auto
```

Stopping, starting, suspending, and restarting services

The Service cmdlets all have the same general form. Services can be specified by common name or display name, and take lists and wildcards as values. To stop the print spooler, use:

PowerShell

```
Stop-Service -Name spooler
```

To start the print spooler after it's stopped, use:

PowerShell

```
Start-Service -Name spooler
```

To suspend the print spooler, use:

PowerShell

```
Suspend-Service -Name spooler
```

The `Restart-Service` cmdlet works in the same manner as the other Service cmdlets:

PowerShell

```
PS> Restart-Service -Name spooler

WARNING: Waiting for service 'Print Spooler (Spooler)' to finish starting...
WARNING: Waiting for service 'Print Spooler (Spooler)' to finish starting...
PS>
```

Notice that you get a repeated warning message about the Print Spooler starting up. When you perform a service operation that takes some time, PowerShell notifies you that it's still attempting to perform the task.

If you want to restart multiple services, you can get a list of services, filter them, and then perform the restart:

PowerShell

```
PS> Get-Service | Where-Object -FilterScript {$_.CanStop} | Restart-Service

WARNING: Waiting for service 'Computer Browser (Browser)' to finish
stopping...
WARNING: Waiting for service 'Computer Browser (Browser)' to finish
stopping...
Restart-Service : can't stop service 'Logical Disk Manager (dmserver)'
because
 it has dependent services. It can only be stopped if the Force flag is set.
At line:1 char:57
+ Get-Service | Where-Object -FilterScript {$_.CanStop} | Restart-Service
<<<<
WARNING: Waiting for service 'Print Spooler (Spooler)' to finish starting...
WARNING: Waiting for service 'Print Spooler (Spooler)' to finish starting...
```

These Service cmdlets don't have a **ComputerName** parameter, but you can run them on a remote computer by using the `Invoke-Command` cmdlet. For example, the following command restarts the Spooler service on the Server01 remote computer.

```
```

PowerShell

```
Invoke-Command -ComputerName Server01 {Restart-Service Spooler}
```

Setting service properties

The `Set-Service` cmdlet changes the properties of a service on a local or remote computer. Because the service status is a property, you can use this cmdlet to start, stop, and suspend a service. The Set-Service cmdlet also has a StartupType parameter that lets you change the service startup type.

To use `Set-Service` on Windows Vista and later versions of Windows, open PowerShell with the **Run as administrator** option.

For more information, see Set-Service

See also

- about_Remote
- Get-Service
- Set-Service
- Restart-Service
- Suspend-Service

Working with printers in Windows

Article • 12/09/2022

> This sample only applies to Windows platforms.

You can use PowerShell to manage printers using WMI and the **WScript.Network** COM object from WSH.

Listing printer connections

The simplest way to list the printers installed on a computer is to use the WMI **Win32_Printer** class:

PowerShell

```
Get-CimInstance -Class Win32_Printer
```

You can also list the printers using the **WScript.Network** COM object that's typically used in WSH scripts:

PowerShell

```
(New-Object -ComObject WScript.Network).EnumPrinterConnections()
```

Because this command returns a simple string collection of port names and printer device names without any distinguishing labels, it isn't easy to interpret.

Adding a network printer

To add a new network printer, use **WScript.Network**:

PowerShell

```
(New-Object -ComObject
WScript.Network).AddWindowsPrinterConnection("\\Printserver01\Xerox5")
```

Setting a default printer

To use WMI to set the default printer, find the printer in the **Win32_Printer** collection and then invoke the **SetDefaultPrinter** method:

```
PowerShell

$printer = Get-CimInstance -Class Win32_Printer -Filter "Name='HP LaserJet 5Si'"
Invoke-CimMethod -InputObject $printer -MethodName SetDefaultPrinter
```

WScript.Network is a little simpler to use, because it has a **SetDefaultPrinter** method that takes only the printer name as an argument:

```
PowerShell

(New-Object -ComObject WScript.Network).SetDefaultPrinter('HP LaserJet 5Si')
```

Removing a printer connection

To remove a printer connection, use the **WScript.Network RemovePrinterConnection** method:

```
PowerShell

(New-Object -ComObject WScript.Network).RemovePrinterConnection("\\Printserver01\Xerox5")
```

Performing networking tasks

Article • 12/09/2022

> This sample only applies to Windows platforms.

Because TCP/IP is the most commonly used network protocol, most low-level network protocol administration tasks involve TCP/IP. In this section, we use PowerShell and WMI to do these tasks.

Listing IP addresses for a computer

To get all IP addresses in use on the local computer, use the following command:

PowerShell

```
Get-CimInstance -Class Win32_NetworkAdapterConfiguration -Filter
IPEnabled=$true |
    Select-Object -ExpandProperty IPAddress
```

Since the **IPAddress** property of a **Win32_NetworkAdapterConfiguration** object is an array, you must use the **ExpandProperty** parameter of `Select-Object` to see the entire list of addresses.

Output

```
10.0.0.1
fe80::60ea:29a7:a233:7cb7
2601:600:a27f:a470:f532:6451:5630:ec8b
2601:600:a27f:a470:e167:477d:6c5c:342d
2601:600:a27f:a470:b021:7f0d:eab9:6299
2601:600:a27f:a470:a40e:ebce:1a8c:a2f3
2601:600:a27f:a470:613c:12a2:e0e0:bd89
2601:600:a27f:a470:444f:17ec:b463:7edd
2601:600:a27f:a470:10fd:7063:28e9:c9f3
2601:600:a27f:a470:60ea:29a7:a233:7cb7
2601:600:a27f:a470::2ec1
```

Using the `Get-Member` cmdlet, you can see that the **IPAddress** property is an array:

PowerShell

```
Get-CimInstance -Class Win32_NetworkAdapterConfiguration -Filter
IPEnabled=$true |
    Get-Member -Name IPAddress
```

Output

```
   TypeName:
Microsoft.Management.Infrastructure.CimInstance#root/cimv2/Win32_NetworkAdap
terConfiguration

Name      MemberType Definition
----      ---------- ----------
IPAddress Property   string[] IPAddress {get;}
```

The IPAddress property for each network adapter is actually an array. The braces in the definition indicate that **IPAddress** isn't a **System.String** value, but an array of **System.String** values.

Listing IP configuration data

To display detailed IP configuration data for each network adapter, use the following command:

PowerShell

```
Get-CimInstance -Class Win32_NetworkAdapterConfiguration -Filter
IPEnabled=$true
```

The default display for the network adapter configuration object is a very reduced set of the available information. For in-depth inspection and troubleshooting, use `Select-Object` or a formatting cmdlet, such as `Format-List`, to specify the properties to be displayed.

In modern TCP/IP networks you are probably not interested in IPX or WINS properties. You can use the **ExcludeProperty** parameter of `Select-Object` to hide properties with names that begin with "WINS" or "IPX".

PowerShell

```
Get-CimInstance -Class Win32_NetworkAdapterConfiguration -Filter
IPEnabled=$true |
    Select-Object -ExcludeProperty IPX*,WINS*
```

This command returns detailed information about DHCP, DNS, routing, and other minor IP configuration properties.

Pinging computers

You can perform a simple ping against a computer using by **Win32_PingStatus**. The following command performs the ping, but returns lengthy output:

PowerShell

```
Get-CimInstance -Class Win32_PingStatus -Filter "Address='127.0.0.1'"
```

A more useful form for summary information a display of the Address, ResponseTime, and StatusCode properties, as generated by the following command. The **Autosize** parameter of `Format-Table` resizes the table columns so that they display properly in PowerShell.

PowerShell

```
Get-CimInstance -Class Win32_PingStatus -Filter "Address='127.0.0.1'" |
    Format-Table -Property Address,ResponseTime,StatusCode -Autosize
```

Output

```
Address   ResponseTime StatusCode
-------   ------------ ----------
127.0.0.1            0          0
```

A StatusCode of 0 indicates a successful ping.

You can use an array to ping multiple computers with a single command. Because there is more than one address, use the `ForEach-Object` to ping each address separately:

PowerShell

```
'127.0.0.1','localhost','bing.com' |
  ForEach-Object -Process {
    Get-CimInstance -Class Win32_PingStatus -Filter ("Address='$_'") |
      Select-Object -Property Address,ResponseTime,StatusCode
  }
```

You can use the same command format to ping all the addresses on a subnet, such as a private network that uses network number 192.168.1.0 and a standard Class C subnet mask (255.255.255.0)., Only addresses in the range of 192.168.1.1 through 192.168.1.254 are legitimate local addresses (0 is always reserved for the network number and 255 is a subnet broadcast address).

To represent an array of the numbers from 1 through 254 in PowerShell, use the expression `1..254`. A complete subnet ping can be performed by adding each value in the range to a partial address in the ping statement:

PowerShell

```
1..254| ForEach-Object -Process {
  Get-CimInstance -Class Win32_PingStatus -Filter ("Address='192.168.1.$_'")
} |
    Select-Object -Property Address,ResponseTime,StatusCode
```

Note that this technique for generating a range of addresses can be used elsewhere as well. You can generate a complete set of addresses in this way:

PowerShell

```
$ips = 1..254 | ForEach-Object -Process {'192.168.1.' + $_}
```

Retrieving network adapter properties

Earlier, we mentioned that you could retrieve general configuration properties using the **Win32_NetworkAdapterConfiguration** class. Although not strictly TCP/IP information, network adapter information such as MAC addresses and adapter types can be useful for understanding what's going on with a computer. To get a summary of this information, use the following command:

PowerShell

```
Get-CimInstance -Class Win32_NetworkAdapter -ComputerName .
```

Assigning the DNS domain for a network adapter

To assign the DNS domain for automatic name resolution, use the **SetDNSDomain** method of the **Win32_NetworkAdapterConfiguration**. The **Query** parameter of `Invoke-CimMethod` takes a WQL query string. The cmdlet calls the method specified on each instance returned by the query.

PowerShell

```
$wql = 'SELECT * FROM Win32_NetworkAdapterConfiguration WHERE
IPEnabled=True'
$args = @{ DnsDomain = 'fabrikam.com'}
Invoke-CimMethod -MethodName SetDNSDomain -Arguments $args -Query $wql
```

Filtering on `IPEnabled=True` is necessary, because even on a network that uses only TCP/IP, several of the network adapter configurations on a computer aren't true TCP/IP adapters. they're general software elements supporting RAS, VPN, QoS, and other services for all adapters and thus don't have an address of their own.

Performing DHCP configuration tasks

Modifying DHCP details involves working with a set of network adapters, just as the DNS configuration does. There are several distinct actions you can perform using WMI.

Finding DHCP-enabled adapters

To find the DHCP-enabled adapters on a computer, use the following command:

PowerShell

```
Get-CimInstance -Class Win32_NetworkAdapterConfiguration -Filter
"DHCPEnabled=$true"
```

To exclude adapters with IP configuration problems, you can retrieve only IP-enabled adapters:

PowerShell

```
Get-CimInstance -Class Win32_NetworkAdapterConfiguration -Filter
"IPEnabled=$true and DHCPEnabled=$true"
```

Retrieving DHCP properties

Because DHCP-related properties for an adapter generally begin with `DHCP`, you can use the Property parameter of `Format-Table` to display only those properties:

PowerShell

```
Get-CimInstance -Class Win32_NetworkAdapterConfiguration -Filter
"IPEnabled=$true and DHCPEnabled=$true" |
  Format-Table -Property DHCP*
```

Enabling DHCP on each adapter

To enable DHCP on all adapters, use the following command:

```PowerShell
$wql = 'SELECT * from Win32_NetworkAdapterConfiguration WHERE IPEnabled=True
and DHCPEnabled=False'
Invoke-CimMethod -MethodName ReleaseDHCPLease -Query $wql
```

Using the filter statement `IPEnabled=True and DHCPEnabled=False` avoids enabling DHCP where it's already enabled.

Releasing and renewing DHCP leases on specific adapters

Instances of the **Win32_NetworkAdapterConfiguration** class has `ReleaseDHCPLease` and `RenewDHCPLease` methods. Both are used in the same way. In general, use these methods if you only need to release or renew addresses for an adapter on a specific subnet. The easiest way to filter adapters on a subnet is to choose only the adapter configurations that use the gateway for that subnet. For example, the following command releases all DHCP leases on adapters on the local computer that are obtaining DHCP leases from 192.168.1.254:

```PowerShell
$wql = 'SELECT * from Win32_NetworkAdapterConfiguration WHERE
DHCPServer="192.168.1.1"'
Invoke-CimMethod -MethodName ReleaseDHCPLease -Query $wql
```

The only change for renewing a DHCP lease is to use the `RenewDHCPLease` method instead of the `ReleaseDHCPLease` method:

```PowerShell
$wql = 'SELECT * from Win32_NetworkAdapterConfiguration WHERE
DHCPServer="192.168.1.1"'
Invoke-CimMethod -MethodName RenewDHCPLease -Query $wql
```

> ⓘ **Note**

When using these methods on a remote computer, be aware that you can lose access to the remote system if you are connected to it through the adapter with the released or renewed lease.

Releasing and renewing DHCP leases on all adapters

You can perform global DHCP address releases or renewals on all adapters by using the **Win32_NetworkAdapterConfiguration** methods, `ReleaseDHCPLeaseAll` and `RenewDHCPLeaseAll`. However, the command must apply to the WMI class, rather than a particular adapter, because releasing and renewing leases globally is performed on the class, not on a specific adapter. The `Invoke-CimMethod` cmdlet can call the methods of a class.

PowerShell

```
Invoke-CimMethod -ClassName Win32_NetworkAdapterConfiguration -MethodName
ReleaseDHCPLeaseAll
```

You can use the same command format to invoke the **RenewDHCPLeaseAll** method:

PowerShell

```
Invoke-CimMethod -ClassName Win32_NetworkAdapterConfiguration -MethodName
RenewDHCPLeaseAll
```

Creating a network share

To create a network share, use the `Create` method of **Win32_Share**:

PowerShell

```
Invoke-CimMethod -ClassName Win32_Share -MethodName Create -Arguments @{
    Path = 'C:\temp'
    Name = 'TempShare'
    Type = [uint32]0 #Disk Drive
    MaximumAllowed = [uint32]25
    Description = 'test share of the temp folder'
}
```

This is equivalent to the following `net share` command on Windows:

PowerShell

```
net share tempshare=c:\temp /users:25 /remark:"test share of the temp
folder"
```

To call a method of a WMI class that takes parameters you must know what parameters are available and the types of those parameters. For example, you can list the methods of the **Win32_Class** with the following commands:

PowerShell

```
(Get-CimClass -ClassName Win32_Share).CimClassMethods
```

Output

```
Name          ReturnType Parameters
Qualifiers
----          ---------- ----------                                  ------
----
Create            UInt32 {Access, Description, MaximumAllowed, Name…}
{Constructor, Implemented, MappingStrings, Stati…
SetShareInfo      UInt32 {Access, Description, MaximumAllowed}
{Implemented, MappingStrings}
GetAccessMask     UInt32 {}
{Implemented, MappingStrings}
Delete            UInt32 {}
{Destructor, Implemented, MappingStrings}
```

Use the following command to list the parameters of the `Create` method.

PowerShell

```
(Get-CimClass -ClassName Win32_Share).CimClassMethods['Create'].Parameters
```

Output

```
Name            CimType Qualifiers
ReferenceClassName
----            ------- ----------                                 --------
----------
Access         Instance {EmbeddedInstance, ID, In, MappingStrings…}
Description      String {ID, In, MappingStrings, Optional}
MaximumAllowed   UInt32 {ID, In, MappingStrings, Optional}
Name             String {ID, In, MappingStrings}
Password         String {ID, In, MappingStrings, Optional}
Path             String {ID, In, MappingStrings}
Type             UInt32 {ID, In, MappingStrings}
```

You can also read the documentation for Create method of the **Win32_Share** class.

Removing a network share

You can remove a network share with **Win32_Share**, but the process is slightly different from creating a share, because you need to retrieve the specific instance to be removed, rather than the **Win32_Share** class. The following example deletes the share **TempShare**:

PowerShell

```
$wql = 'SELECT * from Win32_Share WHERE Name="TempShare"'
Invoke-CimMethod -MethodName Delete -Query $wql
```

Connecting a Windows-accessible network drive

The `New-PSDrive` cmdlet can create a PowerShell drive that's mapped to a network share.

PowerShell

```
New-PSDrive -Name "X" -PSProvider "FileSystem" -Root "\\Server01\Public"
```

However, drives created this way are only available to PowerShell session where they're created. To map a drive that's available outside of PowerShell (or to other PowerShell sessions), you must use the **Persist** parameter.

PowerShell

```
New-PSDrive -Persist -Name "X" -PSProvider "FileSystem" -Root
"\\Server01\Public"
```

> ⓘ Note
>
> Persistently mapped drives may not be available when running in an elevated context. This is the default behavior of Windows UAC. For more information, see the following article:
>
> - **Mapped drives aren't available from an elevated prompt when UAC is configured to Prompt for credentials**

Working with software installations

Article • 03/17/2023

Applications installed with the Windows Installer can be found through WMI's queries, but not all applications use the Windows Installer. The specific techniques for find applications installed with other tools depends on the installer software.

For example, applications installed by copying the files to a folder on the computer usually can't be managed using techniques discussed here. You can manage these applications as files and folders using the techniques discussed in Working With Files and Folders.

For software installed using an installer package, the Windows Installer can be found using the **Win32Reg_AddRemovePrograms** or the **Win32_Product** classes. However, both of these have problems. The **Win32Reg_AddRemovePrograms** is only available if you are using System Center Configuration Manager (SCCM). And the **Win32_Product** class can be slow and has side effects.

> **⊗ Caution**
>
> The **Win32_Product** class isn't query optimized. Queries that use wildcard filters cause WMI to use the MSI provider to enumerate all installed products then parse the full list sequentially to handle the filter. This also initiates a consistency check of packages installed, verifying and repairing the install. The validation is a slow process and may result in errors in the event logs. For more information seek **KB article 974524**.

This article provides an alternative method for finding installed software.

Querying the Uninstall registry key to find installed software

Because most standard applications register an uninstaller with Windows, we can work with those locally by finding them in the Windows registry. There is no guaranteed way to find every application on a system. However, it's possible to find all programs with listings displayed in **Add or Remove Programs** in the following registry key:

`HKEY_LOCAL_MACHINE\Software\Microsoft\Windows\CurrentVersion\Uninstall`.

We can find the number of installed applications by counting the number of registry keys:

PowerShell

```
$UninstallPath = 'HKLM:\Software\Microsoft\Windows\CurrentVersion\Uninstall'
(Get-ChildItem -Path $UninstallPath).Count
```

Output

```
459
```

We can search this list of applications further using a variety of techniques. To display the values of the registry values in the registry keys under `Uninstall`, use the `GetValue()` method of the registry keys. The value of the method is the name of the registry entry. For example, to find the display names of applications in the `Uninstall` key, use the following command:

PowerShell

```
Get-ChildItem -Path $UninstallPath |
    ForEach-Object -Process { $_.GetValue('DisplayName') } |
    Sort-Object
```

> **Note**
>
> There is no guarantee that the **DisplayName** values are unique.

The following example produces output similar to the **Win32Reg_AddRemovePrograms** class:

PowerShell

```
Get-ChildItem $UninstallPath |
    ForEach-Object {
        $ProdID = ($_.Name -split '\\')[-1]
        Get-ItemProperty -Path "$UninstallPath\$ProdID" -ea SilentlyContinue
|
        Select-Object -Property DisplayName, InstallDate, @{n='ProdID'; e=
{$ProdID}}, Publisher, DisplayVersion
} | Select-Object -First 3
```

For the sake of brevity, this example uses `Select-Object` to limit the number of items returned to three.

Output

```
DisplayName    : 7-Zip 22.01 (x64)
InstallDate    :
ProdID         : 7-Zip
Publisher      : Igor Pavlov
DisplayVersion : 22.01

DisplayName    : AutoHotkey 1.1.33.10
InstallDate    :
ProdID         : AutoHotkey
Publisher      : Lexikos
DisplayVersion : 1.1.33.10

DisplayName    : Beyond Compare 4.4.6
InstallDate    : 20230310
ProdID         : BeyondCompare4_is1
Publisher      : Scooter Software
DisplayVersion : 4.4.6.27483
```

Decode a PowerShell command from a running process

Article • 12/09/2022

> This sample only runs on Windows platforms.

At times, you may have a PowerShell process running that's taking up a large amount of resources. This process could be running in the context of a Task Scheduler job or a SQL Server Agent job. Where there are multiple PowerShell processes running, it can be difficult to know which process represents the problem. This article shows how to decode a script block that a PowerShell process is currently running.

Create a long running process

To demonstrate this scenario, open a new PowerShell window and run the following code. It executes a PowerShell command that outputs a number every minute for 10 minutes.

PowerShell

```
powershell.exe -Command {
    $i = 1
    while ( $i -le 10 )
    {
        Write-Output -InputObject $i
        Start-Sleep -Seconds 60
        $i++
    }
}
```

View the process

The body of the command that PowerShell is executing is stored in the **CommandLine** property of the Win32_Process class. If the command is an encoded command, the **CommandLine** property contains the string "EncodedCommand". Using this information, the encoded command can be de-obfuscated via the following process.

Start PowerShell as Administrator. It's vital that PowerShell is running as administrator, otherwise no results are returned when querying the running processes.

Execute the following command to get all the PowerShell processes that have an encoded command:

```PowerShell
$powerShellProcesses = Get-CimInstance -ClassName Win32_Process -Filter
'CommandLine LIKE "%EncodedCommand%"'
```

The following command creates a custom PowerShell object that contains the process ID and the encoded command.

```PowerShell
$commandDetails = $powerShellProcesses | Select-Object -Property ProcessId,
@{
    name       = 'EncodedCommand'
    expression = {
        if ( $_.CommandLine -match 'encodedCommand (.*) -inputFormat' )
        {
            return $matches[1]
        }
    }
}
```

Now the encoded command can be decoded. The following snippet iterates over the command details object, decodes the encoded command, and adds the decoded command back to the object for further investigation.

```PowerShell
$commandDetails | ForEach-Object -Process {
    # Get the current process
    $currentProcess = $_

    # Convert the Base 64 string to a Byte Array
    $commandBytes =
[System.Convert]::FromBase64String($currentProcess.EncodedCommand)

    # Convert the Byte Array to a string
    $decodedCommand =
[System.Text.Encoding]::Unicode.GetString($commandBytes)

    # Add the decoded command back to the object
    $commandDetails |
        Where-Object -FilterScript { $_.ProcessId -eq
$currentProcess.processId } |
        Add-Member -MemberType NoteProperty -Name DecodedCommand -Value
$decodedCommand
```

```
}
$commandDetails[0] | Format-List -Property *
```

The decoded command can now be reviewed by selecting the decoded command property.

Output

```
ProcessId      : 8752
EncodedCommand :
IAAKAAoACgAgAAoAIAAgACAAIAAkAGkAIAA9ACAAMQAgAAoACgAKACAACgAgACAAIAAgAHcAaABp
AGwAZQAgACgAIAAkAGkAIAAtAG

wAZQAgADEAMAAgACkAIAAKAAoACgAgAAoAIAAgACAAIAB7ACAACgAKAAoAIAAKACAAIAAgACAAIA
AgACAAIABXAHIAaQB0AGUALQBP

AHUAdABwAHUAdAAgAC0ASQBuAHAAdQB0AE8AYgBqAGUAYwB0ACAAJABpACAACgAKAAoAIAAKACAA
IAAgACAAIAAgACAAIABTAHQAYQ

ByAHQALQBTAGwAZQBlAHAAIAAtAFMAZQBjAG8AbgBkAHMAIAA2ADAAIAAKAAoACgAgAAoAIAAgAC
AAIAAgACAAIAAgACQAaQArACsA
                 IAAKAAoACgAgAAoAIAAgACAAIAB9ACAACgAKAAoAIAAKAA==
DecodedCommand :
                     $i = 1
                     while ( $i -le 10 )
                     {
                         Write-Output -InputObject $i
                         Start-Sleep -Seconds 60
                         $i++
                     }
```

Redirecting output

Article • 12/09/2022

PowerShell provides several cmdlets that let you control data output directly. These cmdlets share two important characteristics.

First, they generally transform data to some form of text. They do this because they output the data to system components that require text input. This means they need to represent the objects as text. Therefore, the text is formatted as you see it in the PowerShell console window.

Second, these cmdlets use the PowerShell verb **Out** because they send information out from PowerShell to somewhere else.

Console output

By default, PowerShell sends data to the host window, which is exactly what the `Out-Host` cmdlet does. The primary use for the `Out-Host` cmdlet is paging. For example, the following command uses `Out-Host` to page the output of the `Get-Command` cmdlet:

PowerShell

```
Get-Command | Out-Host -Paging
```

The host window display is outside of PowerShell. This is important because when data is sent out of PowerShell, it's actually removed. You can see this if you try to create a pipeline that pages data to the host window, and then attempt to format it as a list, as shown here:

PowerShell

```
Get-Process | Out-Host -Paging | Format-List
```

You might expect the command to display pages of process information in list format. Instead, it displays the default tabular list:

Output

```
Handles  NPM(K)    PM(K)      WS(K) VM(M)   CPU(s)     Id ProcessName
-------  ------    -----      ----- -----   ------     -- -----------
    101       5     1076       3316    32     0.05   2888 alg
...
```

```
    618      18    39348      51108   143   211.20    740 explorer
    257       8     9752      16828    79     3.02   2560 explorer
...
<SPACE> next page; <CR> next line; Q quit
...
```

The `Out-Host` cmdlet sends the data directly to the console, so the `Format-List` command never receives anything to format.

The correct way to structure this command is to put the `Out-Host` cmdlet at the end of the pipeline as shown below. This causes the process data to be formatted in a list before being paged and displayed.

PowerShell

```
Get-Process | Format-List | Out-Host -Paging
```

Output

```
Id      : 2888
Handles : 101
CPU     : 0.046875
Name    : alg
...

Id      : 740
Handles : 612
CPU     : 211.703125
Name    : explorer

Id      : 2560
Handles : 257
CPU     : 3.015625
Name    : explorer
...
<SPACE> next page; <CR> next line; Q quit
...
```

This applies to all of the **Out** cmdlets. An **Out** cmdlet should always appear at the end of the pipeline.

> ⓘ **Note**
>
> All the **Out** cmdlets render output as text, using the formatting in effect for the console window, including line length limits.

Discarding output

The `Out-Null` cmdlet is designed to immediately discard any input it receives. This is useful for discarding unnecessary data that you get as a side-effect of running a command. When type the following command, you don't get anything back from the command:

PowerShell

```
Get-Command | Out-Null
```

The `Out-Null` cmdlet doesn't discard error output. For example, if you enter the following command, a message is displayed informing you that PowerShell doesn't recognize `Is-NotACommand`:

```
PS> Get-Command Is-NotACommand | Out-Null
Get-Command : 'Is-NotACommand' isn't recognized as a cmdlet, function,
operable program, or script file.
At line:1 char:12
+ Get-Command  <<<< Is-NotACommand | Out-Null
```

Printing data

> `Out-Printer` is only available on Windows platforms.

You can print data using the `Out-Printer` cmdlet. The `Out-Printer` cmdlet uses your default printer if you don't provide a printer name. You can use any Windows-based printer by specifying its display name. There is no need for any kind of printer port mapping or even a real physical printer. For example, if you have the Microsoft Office document imaging tools installed, you can send the data to an image file by typing:

PowerShell

```
Get-Command Get-Command | Out-Printer -Name 'Microsoft Office Document Image
Writer'
```

Saving data

You can send output to a file instead of the console window using the `Out-File` cmdlet. The following command line sends a list of processes to the file `C:\temp\processlist.txt`:

PowerShell

```
Get-Process | Out-File -FilePath C:\temp\processlist.txt
```

The results of using the `Out-File` cmdlet may not be what you expect if you are used to traditional output redirection. To understand its behavior, you must be aware of the context in which the `Out-File` cmdlet operates.

On Window PowerShell 5.1, the `Out-File` cmdlet creates a Unicode file. Some tools, that expect ASCII files, don't work correctly with the default output format. You can change the default output format to ASCII using the **Encoding** parameter:

PowerShell

```
Get-Process | Out-File -FilePath C:\temp\processlist.txt -Encoding ASCII
```

`Out-file` formats file contents to look like console output. This causes the output to be truncated just as it's in a console window in most circumstances. For example, if you run the following command:

PowerShell

```
Get-Command | Out-File -FilePath c:\temp\output.txt
```

The output will look like this:

Output

```
CommandType     Name                                Definition
-----------     ----                                ----------
Cmdlet          Add-Content                         Add-Content [-Path]
<String[...
Cmdlet          Add-History                         Add-History [[-InputObject]
...
...
```

To get output that doesn't force line wraps to match the screen width, you can use the **Width** parameter to specify line width. Because **Width** is a 32-bit integer parameter, the maximum value it can have is 2147483647. Type the following to set the line width to this maximum value:

PowerShell

```
Get-Command | Out-File -FilePath c:\temp\output.txt -Width 2147483647
```

The `Out-File` cmdlet is most useful when you want to save output as it would have displayed on the console.

Using Format commands to change output view

Article • 12/09/2022

PowerShell has a set of cmdlets that allow you to control how properties are displayed for particular objects. The names of all the cmdlets begin with the verb `Format`. They let you select which properties you want to show.

PowerShell

```
Get-Command -Verb Format -Module Microsoft.PowerShell.Utility
```

Output

```
CommandType     Name                Version    Source
-----------     ----                -------    ------
Cmdlet          Format-Custom       6.1.0.0    Microsoft.PowerShell.Utility
Cmdlet          Format-Hex          6.1.0.0    Microsoft.PowerShell.Utility
Cmdlet          Format-List         6.1.0.0    Microsoft.PowerShell.Utility
Cmdlet          Format-Table        6.1.0.0    Microsoft.PowerShell.Utility
Cmdlet          Format-Wide         6.1.0.0    Microsoft.PowerShell.Utility
```

This article describes the `Format-Wide`, `Format-List`, and `Format-Table` cmdlets.

Each object type in PowerShell has default properties that are used when you don't select the properties to display. Each cmdlet uses the same **Property** parameter to specify which properties you want displayed. Because `Format-Wide` only shows a single property, its **Property** parameter only takes a single value, but the property parameters of `Format-List` and `Format-Table` accept a list of property names.

In this example, the default output of `Get-Process` cmdlet shows that we've two instances of Internet Explorer running.

PowerShell

```
Get-Process -Name iexplore
```

The default format for **Process** objects displays the properties shown here:

Output

```
 NPM(K)    PM(M)      WS(M)     CPU(s)      Id  SI ProcessName
 ------    -----      -----     ------      --  -- -----------
     32    25.52      10.25      13.11   12808   1 iexplore
     52    11.46      26.46       3.55   21748   1 iexplore
```

Using Format-Wide for single-item output

The `Format-Wide` cmdlet, by default, displays only the default property of an object. The information associated with each object is displayed in a single column:

PowerShell

```
Get-Command -Verb Format | Format-Wide
```

Output

```
Format-Custom          Format-Hex
Format-List            Format-Table
Format-Wide
```

You can also specify a non-default property:

PowerShell

```
Get-Command -Verb Format | Format-Wide -Property Noun
```

Output

```
Custom                 Hex
List                   Table
Wide
```

Controlling Format-Wide display with column

With the `Format-Wide` cmdlet, you can only display a single property at a time. This makes it useful for displaying large lists in multiple columns.

PowerShell

```
Get-Command -Verb Format | Format-Wide -Property Noun -Column 3
```

Output

```
Custom                Hex                List
Table                 Wide
```

Using Format-List for a list view

The `Format-List` cmdlet displays an object in the form of a listing, with each property labeled and displayed on a separate line:

PowerShell

```
Get-Process -Name iexplore | Format-List
```

Output

```
Id      : 12808
Handles : 578
CPU     : 13.140625
SI      : 1
Name    : iexplore

Id      : 21748
Handles : 641
CPU     : 3.59375
SI      : 1
Name    : iexplore
```

You can specify as many properties as you want:

PowerShell

```
Get-Process -Name iexplore | Format-List -Property
ProcessName,FileVersion,StartTime,Id
```

Output

```
ProcessName : iexplore
FileVersion : 11.00.18362.1 (WinBuild.160101.0800)
StartTime   : 10/22/2019 11:23:58 AM
Id          : 12808

ProcessName : iexplore
FileVersion : 11.00.18362.1 (WinBuild.160101.0800)
```

```
StartTime   : 10/22/2019 11:23:57 AM
Id          : 21748
```

Getting detailed information using Format-List with wildcards

The `Format-List` cmdlet lets you use a wildcard as the value of its **Property** parameter. This lets you display detailed information. Often, objects include more information than you need, which is why PowerShell doesn't show all property values by default. To show all properties of an object, use the `Format-List -Property *` command. The following command generates more than 60 lines of output for a single process:

PowerShell

```
Get-Process -Name iexplore | Format-List -Property *
```

Although the `Format-List` command is useful for showing detail, if you want an overview of output that includes many items, a simpler tabular view is often more useful.

Using Format-Table for tabular output

If you use the `Format-Table` cmdlet with no property names specified to format the output of the `Get-Process` command, you get exactly the same output as you do without a `Format` cmdlet. By default, PowerShell displays **Process** objects in a tabular format.

PowerShell

```
Get-Service -Name win* | Format-Table
```

Output

```
Status   Name               DisplayName
------   ----               -----------
Running  WinDefend          Windows Defender Antivirus Service
Running  WinHttpAutoProx... WinHTTP Web Proxy Auto-Discovery Se...
Running  Winmgmt            Windows Management Instrumentation
Running  WinRM              Windows Remote Management (WS-Manag...
```

> ⓘ **Note**

`Get-Service` is only available on Windows platforms.

Improving Format-Table output

Although a tabular view is useful for displaying lots of information, it may be difficult to interpret if the display is too narrow for the data. In the previous example, the output is truncated. If you specify the **AutoSize** parameter when you run the `Format-Table` command, PowerShell calculates column widths based on the actual data displayed. This makes the columns readable.

PowerShell

```
Get-Service -Name win* | Format-Table -AutoSize
```

Output

```
Status  Name               DisplayName
------  ----               -----------
Running WinDefend          Windows Defender Antivirus Service
Running WinHttpAutoProxySvc WinHTTP Web Proxy Auto-Discovery Service
Running Winmgmt            Windows Management Instrumentation
Running WinRM              Windows Remote Management (WS-Management)
```

The `Format-Table` cmdlet might still truncate data, but it only truncates at the end of the screen. Properties, other than the last one displayed, are given as much size as they need for their longest data element to display correctly.

PowerShell

```
Get-Service -Name win* |
    Format-Table -Property Name, Status, StartType, DisplayName,
DependentServices -AutoSize
```

Output

```
Name                Status StartType DisplayName
DependentServi

ces
----                ------ --------- -----------
-------------
WinDefend           Running Automatic Windows Defender Antivirus Service
{}
WinHttpAutoProxySvc Running    Manual WinHTTP Web Proxy Auto-Discovery
Service  {NcaSvc, iphl…
```

```
Winmgmt               Running Automatic Windows Management Instrumentation
{vmms, TPHKLO…
WinRM                 Running Automatic Windows Remote Management (WS-
Management) {}
```

The `Format-Table` command assumes that properties are listed in order of importance. The cmdlet attempts to fully display the properties nearest the beginning. If the `Format-Table` command can't display all the properties, it removes some columns from the display. You can see this behavior in the **DependentServices** property previous example.

Wrapping Format-Table output in columns

You can force lengthy `Format-Table` data to wrap within its display column using the **Wrap** parameter. Using the **Wrap** parameter may not do what you expect, since it uses default settings if you don't also specify **AutoSize**:

PowerShell

```powershell
Get-Service -Name win* |
    Format-Table -Property Name, Status, StartType, DisplayName,
DependentServices -Wrap
```

Output

```
Name                 Status StartType DisplayName
DependentServi

ces
----                 ------ --------- -----------
--------------
WinDefend            Running Automatic Windows Defender Antivirus Service
{}
WinHttpAutoProxySvc Running    Manual WinHTTP Web Proxy Auto-Discovery
Service  {NcaSvc,

iphlpsvc}
Winmgmt              Running Automatic Windows Management Instrumentation
{vmms,

TPHKLOAD,

SUService,

smstsmgr…}
WinRM                Running Automatic Windows Remote Management (WS-
Management) {}
```

Using the **Wrap** parameter by itself doesn't slow down processing very much. However, using **AutoSize** to format a recursive file listing of a large directory structure can take a long time and use lots of memory before displaying the first output items.

If you aren't concerned about system load, then **AutoSize** works well with the **Wrap** parameter. The initial columns still use as much width as needed to display items on one line, but the final column is wrapped, if necessary.

> ⓘ **Note**
>
> Some columns may not be displayed when you specify the widest columns first. For best results, specify the smallest data elements first.

In the following example, we specify the widest properties first.

PowerShell

```
Get-Process -Name iexplore |
    Format-Table -Wrap -AutoSize -Property FileVersion, Path, Name, Id
```

Even with wrapping, the final **Id** column is omitted:

Output

```
FileVersion                         Path
Nam

e
-----------                         ----
---
11.00.18362.1 (WinBuild.160101.0800) C:\Program Files (x86)\Internet
Explorer\IEXPLORE.EXE iex

plo

re
11.00.18362.1 (WinBuild.160101.0800) C:\Program Files\Internet
Explorer\iexplore.exe       iex

plo

re
```

Organizing table output

Another useful parameter for tabular output control is **GroupBy**. Longer tabular listings in particular may be hard to compare. The **GroupBy** parameter groups output based on a property value. For example, we can group services by **StartType** for easier inspection, omitting the **StartType** value from the property listing:

PowerShell

```
Get-Service -Name win* | Sort-Object StartType | Format-Table -GroupBy
StartType
```

Output

```
   StartType: Automatic
Status   Name               DisplayName
------   ----               -----------
Running  WinDefend          Windows Defender Antivirus Service
Running  Winmgmt            Windows Management Instrumentation
Running  WinRM              Windows Remote Management (WS-Managem…

   StartType: Manual
Status   Name               DisplayName
------   ----               -----------
Running  WinHttpAutoProxyS… WinHTTP Web Proxy Auto-Discovery Serv…
```

Managing current location

Article • 12/09/2022

When navigating folder systems in File Explorer, you usually have a specific working location - namely, the current open folder. Items in the current folder can be manipulated easily by clicking them. For command-line interfaces such as Cmd.exe, when you are in the same folder as a particular file, you can access it by specifying a relatively short name, rather than needing to specify the entire path to the file. The current directory is called the working directory.

PowerShell uses the noun **Location** to refer to the working directory, and implements a family of cmdlets to examine and manipulate your location.

Getting your current location (Get-Location)

To determine the path of your current directory location, enter the `Get-Location` command:

PowerShell

```
Get-Location
```

Output

```
Path
----
C:\Documents and Settings\PowerUser
```

> **Note**
>
> The `Get-Location` cmdlet is similar to the **pwd** command in the BASH shell. The `Set-Location` cmdlet is similar to the **cd** command in Cmd.exe.

Setting your current location (Set-Location)

The `Get-Location` command is used with the `Set-Location` command. The `Set-Location` command allows you to specify your current directory location.

PowerShell

```
Set-Location -Path C:\Windows
```

After you enter the command, notice that you don't receive any direct feedback about the effect of the command. Most PowerShell commands that perform an action produce little or no output because the output isn't always useful. To verify that a successful directory change has occurred when you enter the `Set-Location` command, include the **PassThru** parameter when you enter the `Set-Location` command:

PowerShell

```
Set-Location -Path C:\Windows -PassThru
```

Output

```
Path
----
C:\WINDOWS
```

The **PassThru** parameter can be used with many Set commands in PowerShell to return information about the result for cases in which there is no default output.

You can specify paths relative to your current location in the same way as you would in most UNIX and Windows command shells. In standard notation for relative paths, a period (`.`) represents your current folder, and a doubled period (`..`) represents the parent directory of your current location.

For example, if you are in the `C:\Windows` folder, a period (`.`) represents `C:\Windows` and double periods (`..`) represent `C:`. You can change from your current location to the root of the `C:` drive by typing:

PowerShell

```
Set-Location -Path .. -PassThru
```

Output

```
Path
----
C:\
```

The same technique works on PowerShell drives that aren't file system drives, such as `HKLM:`. You can set your location to the `HKLM\Software` key in the registry by typing:

PowerShell

```
Set-Location -Path HKLM:\SOFTWARE -PassThru
```

Output

```
Path
----
HKLM:\SOFTWARE
```

You can then change the directory location to the parent directory, using a relative path:

PowerShell

```
Set-Location -Path .. -PassThru
```

Output

```
Path
----
HKLM:\
```

You can type `Set-Location` or use any of the built-in PowerShell aliases for `Set-Location` (`cd`, `chdir`, `sl`). For example:

PowerShell

```
cd -Path C:\Windows
```

PowerShell

```
chdir -Path .. -PassThru
```

PowerShell

```
sl -Path HKLM:\SOFTWARE -PassThru
```

Saving and recalling recent locations (Push-Location and Pop-Location)

When changing locations, it's helpful to keep track of where you have been and to be able to return to your previous location. The `Push-Location` cmdlet in PowerShell creates a ordered history (a "stack") of directory paths where you have been, and you can step back through the history of directory paths using the `Pop-Location` cmdlet.

For example, PowerShell typically starts in the user's home directory.

PowerShell

```
Get-Location

Path
----
C:\Documents and Settings\PowerUser
```

> **Note**
>
> The word **stack** has a special meaning in many programming settings, including .NET Framework. Like a physical stack of items, the last item you put onto the stack is the first item that you can pull off the stack. Adding an item to a stack is colloquially known as "pushing" the item onto the stack. Pulling an item off the stack is colloquially known as "popping" the item off the stack.

To push the current location onto the stack, and then move to the Local Settings folder, type:

PowerShell

```
Push-Location -Path "Local Settings"
```

You can then push the Local Settings location onto the stack and move to the Temp folder by typing:

PowerShell

```
Push-Location -Path Temp
```

You can verify that you changed directories by entering the `Get-Location` command:

PowerShell

```
Get-Location
```

Output

```
Path
----
C:\Documents and Settings\PowerUser\Local Settings\Temp
```

You can then pop back into the most recently visited directory by entering the `Pop-Location` command, and verify the change by entering the `Get-Location` command:

PowerShell

```
Pop-Location
Get-Location
```

Output

```
Path
----
C:\Documents and Settings\me\Local Settings
```

Just as with the `Set-Location` cmdlet, you can include the **PassThru** parameter when you enter the `Pop-Location` cmdlet to display the directory that you entered:

PowerShell

```
Pop-Location -PassThru
```

Output

```
Path
----
C:\Documents and Settings\PowerUser
```

You can also use the Location cmdlets with network paths. If you have a server named FS01 with an share named Public, you can change your location by typing

PowerShell

```
Set-Location \\FS01\Public
```

or

PowerShell

```
Push-Location \\FS01\Public
```

You can use the `Push-Location` and `Set-Location` commands to change the location to any available drive. For example, if you have a local CD-ROM drive with drive letter D that contains a data CD, you can change the location to the CD drive by entering the `Set-Location D:` command.

If the drive is empty, you get the following error message:

PowerShell

```
Set-Location D:
```

Output

```
Set-Location : Cannot find path 'D:\' because it does not exist.
```

When you are using a command-line interface, it's not convenient to use File Explorer to examine the available physical drives. Also, File Explorer would not show you the all the PowerShell drives. PowerShell provides a set of commands for manipulating PowerShell drives.

Managing PowerShell drives

Article • 12/09/2022

> This sample only applies to Windows platforms.

A *PowerShell drive* is a data store location that you can access like a filesystem drive in PowerShell. The PowerShell providers create some drives for you, such as the file system drives (including `C:` and `D:`), the registry drives (`HKCU:` and `HKLM:`), and the certificate drive (`Cert:`), and you can create your own PowerShell drives. These drives are useful, but they're available only within PowerShell. You can't access them using other Windows tools, such as File Explorer or `Cmd.exe`.

PowerShell uses the noun, **PSDrive**, for commands that work with PowerShell drives. For a list of the PowerShell drives in your PowerShell session, use the `Get-PSDrive` cmdlet.

PowerShell

```
Get-PSDrive
```

Output

```
Name       Provider      Root
CurrentLocation
----       --------      ----                                 ------------
---
A          FileSystem    A:\
Alias      Alias
C          FileSystem    C:\                                ...And
Settings\me
cert       Certificate   \
D          FileSystem    D:\
Env        Environment
Function   Function
HKCU       Registry      HKEY_CURRENT_USER
HKLM       Registry      HKEY_LOCAL_MACHINE
Variable   Variable
```

Although the drives in the display vary with the drives on your system, the listing looks similar to the output of the `Get-PSDrive` command shown above.

filesystem drives are a subset of the PowerShell drives. You can identify the filesystem drives by the FileSystem entry in the Provider column. The filesystem drives in PowerShell are supported by the PowerShell FileSystem provider.

To see the syntax of the `Get-PSDrive` cmdlet, type a `Get-Command` command with the **Syntax** parameter:

PowerShell

```
Get-Command -Name Get-PSDrive -Syntax
```

Output

```
Get-PSDrive [[-Name] <String[]>] [-Scope <String>] [-PSProvider <String[]>]
[-V
erbose] [-Debug] [-ErrorAction <ActionPreference>] [-ErrorVariable <String>]
[-
OutVariable <String>] [-OutBuffer <Int32>]
```

The **PSProvider** parameter lets you display only the PowerShell drives that are supported by a particular provider. For example, to display only the PowerShell drives that are supported by the PowerShell FileSystem provider, type a `Get-PSDrive` command with the **PSProvider** parameter and the **FileSystem** value:

PowerShell

```
Get-PSDrive -PSProvider FileSystem
```

Output

```
Name       Provider      Root
CurrentLocation
----       --------      ----                                 ------------
---
A          FileSystem    A:\
C          FileSystem    C:\                            ...nd
Settings\PowerUser
D          FileSystem    D:\
```

To view the PowerShell drives that represent registry hives, use the **PSProvider** parameter to display only the PowerShell drives that are supported by the PowerShell Registry provider:

PowerShell

```
Get-PSDrive -PSProvider Registry
```

Output

```
Name       Provider      Root
CurrentLocation
----       --------      ----                                 ------------
---
HKCU       Registry      HKEY_CURRENT_USER
HKLM       Registry      HKEY_LOCAL_MACHINE
```

You can also use the standard Location cmdlets with the PowerShell drives:

PowerShell

```
Set-Location HKLM:\SOFTWARE
Push-Location .\Microsoft
Get-Location
```

Output

```
Path
----
HKLM:\SOFTWARE\Microsoft
```

Adding new PowerShell drives

You can add your own PowerShell drives by using the `New-PSDrive` command. To get the syntax for the `New-PSDrive` command, enter the `Get-Command` command with the **Syntax** parameter:

PowerShell

```
Get-Command -Name New-PSDrive -Syntax
```

Output

```
New-[-Description <String>] [-Scope <String>] [-Credential <PSCredential>]
[-Verbose] [-Debug ]
[-ErrorAction <ActionPreference>] [-ErrorVariable <String>] [-OutVariable
<St ring>]
[-OutBuffer <Int32>] [-WhatIf] [-Confirm]
```

To create a new PowerShell drive, you must supply three parameters:

- A name for the drive (you can use any valid PowerShell name)
- The PSProvider - use `FileSystem` for filesystem locations and `Registry` for registry locations

- The root, that is, the path to the root of the new drive

For example, you can create a drive named `Office` that's mapped to the folder that contains the Microsoft Office applications on your computer, such as `C:\Program Files\MicrosoftOffice\OFFICE11`. To create the drive, type the following command:

PowerShell

```
New-PSDrive -Name Office -PSProvider FileSystem -Root "C:\Program
Files\Microsoft Office\OFFICE11"
```

Output

```
Name       Provider      Root
CurrentLocation
----       --------      ----                                 ------------
---
Office     FileSystem    C:\Program Files\Microsoft Offic...
```

> **Note**
>
> In general, paths aren't case-sensitive.

A PowerShell drive is accessed using its name followed by a colon (`:`).

A PowerShell drive can make many tasks much simpler. For example, some of the most important keys in the Windows registry have extremely long paths, making them cumbersome to access and difficult to remember. Critical configuration information resides under `HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion`. To view and change items in the CurrentVersion registry key, you can create a PowerShell drive that's rooted in that key by typing:

PowerShell

```
New-PSDrive -Name cvkey -PSProvider Registry -Root
HKLM\Software\Microsoft\Windows\CurrentVersion
```

Output

```
Name       Provider      Root
CurrentLocation
----       --------      ----                                 ------------
---
cvkey      Registry      HKLM\Software\Microsoft\Windows\...
```

You can then change location to the **cvkey:** drive as you would any other drive:

PowerShell

```
cd cvkey:
```

or:

PowerShell

```
Set-Location cvkey: -PassThru
```

Output

```
Path
----
cvkey:\
```

The `New-PSDrive` cmdlet adds the new drive only to the current PowerShell session. If you close the PowerShell window, the new drive is lost. To save a PowerShell drive, use the `Export-Console` cmdlet to export the current PowerShell session, and then use the `PowerShell.exe` **PSConsoleFile** parameter to import it. Or, add the new drive to your Windows PowerShell profile.

Deleting PowerShell drives

You can delete drives from PowerShell using the `Remove-PSDrive` cmdlet. For example, if you added the `Office:` PowerShell drive, as shown in the `New-PSDrive` topic, you can delete it by typing:

PowerShell

```
Remove-PSDrive -Name Office
```

To delete the `cvkey:` PowerShell drive, use the following command:

PowerShell

```
Remove-PSDrive -Name cvkey
```

However, you can't delete it while you are in the drive. For example:

PowerShell

```
cd office:
Remove-PSDrive -Name office
```

Output

```
Remove-PSDrive : Cannot remove drive 'Office' because it is in use.
At line:1 char:15
+ remove-psdrive  <<<< -name office
```

Adding and removing drives outside PowerShell

PowerShell detects filesystem drives that are added or removed in Windows, including:

- network drives that are mapped
- USB drives that are attached
- Drives that are deleted using the `net use` command or from a Windows Script Host (WSH) script

Working with files and folders

Article • 12/09/2022

Navigating through PowerShell drives and manipulating the items on them is similar to manipulating files and folders on Windows disk drives. This article discusses how to deal with specific file and folder manipulation tasks using PowerShell.

Listing all files and folders within a folder

You can get all items directly within a folder using `Get-ChildItem`. Add the optional **Force** parameter to display hidden or system items. For example, this command displays the direct contents of PowerShell Drive `C:`.

PowerShell

```
Get-ChildItem -Path C:\ -Force
```

The command lists only the directly contained items, much like using the `dir` command in `cmd.exe` or `ls` in a UNIX shell. To show items in subfolder, you need to specify the **Recurse** parameter. The following command lists everything on the `C:` drive:

PowerShell

```
Get-ChildItem -Path C:\ -Force -Recurse
```

`Get-ChildItem` can filter items with its **Path**, **Filter**, **Include**, and **Exclude** parameters, but those are typically based only on name. You can perform complex filtering based on other properties of items using `Where-Object`.

The following command finds all executables within the Program Files folder that were last modified after October 1, 2005 and that are neither smaller than 1 megabyte nor larger than 10 megabytes:

PowerShell

```
Get-ChildItem -Path $env:ProgramFiles -Recurse -Include *.exe |
    Where-Object -FilterScript {
        ($_.LastWriteTime -gt '2005-10-01') -and ($_.Length -ge 1mb) -and
($_.Length -le 10mb)
    }
```

Copying files and folders

Copying is done with `Copy-Item`. The following command backs up `C:\boot.ini` to `C:\boot.bak`:

PowerShell

```
Copy-Item -Path C:\boot.ini -Destination C:\boot.bak
```

If the destination file already exists, the copy attempt fails. To overwrite a pre-existing destination, use the **Force** parameter:

PowerShell

```
Copy-Item -Path C:\boot.ini -Destination C:\boot.bak -Force
```

This command works even when the destination is read-only.

Folder copying works the same way. This command copies the folder `C:\temp\test1` to the new folder `C:\temp\DeleteMe` recursively:

PowerShell

```
Copy-Item C:\temp\test1 -Recurse C:\temp\DeleteMe
```

You can also copy a selection of items. The following command copies all `.txt` files contained anywhere in `C:\data` to `C:\temp\text`:

PowerShell

```
Copy-Item -Filter *.txt -Path c:\data -Recurse -Destination C:\temp\text
```

You can still use other tools to perform file system copies. XCOPY, ROBOCOPY, and COM objects, such as the **Scripting.FileSystemObject,** all work in PowerShell. For example, you can use the Windows Script Host **Scripting.FileSystem** COM class to back up `C:\boot.ini` to `C:\boot.bak`:

PowerShell

```
(New-Object -ComObject Scripting.FileSystemObject).CopyFile('C:\boot.ini',
'C:\boot.bak')
```

Creating files and folders

Creating new items works the same on all PowerShell providers. If a PowerShell provider has more than one type of item—for example, the FileSystem PowerShell provider distinguishes between directories and files—you need to specify the item type.

This command creates a new folder `C:\temp\New Folder`:

PowerShell

```
New-Item -Path 'C:\temp\New Folder' -ItemType Directory
```

This command creates a new empty file `C:\temp\New Folder\file.txt`

PowerShell

```
New-Item -Path 'C:\temp\New Folder\file.txt' -ItemType File
```

> **ⓘ Important**
>
> When using the **Force** switch with the `New-Item` command to create a folder, and the folder already exists, it *won't* overwrite or replace the folder. It will simply return the existing folder object. However, if you use `New-Item -Force` on a file that already exists, the file is overwritten.

Removing all files and folders within a folder

You can remove contained items using `Remove-Item`, but you will be prompted to confirm the removal if the item contains anything else. For example, if you attempt to delete the folder `C:\temp\DeleteMe` that contains other items, PowerShell prompts you for confirmation before deleting the folder:

```
Remove-Item -Path C:\temp\DeleteMe

Confirm
The item at C:\temp\DeleteMe has children and the Recurse parameter wasn't
specified. If you continue, all children will be removed with the item. Are
you
sure you want to continue?
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
(default is "Y"):
```

If you don't want to be prompted for each contained item, specify the **Recurse** parameter:

```
PowerShell

Remove-Item -Path C:\temp\DeleteMe -Recurse
```

Mapping a local folder as a drive

You can also map a local folder, using the `New-PSDrive` command. The following command creates a local drive `P:` rooted in the local Program Files directory, visible only from the PowerShell session:

```
PowerShell

New-PSDrive -Name P -Root $env:ProgramFiles -PSProvider FileSystem
```

Just as with network drives, drives mapped within PowerShell are immediately visible to the PowerShell shell. To create a mapped drive visible from File Explorer, use the **Persist** parameter. However, only remote paths can be used with **Persist**.

Reading a text file into an array

One of the more common storage formats for text data is in a file with separate lines treated as distinct data elements. The `Get-Content` cmdlet can be used to read an entire file in one step, as shown here:

```
PS> Get-Content -Path C:\boot.ini
[boot loader]
timeout=5
default=multi(0)disk(0)rdisk(0)partition(1)\WINDOWS
[operating systems]
multi(0)disk(0)rdisk(0)partition(1)\WINDOWS="Microsoft Windows XP
Professional"
 /noexecute=AlwaysOff /fastdetect
multi(0)disk(0)rdisk(0)partition(1)\WINDOWS=" Microsoft Windows XP
Professional
with Data Execution Prevention" /noexecute=optin /fastdetect
```

`Get-Content` treats the data read from the file as an array, with one element per line of file content. You can confirm this by checking the **Length** of the returned content:

```
PS> (Get-Content -Path C:\boot.ini).Length
6
```

This command is most useful for getting lists of information into PowerShell. For example, you might store a list of computer names or IP addresses in the file `C:\temp\domainMembers.txt`, with one name on each line of the file. You can use `Get-Content` to retrieve the file contents and put them in the variable `$Computers`:

PowerShell

```
$Computers = Get-Content -Path C:\temp\DomainMembers.txt
```

`$Computers` is now an array containing a computer name in each element.

Working with files, folders and registry keys

Article • 12/09/2022

> This sample only applies to Windows platforms.

PowerShell uses the noun **Item** to refer to items found on a PowerShell drive. When dealing with the PowerShell FileSystem provider, an **Item** might be a file, a folder, or the PowerShell drive. Listing and working with these items is a critical basic task in most administrative settings, so we want to discuss these tasks in detail.

Enumerating files, folders, and registry keys

Since getting a collection of items from a particular location is such a common task, the `Get-ChildItem` cmdlet is designed specifically to return all items found within a container such as a folder.

If you want to return all files and folders that are contained directly within the folder `C:\Windows`, type:

```
PS> Get-ChildItem -Path C:\Windows
    Directory: Microsoft.PowerShell.Core\FileSystem::C:\Windows

Mode                 LastWriteTime     Length Name
----                 -------------     ------ ----
-a---         2006-05-16   8:10 AM          0 0.log
-a---         2005-11-29   3:16 PM         97 acc1.txt
-a---         2005-10-23  11:21 PM       3848 actsetup.log
...
```

The listing looks similar to what you would see when you enter the `dir` command in `cmd.exe`, or the `ls` command in a UNIX command shell.

You can perform complex listings using parameters of the `Get-ChildItem` cmdlet. You can see the syntax the `Get-ChildItem` cmdlet by typing:

PowerShell

```
Get-Command -Name Get-ChildItem -Syntax
```

These parameters can be mixed and matched to get highly customized output.

Listing all contained items

To see both the items inside a Windows folder and any items that are contained within the subfolders, use the **Recurse** parameter of `Get-ChildItem`. The listing displays everything within the Windows folder and the items in its subfolders. For example:

```
PS> Get-ChildItem -Path C:\WINDOWS -Recurse

    Directory: Microsoft.PowerShell.Core\FileSystem::C:\WINDOWS
    Directory: Microsoft.PowerShell.Core\FileSystem::C:\WINDOWS\AppPatch
Mode                 LastWriteTime     Length Name
----                 -------------     ------ ----
-a---         2004-08-04   8:00 AM    1852416 AcGenral.dll
...
```

Filtering items by name

To display only the names of items, use the **Name** parameter of `Get-Childitem`:

```
PS> Get-ChildItem -Path C:\WINDOWS -Name
addins
AppPatch
assembly
...
```

Forcibly listing hidden items

Items that are hidden in File Explorer or `cmd.exe` aren't displayed in the output of a `Get-ChildItem` command. To display hidden items, use the **Force** parameter of `Get-ChildItem`. For example:

PowerShell

```
Get-ChildItem -Path C:\Windows -Force
```

This parameter is named **Force** because you can forcibly override the normal behavior of the `Get-ChildItem` command. **Force** is a widely used parameter that forces an action

that a cmdlet wouldn't normally perform, although it can't perform any action that compromises the security of the system.

Matching item names with wildcards

The `Get-ChildItem` command accepts wildcards in the path of the items to list.

Because wildcard matching is handled by the PowerShell engine, all cmdlets that accepts wildcards use the same notation and have the same matching behavior. The PowerShell wildcard notation includes:

- Asterisk (`*`) matches zero or more occurrences of any character.
- Question mark (`?`) matches exactly one character.
- Left bracket (`[`) character and right bracket (`]`) character surround a set of characters to be matched.

Here are some examples of how wildcard specification works.

To find all files in the Windows directory with the suffix `.log` and exactly five characters in the base name, enter the following command:

```
PS> Get-ChildItem -Path C:\Windows\?????.log

    Directory: Microsoft.PowerShell.Core\FileSystem::C:\Windows
Mode                 LastWriteTime     Length Name
----                 -------------     ------ ----
...
-a---        2006-05-11   6:31 PM     204276 ocgen.log
-a---        2006-05-11   6:31 PM      22365 ocmsn.log
...
-a---        2005-11-11   4:55 AM         64 setup.log
-a---        2005-12-15   2:24 PM      17719 VxSDM.log
...
```

To find all files that begin with the letter `x` in the Windows directory, type:

PowerShell

```
Get-ChildItem -Path C:\Windows\x*
```

To find all files whose names begin with "x" or "z", type:

PowerShell

```
Get-ChildItem -Path C:\Windows\[xz]*
```

For more information about wildcards, see about_Wildcards.

Excluding items

You can exclude specific items using the **Exclude** parameter of `Get-ChildItem`. This lets you perform complex filtering in a single statement.

For example, suppose you are trying to find the Windows Time Service DLL in the **System32** folder, and all you can remember about the DLL name is that it begins with "W" and has "32" in it.

An expression like `w*32*.dll` will find all DLLs that satisfy the conditions, but you may want to further filter out the files and omit any win32 files. You can omit these files using the **Exclude** parameter with the pattern `win*`:

```
PS> Get-ChildItem -Path C:\WINDOWS\System32\w*32*.dll -Exclude win*

    Directory: C:\WINDOWS\System32

Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a---           3/18/2019  9:43 PM         495616 w32time.dll
-a---           3/18/2019  9:44 PM          35328 w32topl.dll
-a---           1/24/2020  5:44 PM         401920 Wldap32.dll
-a---          10/10/2019  5:40 PM         442704 ws2_32.dll
-a---           3/18/2019  9:44 PM          66048 wsnmp32.dll
-a---           3/18/2019  9:44 PM          18944 wsock32.dll
-a---           3/18/2019  9:44 PM          64792 wtsapi32.dll
```

Mixing Get-ChildItem parameters

You can use several of the parameters of the `Get-ChildItem` cmdlet in the same command. Before you mix parameters, be sure that you understand wildcard matching. For example, the following command returns no results:

PowerShell

```
Get-ChildItem -Path C:\Windows\*.dll -Recurse -Exclude [a-y]*.dll
```

There are no results, even though there are two DLLs that begin with the letter "z" in the Windows folder.

No results were returned because we specified the wildcard as part of the path. Even though the command was recursive, the `Get-ChildItem` cmdlet restricted the items to those that are in the Windows folder with names ending with `.dll`.

To specify a recursive search for files whose names match a special pattern, use the **Include** parameter.

```
PS> Get-ChildItem -Path C:\Windows -Include *.dll -Recurse -Exclude [a-
y]*.dll

    Directory:
Microsoft.PowerShell.Core\FileSystem::C:\Windows\System32\Setup

Mode                 LastWriteTime     Length Name
----                 -------------     ------ ----
-a---         2004-08-04   8:00 AM       8261 zoneoc.dll

    Directory: Microsoft.PowerShell.Core\FileSystem::C:\Windows\System32

Mode                 LastWriteTime     Length Name
----                 -------------     ------ ----
-a---         2004-08-04   8:00 AM     337920 zipfldr.dll
```

Working with registry entries

Article • 12/09/2022

> This sample only applies to Windows platforms.

Because registry entries are properties of keys and, as such, can't be directly browsed, we need to take a slightly different approach when working with them.

Listing registry entries

There are many different ways to examine registry entries. The simplest way is to get the property names associated with a key. For example, to see the names of the entries in the registry key `HKEY_LOCAL_MACHINE\Software\Microsoft\Windows\CurrentVersion`, use `Get-Item`. Registry keys have a property with the generic name of "Property" that's a list of registry entries in the key. The following command selects the Property property and expands the items so that they're displayed in a list:

PowerShell

```
Get-Item -Path
Registry::HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion |
    Select-Object -ExpandProperty Property
```

Output

```
DevicePath
MediaPathUnexpanded
ProgramFilesDir
CommonFilesDir
ProductId
```

To view the registry entries in a more readable form, use `Get-ItemProperty`:

PowerShell

```
Get-ItemProperty -Path
Registry::HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion
```

Output

```
ProgramFilesDir          : C:\Program Files
CommonFilesDir           : C:\Program Files\Common Files
```

```
ProgramFilesDir (x86)    : C:\Program Files (x86)
CommonFilesDir (x86)     : C:\Program Files (x86)\Common Files
CommonW6432Dir           : C:\Program Files\Common Files
DevicePath               : C:\WINDOWS\inf
MediaPathUnexpanded      : C:\WINDOWS\Media
ProgramFilesPath         : C:\Program Files
ProgramW6432Dir          : C:\Program Files
SM_ConfigureProgramsName : Set Program Access and Defaults
SM_GamesName             : Games
PSPath                   :
Microsoft.PowerShell.Core\Registry::HKEY_LOCAL_MACHINE\SOFTWA
                           RE\Microsoft\Windows\CurrentVersion
PSParentPath             :
Microsoft.PowerShell.Core\Registry::HKEY_LOCAL_MACHINE\SOFTWA
                           RE\Microsoft\Windows
PSChildName              : CurrentVersion
PSDrive                  : HKLM
PSProvider               : Microsoft.PowerShell.Core\Registry
```

The Windows PowerShell-related properties for the key are all prefixed with "PS", such as **PSPath**, **PSParentPath**, **PSChildName**, and **PSProvider**.

You can use the `*.*` notation for referring to the current location. You can use `Set-Location` to change to the **CurrentVersion** registry container first:

PowerShell

```
Set-Location -Path
Registry::HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion
```

Alternatively, you can use the built-in `HKLM:` PSDrive with `Set-Location`:

PowerShell

```
Set-Location -Path HKLM:\SOFTWARE\Microsoft\Windows\CurrentVersion
```

You can then use the `.` notation for the current location to list the properties without specifying a full path:

PowerShell

```
Get-ItemProperty -Path .
```

Output

```
...
DevicePath          : C:\WINDOWS\inf
```

```
MediaPathUnexpanded : C:\WINDOWS\Media
ProgramFilesDir     : C:\Program Files
...
```

Path expansion works the same as it does within the filesystem, so from this location you can get the **ItemProperty** listing for `HKLM:\SOFTWARE\Microsoft\Windows\Help` using `Get-ItemProperty -Path ..\Help`.

Getting a single registry entry

If you want to retrieve a specific entry in a registry key, you can use one of several possible approaches. This example finds the value of **DevicePath** in `HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion`.

Using `Get-ItemProperty`, use the **Path** parameter to specify the name of the key, and the **Name** parameter to specify the name of the **DevicePath** entry.

PowerShell

```
Get-ItemProperty -Path HKLM:\Software\Microsoft\Windows\CurrentVersion -Name
DevicePath
```

Output

```
DevicePath   : C:\WINDOWS\inf
PSPath       :
Microsoft.PowerShell.Core\Registry::HKEY_LOCAL_MACHINE\Software\Microsoft\Wi
ndows\CurrentVersion
PSParentPath :
Microsoft.PowerShell.Core\Registry::HKEY_LOCAL_MACHINE\Software\Microsoft\Wi
ndows
PSChildName  : CurrentVersion
PSDrive      : HKLM
PSProvider   : Microsoft.PowerShell.Core\Registry
```

This command returns the standard Windows PowerShell properties as well as the **DevicePath** property.

> ⓘ **Note**
>
> Although `Get-ItemProperty` has **Filter**, **Include**, and **Exclude** parameters, they can't be used to filter by property name. These parameters refer to registry keys, which are item paths and not registry entries, which are item properties.

Another option is to use the `reg.exe` command line tool. For help with `reg.exe`, type `reg.exe /?` at a command prompt. To find the **DevicePath** entry, use `reg.exe` as shown in the following command:

PowerShell

```
reg query HKLM\SOFTWARE\Microsoft\Windows\CurrentVersion /v DevicePath
```

Output

```
! REG.EXE VERSION 3.0

HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion
    DevicePath  REG_EXPAND_SZ   %SystemRoot%\inf
```

You can also use the **WshShell** COM object to find some registry entries, although this method doesn't work with large binary data or with registry entry names that include characters such as backslash (`\`). Append the property name to the item path with a `\` separator:

PowerShell

```
(New-Object -ComObject
WScript.Shell).RegRead("HKLM\SOFTWARE\Microsoft\Windows\CurrentVersion\Devic
ePath")
```

Output

```
%SystemRoot%\inf
```

Setting a single registry entry

If you want to change a specific entry in a registry key, you can use one of several possible approaches. This example modifies the **Path** entry under `HKEY_CURRENT_USER\Environment`. The **Path** entry specifies where to find executable files.

1. Retrieve the current value of the **Path** entry using `Get-ItemProperty`.
2. Add the new value, separating it with a `;`.
3. Use `Set-ItemProperty` with the specified key, entry name, and value to modify the registry entry.

PowerShell

```
$value = Get-ItemProperty -Path HKCU:\Environment -Name Path
$newpath = $value.Path += ";C:\src\bin\"
Set-ItemProperty -Path HKCU:\Environment -Name Path -Value $newpath
```

> **Note**
>
> Although `Set-ItemProperty` has **Filter**, **Include**, and **Exclude** parameters, they can't be used to filter by property name. These parameters refer to registry keys—which are item paths—and not registry entries—which are item properties.

Another option is to use the Reg.exe command line tool. For help with reg.exe, type `reg.exe /?` at a command prompt.

The following example changes the **Path** entry by removing the path added in the example above. `Get-ItemProperty` is still used to retrieve the current value to avoid having to parse the string returned from `reg query`. The **SubString** and **LastIndexOf** methods are used to retrieve the last path added to the **Path** entry.

PowerShell

```
$value = Get-ItemProperty -Path HKCU:\Environment -Name Path
$newpath = $value.Path.SubString(0, $value.Path.LastIndexOf(';'))
reg add HKCU\Environment /v Path /d $newpath /f
```

Output

```
The operation completed successfully.
```

Creating new registry entries

To add a new entry named "PowerShellPath" to the **CurrentVersion** key, use `New-ItemProperty` with the path to the key, the entry name, and the value of the entry. For this example, we will take the value of the Windows PowerShell variable `$PSHome`, which stores the path to the installation directory for Windows PowerShell.

You can add the new entry to the key using the following command, and the command also returns information about the new entry:

PowerShell

```
New-ItemProperty -Path HKLM:\SOFTWARE\Microsoft\Windows\CurrentVersion -Name
PowerShellPath -PropertyType String -Value $PSHome
```

Output

```
PSPath         :
Microsoft.PowerShell.Core\Registry::HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Wi
ndows\CurrentVersion
PSParentPath   :
Microsoft.PowerShell.Core\Registry::HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Wi
ndows
PSChildName    : CurrentVersion
PSDrive        : HKLM
PSProvider     : Microsoft.PowerShell.Core\Registry
PowerShellPath : C:\Program Files\Windows PowerShell\v1.0
```

The **PropertyType** must be the name of a **Microsoft.Win32.RegistryValueKind** enumeration member from the following table:

PropertyType Value	**Meaning**
Binary	Binary data
DWord	A number that's a valid **UInt32**
ExpandString	A string that can contain environment variables that are dynamically expanded
MultiString	A multiline string
String	Any string value
QWord	8 bytes of binary data

You can add a registry entry to multiple locations by specifying an array of values for the **Path** parameter:

PowerShell

```
New-ItemProperty -Name PowerShellPath -PropertyType String -Value $PSHome `
  -Path HKLM:\SOFTWARE\Microsoft\Windows\CurrentVersion,
HKCU:\SOFTWARE\Microsoft\Windows\CurrentVersion
```

You can also overwrite a pre-existing registry entry value by adding the **Force** parameter to any `New-ItemProperty` command.

Renaming registry entries

To rename the **PowerShellPath** entry to "PSHome," use `Rename-ItemProperty`:

```
PowerShell

Rename-ItemProperty -Path HKLM:\SOFTWARE\Microsoft\Windows\CurrentVersion -
Name PowerShellPath -NewName PSHome
```

To display the renamed value, add the **PassThru** parameter to the command.

```
PowerShell

Rename-ItemProperty -Path HKLM:\SOFTWARE\Microsoft\Windows\CurrentVersion -
Name PowerShellPath -NewName PSHome -passthru
```

Deleting registry entries

To delete both the PSHome and PowerShellPath registry entries, use `Remove-ItemProperty`:

```
PowerShell

Remove-ItemProperty -Path HKLM:\SOFTWARE\Microsoft\Windows\CurrentVersion -
Name PSHome
Remove-ItemProperty -Path HKCU:\SOFTWARE\Microsoft\Windows\CurrentVersion -
Name PowerShellPath
```

Working with registry keys

Article • 12/09/2022

> This sample only applies to Windows platforms.

Because registry keys are items on PowerShell drives, working with them is very similar to working with files and folders. One critical difference is that every item on a registry-based PowerShell drive is a container, just like a folder on a file system drive. However, registry entries and their associated values are properties of the items, not distinct items.

Listing all subkeys of a registry key

You can show all items directly within a registry key using `Get-ChildItem`. Add the optional **Force** parameter to display hidden or system items. For example, this command displays the items directly within PowerShell drive `HKCU:`, which corresponds to the `HKEY_CURRENT_USER` registry hive:

PowerShell

```
Get-ChildItem -Path HKCU:\ | Select-Object Name
```

Output

```
   Hive: Microsoft.PowerShell.Core\Registry::HKEY_CURRENT_USER

Name
----
HKEY_CURRENT_USER\AppEvents
HKEY_CURRENT_USER\Console
HKEY_CURRENT_USER\Control Panel
HKEY_CURRENT_USER\DirectShow
HKEY_CURRENT_USER\dummy
HKEY_CURRENT_USER\Environment
HKEY_CURRENT_USER\EUDC
HKEY_CURRENT_USER\Keyboard Layout
HKEY_CURRENT_USER\MediaFoundation
HKEY_CURRENT_USER\Microsoft
HKEY_CURRENT_USER\Network
HKEY_CURRENT_USER\Printers
HKEY_CURRENT_USER\Software
HKEY_CURRENT_USER\System
HKEY_CURRENT_USER\Uninstall
HKEY_CURRENT_USER\WXP
HKEY_CURRENT_USER\Volatile Environment
```

These are the top-level keys visible under `HKEY_CURRENT_USER` in the Registry Editor (`regedit.exe`).

You can also specify this registry path by specifying the registry provider's name, followed by `::`. The registry provider's full name is `Microsoft.PowerShell.Core\Registry`, but this can be shortened to just `Registry`. Any of the following commands will list the contents directly under `HKCU:`.

PowerShell

```
Get-ChildItem -Path Registry::HKEY_CURRENT_USER
Get-ChildItem -Path Microsoft.PowerShell.Core\Registry::HKEY_CURRENT_USER
Get-ChildItem -Path Registry::HKCU
Get-ChildItem -Path Microsoft.PowerShell.Core\Registry::HKCU
Get-ChildItem HKCU:
```

These commands list only the directly contained items, much like using `DIR` in `cmd.exe` or `ls` in a UNIX shell. To show contained items, you need to specify the **Recurse** parameter. To list all registry keys in `HKCU:`, use the following command.

PowerShell

```
Get-ChildItem -Path HKCU:\ -Recurse
```

`Get-ChildItem` can perform complex filtering capabilities through its **Path**, **Filter**, **Include**, and **Exclude** parameters, but those parameters are typically based only on name. You can perform complex filtering based on other properties of items using the `Where-Object` cmdlet. The following command finds all keys within `HKCU:\Software` that have no more than one subkey and also have exactly four values:

PowerShell

```
Get-ChildItem -Path HKCU:\Software -Recurse |
    Where-Object {($_.SubKeyCount -le 1) -and ($_.ValueCount -eq 4) }
```

Copying keys

Copying is done with `Copy-Item`. The following example copies the `CurrentVersion` subkey of `HKLM:\SOFTWARE\Microsoft\Windows\` and all of its properties to `HKCU:\`.

PowerShell

```
Copy-Item -Path 'HKLM:\SOFTWARE\Microsoft\Windows\CurrentVersion' -
Destination HKCU:
```

If you examine this new key in the registry editor or using `Get-ChildItem`, you notice that you don't have copies of the contained subkeys in the new location. In order to copy all of the contents of a container, you need to specify the **Recurse** parameter. To make the preceding copy command recursive, you would use this command:

PowerShell

```
Copy-Item -Path 'HKLM:\SOFTWARE\Microsoft\Windows\CurrentVersion' -
Destination HKCU: -Recurse
```

You can still use other tools you already have available to perform filesystem copies. Any registry editing tools—including `reg.exe`, `regini.exe`, `regedit.exe`, and COM objects that support registry editing, such as **WScript.Shell** and WMI's **StdRegProv** class can be used from within PowerShell.

Creating keys

Creating new keys in the registry is simpler than creating a new item in a file system. Because all registry keys are containers, you don't need to specify the item type. Just provide an explicit path, such as:

PowerShell

```
New-Item -Path HKCU:\Software_DeleteMe
```

You can also use a provider-based path to specify a key:

PowerShell

```
New-Item -Path Registry::HKCU\Software_DeleteMe
```

Deleting keys

Deleting items is essentially the same for all providers. The following commands silently remove items:

PowerShell

```
Remove-Item -Path HKCU:\Software_DeleteMe
Remove-Item -Path 'HKCU:\key with spaces in the name'
```

Removing all keys under a specific key

You can remove contained items using `Remove-Item`, but you will be prompted to confirm the removal if the item contains anything else. For example, if we attempt to delete the `HKCU:\CurrentVersion` subkey we created, we see this:

PowerShell

```
Remove-Item -Path HKCU:\CurrentVersion
```

Output

```
Confirm
The item at HKCU:\CurrentVersion\AdminDebug has children and the -recurse
parameter was not specified. If you continue, all children will be removed
with
the item. Are you sure you want to continue?
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
(default is "Y"):
```

To delete contained items without prompting, specify the **Recurse** parameter:

PowerShell

```
Remove-Item -Path HKCU:\CurrentVersion -Recurse
```

If you wanted to remove all items within `HKCU:\CurrentVersion` but not `HKCU:\CurrentVersion` itself, you could instead use:

PowerShell

```
Remove-Item -Path HKCU:\CurrentVersion\* -Recurse
```

Creating a custom input box

Article • 12/09/2022

> This sample only applies to Windows platforms.

Script a graphical custom input box using Microsoft .NET Framework form-building features in Windows PowerShell 3.0 and later releases.

Create a custom, graphical input box

Copy and then paste the following into Windows PowerShell ISE, and then save it as a PowerShell script (`.ps1`) file.

PowerShell

```
Add-Type -AssemblyName System.Windows.Forms
Add-Type -AssemblyName System.Drawing

$form = New-Object System.Windows.Forms.Form
$form.Text = 'Data Entry Form'
$form.Size = New-Object System.Drawing.Size(300,200)
$form.StartPosition = 'CenterScreen'

$okButton = New-Object System.Windows.Forms.Button
$okButton.Location = New-Object System.Drawing.Point(75,120)
$okButton.Size = New-Object System.Drawing.Size(75,23)
$okButton.Text = 'OK'
$okButton.DialogResult = [System.Windows.Forms.DialogResult]::OK
$form.AcceptButton = $okButton
$form.Controls.Add($okButton)

$cancelButton = New-Object System.Windows.Forms.Button
$cancelButton.Location = New-Object System.Drawing.Point(150,120)
$cancelButton.Size = New-Object System.Drawing.Size(75,23)
$cancelButton.Text = 'Cancel'
$cancelButton.DialogResult = [System.Windows.Forms.DialogResult]::Cancel
$form.CancelButton = $cancelButton
$form.Controls.Add($cancelButton)

$label = New-Object System.Windows.Forms.Label
$label.Location = New-Object System.Drawing.Point(10,20)
$label.Size = New-Object System.Drawing.Size(280,20)
$label.Text = 'Please enter the information in the space below:'
$form.Controls.Add($label)

$textBox = New-Object System.Windows.Forms.TextBox
$textBox.Location = New-Object System.Drawing.Point(10,40)
$textBox.Size = New-Object System.Drawing.Size(260,20)
```

```
$form.Controls.Add($textBox)

$form.Topmost = $true

$form.Add_Shown({$textBox.Select()})
$result = $form.ShowDialog()

if ($result -eq [System.Windows.Forms.DialogResult]::OK)
{
    $x = $textBox.Text
    $x
}
```

The script begins by loading two .NET Framework classes: **System.Drawing** and **System.Windows.Forms**. You then start a new instance of the .NET Framework class **System.Windows.Forms.Form**. That provides a blank form or window to which you can start adding controls.

PowerShell

```
$form = New-Object System.Windows.Forms.Form
```

After you create an instance of the Form class, assign values to three properties of this class.

- **Text.** This becomes the title of the window.
- **Size.** This is the size of the form, in pixels. The preceding script creates a form that's 300 pixels wide by 200 pixels tall.
- **StartingPosition.** This optional property is set to **CenterScreen** in the preceding script. If you don't add this property, Windows selects a location when the form is opened. By setting the **StartingPosition** to **CenterScreen**, you're automatically displaying the form in the middle of the screen each time it loads.

PowerShell

```
$form.Text = 'Data Entry Form'
$form.Size = New-Object System.Drawing.Size(300,200)
$form.StartPosition = 'CenterScreen'
```

Next, create an **OK** button for your form. Specify the size and behavior of the **OK** button. In this example, the button position is 120 pixels from the form's top edge, and 75 pixels from the left edge. The button height is 23 pixels, while the button length is 75 pixels. The script uses predefined Windows Forms types to determine the button behaviors.

PowerShell

```
$okButton = New-Object System.Windows.Forms.Button
$okButton.Location = New-Object System.Drawing.Point(75,120)
$okButton.Size = New-Object System.Drawing.Size(75,23)
$okButton.Text = 'OK'
$okButton.DialogResult = [System.Windows.Forms.DialogResult]::OK
$form.AcceptButton = $OKButton
$form.Controls.Add($OKButton)
```

Similarly, you create a **Cancel** button. The **Cancel** button is 120 pixels from the top, but 150 pixels from the left edge of the window.

PowerShell

```
$cancelButton = New-Object System.Windows.Forms.Button
$cancelButton.Location = New-Object System.Drawing.Point(150,120)
$cancelButton.Size = New-Object System.Drawing.Size(75,23)
$cancelButton.Text = 'Cancel'
$cancelButton.DialogResult = [System.Windows.Forms.DialogResult]::Cancel
$form.CancelButton = $cancelButton
$form.Controls.Add($cancelButton)
```

Next, provide label text on your window that describes the information you want users to provide.

PowerShell

```
$label = New-Object System.Windows.Forms.Label
$label.Location = New-Object System.Drawing.Point(10,20)
$label.Size = New-Object System.Drawing.Size(280,20)
$label.Text = 'Please enter the information in the space below:'
$form.Controls.Add($label)
```

Add the control (in this case, a text box) that lets users provide the information you've described in your label text. There are many other controls you can apply besides text boxes. For more controls, see System.Windows.Forms Namespace.

PowerShell

```
$textBox = New-Object System.Windows.Forms.TextBox
$textBox.Location = New-Object System.Drawing.Point(10,40)
$textBox.Size = New-Object System.Drawing.Size(260,20)
$form.Controls.Add($textBox)
```

Set the **Topmost** property to **$true** to force the window to open atop other open windows and dialog boxes.

PowerShell

```
$form.Topmost = $true
```

Next, add this line of code to activate the form, and set the focus to the text box that you created.

PowerShell

```
$form.Add_Shown({$textBox.Select()})
```

Add the following line of code to display the form in Windows.

PowerShell

```
$result = $form.ShowDialog()
```

Finally, the code inside the **If** block instructs Windows what to do with the form after users provide text in the text box, and then click the **OK** button or press the **Enter** key.

PowerShell

```
if ($result -eq [System.Windows.Forms.DialogResult]::OK) {
    $x = $textBox.Text
    $x
}
```

See also

- GitHub: Dave Wyatt's WinFormsExampleUpdates)
- Windows PowerShell Tip of the Week: Creating a Custom Input Box

Creating a graphical date picker

Article • 12/09/2022

> This sample only applies to Windows platforms.

Use Windows PowerShell 3.0 and later releases to create a form with a graphical, calendar-style control that lets users select a day of the month.

Create a graphical date-picker control

Copy and then paste the following into Windows PowerShell ISE, and then save it as a PowerShell script (`.ps1`) file.

PowerShell

```
Add-Type -AssemblyName System.Windows.Forms
Add-Type -AssemblyName System.Drawing

$form = New-Object Windows.Forms.Form -Property @{
    StartPosition = [Windows.Forms.FormStartPosition]::CenterScreen
    Size          = New-Object Drawing.Size 243, 230
    Text          = 'Select a Date'
    Topmost       = $true
}

$calendar = New-Object Windows.Forms.MonthCalendar -Property @{
    ShowTodayCircle   = $false
    MaxSelectionCount = 1
}
$form.Controls.Add($calendar)

$okButton = New-Object Windows.Forms.Button -Property @{
    Location     = New-Object Drawing.Point 38, 165
    Size         = New-Object Drawing.Size 75, 23
    Text         = 'OK'
    DialogResult = [Windows.Forms.DialogResult]::OK
}
$form.AcceptButton = $okButton
$form.Controls.Add($okButton)

$cancelButton = New-Object Windows.Forms.Button -Property @{
    Location     = New-Object Drawing.Point 113, 165
    Size         = New-Object Drawing.Size 75, 23
    Text         = 'Cancel'
    DialogResult = [Windows.Forms.DialogResult]::Cancel
}
$form.CancelButton = $cancelButton
$form.Controls.Add($cancelButton)
```

```
$result = $form.ShowDialog()

if ($result -eq [Windows.Forms.DialogResult]::OK) {
    $date = $calendar.SelectionStart
    Write-Host "Date selected: $($date.ToShortDateString())"
}
```

The script begins by loading two .NET Framework classes: **System.Drawing** and **System.Windows.Forms**. You then start a new instance of the .NET Framework class **Windows.Forms.Form**. That provides a blank form or window to which you can start adding controls.

PowerShell

```
$form = New-Object Windows.Forms.Form -Property @{
    StartPosition = [Windows.Forms.FormStartPosition]::CenterScreen
    Size          = New-Object Drawing.Size 243, 230
    Text          = 'Select a Date'
    Topmost       = $true
}
```

This example assigns values to four properties of this class by using the **Property** property and hashtable.

1. **StartPosition**: If you don't add this property, Windows selects a location when the form is opened. By setting this property to **CenterScreen**, you're automatically displaying the form in the middle of the screen each time it loads.
2. **Size**: This is the size of the form, in pixels. The preceding script creates a form that's 243 pixels wide by 230 pixels tall.
3. **Text**: This becomes the title of the window.
4. **Topmost**: By setting this property to `$true`, you can force the window to open atop other open windows and dialog boxes.

Next, create and then add a calendar control in your form. In this example, the current day isn't highlighted or circled. Users can select only one day on the calendar at one time.

PowerShell

```
$calendar = New-Object Windows.Forms.MonthCalendar -Property @{
    ShowTodayCircle   = $false
    MaxSelectionCount = 1
```

```
}
$form.Controls.Add($calendar)
```

Next, create an **OK** button for your form. Specify the size and behavior of the **OK** button. In this example, the button position is 165 pixels from the form's top edge, and 38 pixels from the left edge. The button height is 23 pixels, while the button length is 75 pixels. The script uses predefined Windows Forms types to determine the button behaviors.

PowerShell

```
$okButton = New-Object Windows.Forms.Button -Property @{
    Location     = New-Object Drawing.Point 38, 165
    Size         = New-Object Drawing.Size 75, 23
    Text         = 'OK'
    DialogResult = [Windows.Forms.DialogResult]::OK
}
$form.AcceptButton = $okButton
$form.Controls.Add($okButton)
```

Similarly, you create a **Cancel** button. The **Cancel** button is 165 pixels from the top, but 113 pixels from the left edge of the window.

PowerShell

```
$cancelButton = New-Object Windows.Forms.Button -Property @{
    Location     = New-Object Drawing.Point 113, 165
    Size         = New-Object Drawing.Size 75, 23
    Text         = 'Cancel'
    DialogResult = [Windows.Forms.DialogResult]::Cancel
}
$form.CancelButton = $cancelButton
$form.Controls.Add($cancelButton)
```

Add the following line of code to display the form in Windows.

PowerShell

```
$result = $form.ShowDialog()
```

Finally, the code inside the `if` block instructs Windows what to do with the form after users select a day on the calendar, and then click the **OK** button or press the **Enter** key. Windows PowerShell displays the selected date to users.

PowerShell

```
if ($result -eq [Windows.Forms.DialogResult]::OK) {
    $date = $calendar.SelectionStart
    Write-Host "Date selected: $($date.ToShortDateString())"
}
```

See also

- GitHub: Dave Wyatt's WinFormsExampleUpdates
- Windows PowerShell Tip of the Week: Creating a Graphical Date Picker)

Multiple-selection list boxes

Article • 12/09/2022

> This sample only applies to Windows platforms.

Use Windows PowerShell 3.0 and later releases to create a multiple-selection list box control in a custom Windows Form.

Create list box controls that allow multiple selections

Copy and then paste the following into Windows PowerShell ISE, and then save it as a PowerShell script (`.ps1`) file.

PowerShell

```
Add-Type -AssemblyName System.Windows.Forms
Add-Type -AssemblyName System.Drawing

$form = New-Object System.Windows.Forms.Form
$form.Text = 'Data Entry Form'
$form.Size = New-Object System.Drawing.Size(300,200)
$form.StartPosition = 'CenterScreen'

$OKButton = New-Object System.Windows.Forms.Button
$OKButton.Location = New-Object System.Drawing.Point(75,120)
$OKButton.Size = New-Object System.Drawing.Size(75,23)
$OKButton.Text = 'OK'
$OKButton.DialogResult = [System.Windows.Forms.DialogResult]::OK
$form.AcceptButton = $OKButton
$form.Controls.Add($OKButton)

$CancelButton = New-Object System.Windows.Forms.Button
$CancelButton.Location = New-Object System.Drawing.Point(150,120)
$CancelButton.Size = New-Object System.Drawing.Size(75,23)
$CancelButton.Text = 'Cancel'
$CancelButton.DialogResult = [System.Windows.Forms.DialogResult]::Cancel
$form.CancelButton = $CancelButton
$form.Controls.Add($CancelButton)

$label = New-Object System.Windows.Forms.Label
$label.Location = New-Object System.Drawing.Point(10,20)
$label.Size = New-Object System.Drawing.Size(280,20)
$label.Text = 'Please make a selection from the list below:'
$form.Controls.Add($label)

$listBox = New-Object System.Windows.Forms.Listbox
```

```
$listBox.Location = New-Object System.Drawing.Point(10,40)
$listBox.Size = New-Object System.Drawing.Size(260,20)

$listBox.SelectionMode = 'MultiExtended'

[void] $listBox.Items.Add('Item 1')
[void] $listBox.Items.Add('Item 2')
[void] $listBox.Items.Add('Item 3')
[void] $listBox.Items.Add('Item 4')
[void] $listBox.Items.Add('Item 5')

$listBox.Height = 70
$form.Controls.Add($listBox)
$form.Topmost = $true

$result = $form.ShowDialog()

if ($result -eq [System.Windows.Forms.DialogResult]::OK)
{
    $x = $listBox.SelectedItems
    $x
}
```

The script begins by loading two .NET Framework classes: **System.Drawing** and **System.Windows.Forms**. You then start a new instance of the .NET Framework class **System.Windows.Forms.Form**. That provides a blank form or window to which you can start adding controls.

PowerShell

```
$form = New-Object System.Windows.Forms.Form
```

After you create an instance of the Form class, assign values to three properties of this class.

- **Text.** This becomes the title of the window.
- **Size.** This is the size of the form, in pixels. The preceding script creates a form that's 300 pixels wide by 200 pixels tall.
- **StartingPosition.** This optional property is set to **CenterScreen** in the preceding script. If you don't add this property, Windows selects a location when the form is opened. By setting the **StartingPosition** to **CenterScreen**, you're automatically displaying the form in the middle of the screen each time it loads.

PowerShell

```
$form.Text = 'Data Entry Form'
$form.Size = New-Object System.Drawing.Size(300,200)
$form.StartPosition = 'CenterScreen'
```

Next, create an **OK** button for your form. Specify the size and behavior of the **OK** button. In this example, the button position is 120 pixels from the form's top edge, and 75 pixels from the left edge. The button height is 23 pixels, while the button length is 75 pixels. The script uses predefined Windows Forms types to determine the button behaviors.

PowerShell

```
$OKButton = New-Object System.Windows.Forms.Button
$OKButton.Location = New-Object System.Drawing.Size(75,120)
$OKButton.Size = New-Object System.Drawing.Size(75,23)
$OKButton.Text = 'OK'
$OKButton.DialogResult = [System.Windows.Forms.DialogResult]::OK
$form.AcceptButton = $OKButton
$form.Controls.Add($OKButton)
```

Similarly, you create a **Cancel** button. The **Cancel** button is 120 pixels from the top, but 150 pixels from the left edge of the window.

PowerShell

```
$CancelButton = New-Object System.Windows.Forms.Button
$CancelButton.Location = New-Object System.Drawing.Point(150,120)
$CancelButton.Size = New-Object System.Drawing.Size(75,23)
$CancelButton.Text = 'Cancel'
$CancelButton.DialogResult = [System.Windows.Forms.DialogResult]::Cancel
$form.CancelButton = $CancelButton
$form.Controls.Add($CancelButton)
```

Next, provide label text on your window that describes the information you want users to provide.

PowerShell

```
$label = New-Object System.Windows.Forms.Label
$label.Location = New-Object System.Drawing.Point(10,20)
$label.Size = New-Object System.Drawing.Size(280,20)
$label.Text = 'Please make a selection from the list below:'
$form.Controls.Add($label)
```

Add the control (in this case, a list box) that lets users provide the information you've described in your label text. There are many other controls you can apply besides text boxes; for more controls, see System.Windows.Forms Namespace.

PowerShell

```
$listBox = New-Object System.Windows.Forms.Listbox
$listBox.Location = New-Object System.Drawing.Point(10,40)
$listBox.Size = New-Object System.Drawing.Size(260,20)
```

Here's how you specify that you want to allow users to select multiple values from the list.

PowerShell

```
$listBox.SelectionMode = 'MultiExtended'
```

In the next section, you specify the values you want the list box to display to users.

PowerShell

```
[void] $listBox.Items.Add('Item 1')
[void] $listBox.Items.Add('Item 2')
[void] $listBox.Items.Add('Item 3')
[void] $listBox.Items.Add('Item 4')
[void] $listBox.Items.Add('Item 5')
```

Specify the maximum height of the list box control.

PowerShell

```
$listBox.Height = 70
```

Add the list box control to your form, and instruct Windows to open the form atop other windows and dialog boxes when it's opened.

PowerShell

```
$form.Controls.Add($listBox)
$form.Topmost = $true
```

Add the following line of code to display the form in Windows.

PowerShell

```
$result = $form.ShowDialog()
```

Finally, the code inside the `if` block instructs Windows what to do with the form after users select one or more options from the list box, and then click the **OK** button or press

the **Enter** key.

PowerShell

```
if ($result -eq [System.Windows.Forms.DialogResult]::OK)
{
    $x = $listBox.SelectedItems
    $x
}
```

See also

- Weekend Scripter: Fixing PowerShell GUI Examples
- GitHub: Dave Wyatt's WinFormsExampleUpdates
- Windows PowerShell Tip of the Week: Multi-Select List Boxes - And More!)

Selecting items from a list box

Article • 12/09/2022

> This sample only applies to Windows platforms.

Use Windows PowerShell 3.0 and later releases to create a dialog box that lets users select items from a list box control.

Create a list box control, and select items from it

Copy and then paste the following into Windows PowerShell ISE, and then save it as a PowerShell script (`.ps1`) file.

PowerShell

```
Add-Type -AssemblyName System.Windows.Forms
Add-Type -AssemblyName System.Drawing

$form = New-Object System.Windows.Forms.Form
$form.Text = 'Select a Computer'
$form.Size = New-Object System.Drawing.Size(300,200)
$form.StartPosition = 'CenterScreen'

$okButton = New-Object System.Windows.Forms.Button
$okButton.Location = New-Object System.Drawing.Point(75,120)
$okButton.Size = New-Object System.Drawing.Size(75,23)
$okButton.Text = 'OK'
$okButton.DialogResult = [System.Windows.Forms.DialogResult]::OK
$form.AcceptButton = $okButton
$form.Controls.Add($okButton)

$cancelButton = New-Object System.Windows.Forms.Button
$cancelButton.Location = New-Object System.Drawing.Point(150,120)
$cancelButton.Size = New-Object System.Drawing.Size(75,23)
$cancelButton.Text = 'Cancel'
$cancelButton.DialogResult = [System.Windows.Forms.DialogResult]::Cancel
$form.CancelButton = $cancelButton
$form.Controls.Add($cancelButton)

$label = New-Object System.Windows.Forms.Label
$label.Location = New-Object System.Drawing.Point(10,20)
$label.Size = New-Object System.Drawing.Size(280,20)
$label.Text = 'Please select a computer:'
$form.Controls.Add($label)

$listBox = New-Object System.Windows.Forms.ListBox
```

```
$listBox.Location = New-Object System.Drawing.Point(10,40)
$listBox.Size = New-Object System.Drawing.Size(260,20)
$listBox.Height = 80

[void] $listBox.Items.Add('atl-dc-001')
[void] $listBox.Items.Add('atl-dc-002')
[void] $listBox.Items.Add('atl-dc-003')
[void] $listBox.Items.Add('atl-dc-004')
[void] $listBox.Items.Add('atl-dc-005')
[void] $listBox.Items.Add('atl-dc-006')
[void] $listBox.Items.Add('atl-dc-007')

$form.Controls.Add($listBox)

$form.Topmost = $true

$result = $form.ShowDialog()

if ($result -eq [System.Windows.Forms.DialogResult]::OK)
{
    $x = $listBox.SelectedItem
    $x
}
```

The script begins by loading two .NET Framework classes: **System.Drawing** and **System.Windows.Forms**. You then start a new instance of the .NET Framework class **System.Windows.Forms.Form**. That provides a blank form or window to which you can start adding controls.

PowerShell

```
Add-Type -AssemblyName System.Windows.Forms
Add-Type -AssemblyName System.Drawing
```

After you create an instance of the **Form** class, assign values to three properties of this class.

- **Text.** This becomes the title of the window.
- **Size.** This is the size of the form, in pixels. The preceding script creates a form that's 300 pixels wide by 200 pixels tall.
- **StartingPosition.** This optional property is set to **CenterScreen** in the preceding script. If you don't add this property, Windows selects a location when the form is opened. By setting the **StartingPosition** to **CenterScreen**, you're automatically displaying the form in the middle of the screen each time it loads.

PowerShell

```
$form.Text = 'Select a Computer'
$form.Size = New-Object System.Drawing.Size(300,200)
$form.StartPosition = 'CenterScreen'
```

Next, create an **OK** button for your form. Specify the size and behavior of the **OK** button. In this example, the button position is 120 pixels from the form's top edge, and 75 pixels from the left edge. The button height is 23 pixels, while the button length is 75 pixels. The script uses predefined Windows Forms types to determine the button behaviors.

PowerShell

```
$okButton = New-Object System.Windows.Forms.Button
$okButton.Location = New-Object System.Drawing.Point(75,120)
$okButton.Size = New-Object System.Drawing.Size(75,23)
$okButton.Text = 'OK'
$okButton.DialogResult = [System.Windows.Forms.DialogResult]::OK
$form.AcceptButton = $okButton
$form.Controls.Add($okButton)
```

Similarly, you create a **Cancel** button. The **Cancel** button is 120 pixels from the top, but 150 pixels from the left edge of the window.

PowerShell

```
$cancelButton = New-Object System.Windows.Forms.Button
$cancelButton.Location = New-Object System.Drawing.Point(150,120)
$cancelButton.Size = New-Object System.Drawing.Size(75,23)
$cancelButton.Text = 'Cancel'
$cancelButton.DialogResult = [System.Windows.Forms.DialogResult]::Cancel
$form.CancelButton = $cancelButton
$form.Controls.Add($cancelButton)
```

Next, provide label text on your window that describes the information you want users to provide. In this case, you want users to select a computer.

PowerShell

```
$label = New-Object System.Windows.Forms.Label
$label.Location = New-Object System.Drawing.Point(10,20)
$label.Size = New-Object System.Drawing.Size(280,20)
$label.Text = 'Please select a computer:'
$form.Controls.Add($label)
```

Add the control (in this case, a list box) that lets users provide the information you've described in your label text. There are many other controls you can apply besides list boxes; for more controls, see System.Windows.Forms Namespace.

PowerShell

```
$listBox = New-Object System.Windows.Forms.ListBox
$listBox.Location = New-Object System.Drawing.Point(10,40)
$listBox.Size = New-Object System.Drawing.Size(260,20)
$listBox.Height = 80
```

In the next section, you specify the values you want the list box to display to users.

> **Note**
>
> The list box created by this script allows only one selection. To create a list box control that allows multiple selections, specify a value for the **SelectionMode** property, similarly to the following: `$listBox.SelectionMode = 'MultiExtended'`. For more information, see **Multiple-selection List Boxes**.

PowerShell

```
[void] $listBox.Items.Add('atl-dc-001')
[void] $listBox.Items.Add('atl-dc-002')
[void] $listBox.Items.Add('atl-dc-003')
[void] $listBox.Items.Add('atl-dc-004')
[void] $listBox.Items.Add('atl-dc-005')
[void] $listBox.Items.Add('atl-dc-006')
[void] $listBox.Items.Add('atl-dc-007')
```

Add the list box control to your form, and instruct Windows to open the form atop other windows and dialog boxes when it's opened.

PowerShell

```
$form.Controls.Add($listBox)
$form.Topmost = $true
```

Add the following line of code to display the form in Windows.

PowerShell

```
$result = $form.ShowDialog()
```

Finally, the code inside the **If** block instructs Windows what to do with the form after users select an option from the list box, and then click the **OK** button or press the **Enter** key.

PowerShell

```
if ($result -eq [System.Windows.Forms.DialogResult]::OK) {
    $x = $listBox.SelectedItem
    $x
}
```

See also

- GitHub: Dave Wyatt's WinFormsExampleUpdates
- Windows PowerShell Tip of the Week: Selecting Items from a List Box

Just Enough Administration

Article • 11/17/2022

Just Enough Administration (JEA) is a security technology that enables delegated administration for anything managed by PowerShell. With JEA, you can:

- **Reduce the number of administrators on your machines** using virtual accounts or group-managed service accounts to perform privileged actions on behalf of regular users.
- **Limit what users can do** by specifying which cmdlets, functions, and external commands they can run.
- **Better understand what your users are doing** with transcripts and logs that show you exactly which commands a user executed during their session.

Why is JEA important?

Highly privileged accounts used to administer your servers pose a serious security risk. Should an attacker compromise one of these accounts, they could launch lateral attacks across your organization. Each compromised account gives an attacker access to even more accounts and resources, and puts them one step closer to stealing company secrets, launching a denial-of-service attack, and more.

It's not always easy to remove administrative privileges, either. Consider the common scenario where the DNS role is installed on the same machine as your Active Directory Domain Controller. Your DNS administrators require local administrator privileges to fix issues with the DNS server. But to do so, you must make them members of the highly privileged **Domain Admins** security group. This approach effectively gives DNS Administrators control over your whole domain and access to all resources on that machine.

JEA addresses this problem through the principle of **Least Privilege**. With JEA, you can configure a management endpoint for DNS administrators that gives them access only to the PowerShell commands they need to get their job done. This means you can provide the appropriate access to repair a poisoned DNS cache or restart the DNS server without unintentionally giving them rights to Active Directory, or to browse the file system, or run potentially dangerous scripts. Better yet, when the JEA session is configured to use temporary privileged virtual accounts, your DNS administrators can connect to the server using **non-admin** credentials and still run commands that typically require admin privileges. JEA enables you to remove users from widely privileged local/domain administrator roles and carefully control what they can do on each machine.

Next steps

To learn more about the requirements to use JEA, see the Prerequisites article.

Samples and DSC resource

Sample JEA configurations and the JEA DSC resource can be found in the JEA GitHub repository.

JEA Prerequisites

Article • 11/17/2022

Just Enough Administration is a feature included in PowerShell 5.0 and higher. This article describes the prerequisites that must be satisfied to start using JEA.

Check which version of PowerShell is installed

To check which version of PowerShell is installed on your system, check the `$PSVersionTable` variable in a Windows PowerShell prompt.

PowerShell

```
$PSVersionTable.PSVersion
```

Output

```
Major  Minor  Build  Revision
-----  -----  -----  --------
5      1      14393  1000
```

JEA is available with PowerShell 5.0 and higher. For full functionality, it's recommended that you install the latest version of PowerShell available for your system. The following table describes JEA's availability on Windows Server:

Server Operating System	**JEA Availability**
Windows Server 2016+	Preinstalled
Windows Server 2012 R2	Full functionality with WMF 5.1
Windows Server 2012	Full functionality with WMF 5.1
Windows Server 2008 R2	Reduced functionality[1] with WMF 5.1

You can also use JEA on your home or work computer:

Client Operating System	**JEA Availability**
Windows 10 1607+	Preinstalled
Windows 10 1603, 1511	Preinstalled, with reduced functionality[2]
Windows 10 1507	Not available

Client Operating System	JEA Availability
Windows 8, 8.1	Full functionality with WMF 5.1
Windows 7	Reduced functionality[1] with WMF 5.1

- [1] JEA can't be configured to use group-managed service accounts on Windows Server 2008 R2 or Windows 7. Virtual accounts and other JEA features *are* supported.
- [2] The following JEA features aren't supported on Windows 10 versions 1511 and 1603:
  - Running as a group-managed service account
  - Conditional access rules in session configurations
  - The user drive
  - Granting access to local user accounts

  To get support for these features, update Windows to version 1607 (Anniversary Update) or higher.

Install Windows Management Framework

If you're running an older version of PowerShell, you may need to update your system with the latest Windows Management Framework (WMF) update. For more information, see the WMF documentation.

It's recommended that you test your workload's compatibility with WMF before upgrading all of your servers.

Windows 10 users should install the latest feature updates to obtain the current version of Windows PowerShell.

Enable PowerShell Remoting

PowerShell Remoting provides the foundation on which JEA is built. It's necessary to ensure PowerShell Remoting is enabled and properly secured before you can use JEA. For more information, see WinRM Security.

PowerShell Remoting is enabled by default on Windows Server 2012, 2012 R2, and 2016. You can enable PowerShell Remoting by running the following command in an elevated PowerShell window.

```
PowerShell
```

```
Enable-PSRemoting
```

Enable PowerShell module and script block logging (optional)

The following steps enable logging for all PowerShell actions on your system. PowerShell Module Logging isn't required for JEA, however it's recommended you turn on logging to ensure the commands users run are logged in a central location.

You can configure the PowerShell Module Logging policy using Group Policy.

1. Open the Local Group Policy Editor on a workstation or a Group Policy Object in the Group Policy Management Console on an Active Directory Domain Controller
2. Navigate to **Computer Configuration\Administrative Templates\Windows Components\Windows PowerShell**
3. Double-click on **Turn on Module Logging**
4. Click **Enabled**
5. In the Options section, click on **Show** next to Module Names
6. Type `*` in the pop-up window to log commands from all modules.
7. Click **OK** to set the policy
8. Double-click on **Turn on PowerShell Script Block Logging**
9. Click **Enabled**
10. Click **OK** to set the policy
11. (On domain-joined machines only) Run `gpupdate` or wait for Group Policy to process the updated policy and apply the settings

You can also enable system-wide PowerShell transcription through Group Policy.

Next steps

- Create a role capability file
- Create a session configuration file

See also

- WinRM Security
- PowerShell ♥ the Blue Team

JEA Role Capabilities

Article • 02/02/2023

When creating a JEA endpoint, you need to define one or more role capabilities that describe what someone can do in a JEA session. A role capability is a PowerShell data file with the `.psrc` extension that lists all the cmdlets, functions, providers, and external programs that are made available to connecting users.

Determine which commands to allow

The first step in creating a role capability file is to consider what the users need access to. The requirements gathering process can take a while, but it's important. Giving users access to too few cmdlets and functions can prevent them from getting their job done. Allowing access to too many cmdlets and functions can allow users to do more than you intended and weaken your security stance.

How you go about this process depends on your organization and goals. The following tips can help ensure you're on the right path.

1. **Identify** the commands users are using to get their jobs done. This may involve surveying IT staff, checking automation scripts, or analyzing PowerShell session transcripts and logs.
2. **Update** use of command-line tools to PowerShell equivalents, where possible, for the best auditing and JEA customization experience. External programs can't be constrained as granularly as native PowerShell cmdlets and functions in JEA.
3. **Restrict** the scope of the cmdlets to only allow specific parameters or parameter values. This is especially important if users should manage only part of a system.
4. **Create** custom functions to replace complex commands or commands that are difficult to constrain in JEA. A simple function that wraps a complex command or applies additional validation logic can offer additional control for admins and end-user simplicity.
5. **Test** the scoped list of allowable commands with your users or automation services, and adjust as necessary.

Examples of potentially dangerous commands

Careful selection of commands is important to ensure the JEA endpoint doesn't allow the user to elevate their permissions.

> **ⓘ Important**
>
> Essential information required for user successCommands in a JEA session are often run with elevated privileges.

The following list contains examples of commands that can be used maliciously if allowed in an unconstrained state. This isn't an exhaustive list and should only be used as a cautionary starting point.

- **Risk:** Granting the connecting user admin privileges to bypass JEA

  Example:

  ```PowerShell
  Add-LocalGroupMember -Member 'CONTOSO\jdoe' -Group 'Administrators'
  ```

  Related commands:

  - `Add-ADGroupMember`
  - `Add-LocalGroupMember`
  - `net.exe`
  - `dsadd.exe`

- **Risk:** Running arbitrary code, such as malware, exploits, or custom scripts to bypass protections

  Example:

  ```PowerShell
  Start-Process -FilePath '\\san\share\malware.exe'
  ```

  Related commands:

  - `Start-Process`
  - `New-Service`
  - `Invoke-Item`
  - `Invoke-WmiMethod`
  - `Invoke-CimMethod`
  - `Invoke-Expression`
  - `Invoke-Command`
  - `New-ScheduledTask`

- `Register-ScheduledJob`

Create a role capability file

You can create a new PowerShell role capability file with the New-PSRoleCapabilityFile cmdlet.

```PowerShell
New-PSRoleCapabilityFile -Path .\MyFirstJEARole.psrc
```

You should edit the created role capability file to allow only the commands required for the role. The PowerShell help documentation contains several examples of how you can configure the file.

Allowing PowerShell cmdlets and functions

To authorize users to run PowerShell cmdlets or functions, add the cmdlet or function name to the **VisibleCmdlets** or **VisibleFunctions** fields. If you aren't sure whether a command is a cmdlet or function, you can run `Get-Command <name>` and check the **CommandType** property in the output.

```PowerShell
VisibleCmdlets = @('Restart-Computer', 'Get-NetIPAddress')
```

Sometimes the scope of a specific cmdlet or function is too broad for your users' needs. A DNS admin, for example, may only need access to restart the DNS service. In multi-tenant environments, tenants have access to self-service management tools. Tenants should be limited to managing their own resources. For these cases, you can restrict which parameters are exposed from the cmdlet or function.

```PowerShell
VisibleCmdlets = @{
    Name       = 'Restart-Computer'
    Parameters = @{ Name = 'Name' }
}
```

In more advanced scenarios, you may also need to restrict the values a user may use with these parameters. Role capabilities let you define a set of values or a regular expression pattern that determine what input is allowed.

PowerShell

```
VisibleCmdlets = @(
    @{
        Name       = 'Restart-Service'
        Parameters = @{ Name = 'Name'; ValidateSet = @('Dns', 'Spooler') }
    }
    @{
        Name       = 'Start-Website'
        Parameters = @{ Name = 'Name'; ValidatePattern = 'HR_*' }
    }
)
```

> **Note**
>
> The **common PowerShell parameters** are always allowed, even if you restrict the available parameters. You shouldn't explicitly list them in the Parameters field.

The list below describes the various ways you can customize a visible cmdlet or function. You can mix and match any of the below in the **VisibleCmdlets** field.

- **Use case:** Allow the user to run `My-Func` without any restrictions on the parameters.

  PowerShell

  ```
  @{ Name = 'My-Func' }
  ```

- **Use case:** Allow the user to run `My-Func` from the module **MyModule** without any restrictions on the parameters.

  PowerShell

  ```
  @{ Name = 'MyModule\My-Func' }
  ```

- **Use case:** Allow the user to run any cmdlet or function with the verb `My`.

  PowerShell

  ```
  @{ Name = 'My-*' }
  ```

- **Use case:** Allow the user to run any cmdlet or function with the noun `Func`.

  PowerShell

```
@{ Name = '*-Func' }
```

- **Use case:** Allow the user to run `My-Func` with the `Param1` and `Param2` parameters. Any value can be supplied to the parameters.

  PowerShell

  ```
  @{ Name = 'My-Func'; Parameters = @{ Name = 'Param1'}, @{ Name =
  'Param2' }}
  ```

- **Use case:** Allow the user to run `My-Func` with the `Param1` parameter. Only `Value1` and `Value2` can be supplied to the parameter.

  PowerShell

  ```
  @{
      Name       = 'My-Func'
      Parameters = @{ Name = 'Param1'; ValidateSet = @('Value1',
  'Value2') }
  }
  ```

- **Use case:** Allow the user to run `My-Func` with the `Param1` parameter. Any value starting with `contoso` can be supplied to the parameter.

  PowerShell

  ```
  @{
      Name       = 'My-Func'
      Parameters = @{ Name = 'Param1'; ValidatePattern = 'contoso.*' }
  }
  ```

> ⚠ **Warning**
>
> For best security practices, it isn't recommended to use wildcards when defining visible cmdlets or functions. Instead, you should explicitly list each trusted command to ensure no other commands that share the same naming scheme are unintentionally authorized.

You can't apply both a **ValidatePattern** and **ValidateSet** to the same cmdlet or function.

If you do, the **ValidatePattern** overrides the **ValidateSet**.

For more information about **ValidatePattern**, check out this *Hey, Scripting Guy!* post and the PowerShell Regular Expressions reference content.

Allowing external commands and PowerShell scripts

To allow users to run executables and PowerShell scripts (`.ps1`) in a JEA session, you have to add the full path to each program in the **VisibleExternalCommands** field.

PowerShell

```
VisibleExternalCommands = @(
    'C:\Windows\System32\whoami.exe'
    'C:\Program Files\Contoso\Scripts\UpdateITSoftware.ps1'
)
```

Where possible, use PowerShell cmdlet or function equivalents for any external executables you authorize since you have control over the parameters allowed with PowerShell cmdlets and functions.

Many executables allow you to read the current state and then change it by providing different parameters.

For example, consider the role of a file server admin that manages network shares hosted on a system. One way of managing shares is to use `net share`. However, allowing `net.exe` is dangerous because the user could use the command to gain admin privileges with the command `net group Administrators unprivilegedjeauser /add`. A more secure option is to allow the Get-SmbShare cmdlet, which achieves the same result but has a much more limited scope.

When making external commands available to users in a JEA session, always specify the complete path to the executable. This prevents the execution of similarly named and potentially malicious programs located elsewhere on the system.

Allowing access to PowerShell providers

By default, no PowerShell providers are available in JEA sessions. This reduces the risk of sensitive information and configuration settings being disclosed to the connecting user.

When necessary, you can allow access to the PowerShell providers using the `VisibleProviders` command. For a full list of providers, run `Get-PSProvider`.

PowerShell

```
VisibleProviders = 'Registry'
```

For simple tasks that require access to the file system, registry, certificate store, or other sensitive providers, consider writing a custom function that works with the provider on the user's behalf. The functions, cmdlets, and external programs available in a JEA session aren't subject to the same constraints as JEA. They can access any provider by default. Also consider using the user drive when users need to copy files to or from a JEA endpoint.

Creating custom functions

You can author custom functions in a role capability file to simplify complex tasks for your end users. Custom functions are also useful when you require advanced validation logic for cmdlet parameter values. You can write simple functions in the **FunctionDefinitions** field:

PowerShell

```
VisibleFunctions = 'Get-TopProcess'

FunctionDefinitions = @{
    Name        = 'Get-TopProcess'
    ScriptBlock = {
        param($Count = 10)

        Get-Process |
            Sort-Object -Property CPU -Descending |
            Microsoft.PowerShell.Utility\Select-Object -First $Count
    }
}
```

> **ⓘ Important**
>
> Don't forget to add the name of your custom functions to the **VisibleFunctions** field so they can be run by the JEA users.

The body (script block) of custom functions runs in the default language mode for the system and isn't subject to JEA's language constraints. This means that functions can access the file system and registry, and run commands that weren't made visible in the role capability file. Take care to avoid running arbitrary code when using parameters. Avoid piping user input directly into cmdlets like `Invoke-Expression`.

In the above example, notice that the fully qualified module name (FQMN) `Microsoft.PowerShell.Utility\Select-Object` was used instead of the shorthand `Select-Object`. Functions defined in role capability files are still subject to the scope of JEA sessions, which includes the proxy functions JEA creates to constrain existing commands.

By default, `Select-Object` is a constrained cmdlet in all JEA sessions that doesn't allow the selection of arbitrary properties on objects. To use the unconstrained `Select-Object` in functions, you must explicitly request the full implementation using the FQMN. Any constrained cmdlet in a JEA session has the same constraints when invoked from a function. For more information, see about_Command_Precedence.

If you're writing several custom functions, it's more convenient to put them in a PowerShell script module. You make those functions visible in the JEA session using the **VisibleFunctions** field like you would with built-in and third-party modules.

For tab completion to work properly in JEA sessions you must include the built-in function `tabexpansion2` in the **VisibleFunctions** list.

Make the role capabilities available to a configuration

Prior to PowerShell 6, for PowerShell to find a role capability file it must be stored in a `RoleCapabilities` folder in a PowerShell module. The module can be stored in any folder included in the `$env:PSModulePath` environment variable, however you shouldn't place it in `$env:SystemRoot\System32` or a folder where untrusted users could modify the files.

The following example creates a PowerShell script module called **ContosoJEA** in the `$env:ProgramFiles` path to host the role capabilities file.

PowerShell

```
# Create a folder for the module
$modulePath = Join-Path $env:ProgramFiles
"WindowsPowerShell\Modules\ContosoJEA"
New-Item -ItemType Directory -Path $modulePath

# Create an empty script module and module manifest.
# At least one file in the module folder must have the same name as the
folder itself.
$rootModulePath = Join-Path $modulePath "ContosoJEAFunctions.psm1"
$moduleManifestPath = Join-Path $modulePath "ContosoJEA.psd1"
New-Item -ItemType File -Path $RootModulePath
```

```
New-ModuleManifest -Path $moduleManifestPath -RootModule
"ContosoJEAFunctions.psm1"

# Create the RoleCapabilities folder and copy in the PSRC file
$rcFolder = Join-Path $modulePath "RoleCapabilities"
New-Item -ItemType Directory $rcFolder
Copy-Item -Path .\MyFirstJEARole.psrc -Destination $rcFolder
```

For more information about PowerShell modules, see Understanding a PowerShell Module.

Starting in PowerShell 6, the **RoleDefinitions** property was added to the session configuration file. This property lets you specify the location of a role configuration file for your role definition. See the examples in New-PSSessionConfigurationFile.

Updating role capabilities

You can edit a role capability file to update the settings at any time. Any new JEA sessions started after the role capability has been updated will reflect the revised capabilities.

This is why controlling access to the role capabilities folder is so important. Only highly trusted administrators should be allowed to change role capability files. If an untrusted user can change role capability files, they can easily give themselves access to cmdlets that allow them to elevate their privileges.

For administrators looking to lock down access to the role capabilities, ensure Local System has read-only access to the role capability files and containing modules.

How role capabilities are merged

Users are granted access to all matching role capabilities in the session configuration file when they enter a JEA session. JEA tries to give the user the most permissive set of commands allowed by any of the roles.

VisibleCmdlets and VisibleFunctions

The most complex merge logic affects cmdlets and functions, which can have their parameters and parameter values limited in JEA.

The rules are as follows:

1. If a cmdlet is only made visible in one role, it's visible to the user with any applicable parameter constraints.
2. If a cmdlet is made visible in more than one role, and each role has the same constraints on the cmdlet, the cmdlet is visible to the user with those constraints.
3. If a cmdlet is made visible in more than one role, and each role allows a different set of parameters, the cmdlet and all the parameters defined across every role are visible to the user. If one role doesn't have constraints on the parameters, all parameters are allowed.
4. If one role defines a validate set or validate pattern for a cmdlet parameter, and the other role allows the parameter but doesn't constrain the parameter values, the validate set or pattern is ignored.
5. If a validate set is defined for the same cmdlet parameter in more than one role, all values from all validate sets are allowed.
6. If a validate pattern is defined for the same cmdlet parameter in more than one role, any values that match any of the patterns are allowed.
7. If a validate set is defined in one or more roles, and a validate pattern is defined in another role for the same cmdlet parameter, the validate set is ignored and rule (6) applies to the remaining validate patterns.

Below is an example of how roles are merged according to these rules:

PowerShell

```
# Role A Visible Cmdlets
$roleA = @{
    VisibleCmdlets = @(
        'Get-Service'
         @{
            Name       = 'Restart-Service'
            Parameters = @{ Name = 'DisplayName'; ValidateSet = 'DNS Client'
}
        }
    )
}

# Role B Visible Cmdlets
$roleB = @{
    VisibleCmdlets = @(
        @{
            Name       = 'Get-Service';
            Parameters = @{ Name = 'DisplayName'; ValidatePattern = 'DNS.*'
}
        }
        @{
            Name       = 'Restart-Service'
            Parameters = @{ Name = 'DisplayName'; ValidateSet = 'DNS Server'
}
        }
```

```
    )
}

# Resulting permissions for a user who belongs to both role A and B
# - The constraint in role B for the DisplayName parameter on Get-Service
#   is ignored because of rule #4
# - The ValidateSets for Restart-Service are merged because both roles use
#   ValidateSet on the same parameter per rule #5
$mergedAandB = @{
    VisibleCmdlets = @(
        'Get-Service'
        @{
            Name = 'Restart-Service';
            Parameters = @{
                Name = 'DisplayName'
                ValidateSet = 'DNS Client', 'DNS Server'
            }
        }
    )
}
```

VisibleExternalCommands, VisibleAliases, VisibleProviders, ScriptsToProcess

All other fields in the role capability file are added to a cumulative set of allowable external commands, aliases, providers, and startup scripts. Any command, alias, provider, or script available in one role capability is available to the JEA user.

Be careful to ensure that the combined set of providers from one role capability and cmdlets/functions/commands from another don't allow users unintentional access to system resources. For example, if one role allows the `Remove-Item` cmdlet and another allows the `FileSystem` provider, you are at risk of a JEA user deleting arbitrary files on your computer. Additional information about identifying users' effective permissions can be found in the auditing JEA article.

Next steps

Create a session configuration file

JEA Session Configurations

Article • 11/17/2022

A JEA endpoint is registered on a system by creating and registering a PowerShell session configuration file. Session configurations define who can use the JEA endpoint and which roles they have access to. They also define global settings that apply to all users of the JEA session.

Create a session configuration file

To register a JEA endpoint, you must specify how that endpoint is configured. There are many options to consider. The most important options are:

- Who has access to the JEA endpoint
- Which roles they be assigned
- Which identity JEA uses under the covers
- The name of the JEA endpoint

These options are defined in a PowerShell data file with a `.pssc` extension known as a PowerShell session configuration file. The session configuration file can be edited using any text editor.

Run the following command to create a blank template configuration file.

PowerShell

```
New-PSSessionConfigurationFile -SessionType RestrictedRemoteServer -Path
.\MyJEAEndpoint.pssc
```

> **Tip**
>
> Only the most common configuration options are included in the template file by default. Use the `-Full` switch to include all applicable settings in the generated PSSC.

The `-SessionType RestrictedRemoteServer` field indicates that the session configuration is used by JEA for secure management. Sessions of this type operate in **NoLanguage** mode and only have access to the following default commands (and aliases):

- `Clear-Host` (`cls`, `clear`)

- `Exit-PSSession` (`exsn`, `exit`)
- `Get-Command` (`gcm`)
- `Get-FormatData`
- `Get-Help`
- `Measure-Object` (`measure`)
- `Out-Default`
- `Select-Object` (`select`)

No PowerShell providers are available, nor are any external programs (executables or scripts).

For more information about language modes, see about_Language_modes.

Choose the JEA identity

Behind the scenes, JEA needs an identity (account) to use when running a connected user's commands. You define which identity JEA uses in the session configuration file.

Local Virtual Account

Local virtual accounts are useful when all roles defined for the JEA endpoint are used to manage the local machine and a local administrator account is sufficient to run the commands successfully. Virtual accounts are temporary accounts that are unique to a specific user and only last for the duration of their PowerShell session. On a member server or workstation, virtual accounts belong to the local computer's **Administrators** group. On an Active Directory Domain Controller, virtual accounts belong to the domain's **Domain Admins** group.

PowerShell

```
# Setting the session to use a virtual account
RunAsVirtualAccount = $true
```

If the roles defined by the session configuration don't require full administrative privilege, you can specify the security groups to which the virtual account will belong. On a member server or workstation, the specified security groups must be local groups, not groups from a domain.

When one or more security groups are specified, the virtual account isn't assigned to the local or domain administrators group.

PowerShell

```
# Setting the session to use a virtual account that only belongs to the
NetworkOperator and NetworkAuditor local groups
RunAsVirtualAccount = $true
RunAsVirtualAccountGroups = 'NetworkOperator', 'NetworkAuditor'
```

> ⓘ Note
>
> Virtual accounts are temporarily granted the Logon as a service right in the local server security policy. If one of the VirtualAccountGroups specified has already been granted this right in the policy, the individual virtual account will no longer be added and removed from the policy. This can be useful in scenarios such as domain controllers where revisions to the domain controller security policy are closely audited. This is only available in Windows Server 2016 with the November 2018 or later rollup and Windows Server 2019 with the January 2019 or later rollup.

Group-managed service account

A group-managed service account (GMSA) is the appropriate identity to use when JEA users need to access network resources such as file shares and web services. GMSAs give you a domain identity that's used to authenticate with resources on any machine within the domain. The rights that a GMSA provides are determined by the resources you're accessing. You don't have admin rights on any machines or services unless the machine or service administrator has explicitly granted those rights to the GMSA.

PowerShell

```
# Configure JEA sessions to use the GMSA in the local computer's domain
# with the sAMAccountName of 'MyJEAGMSA'
GroupManagedServiceAccount = 'Domain\MyJEAGMSA'
```

GMSAs should only be used when necessary:

- It's difficult to trace back actions to a user when using a GMSA. Every user shares the same run-as identity. You must review PowerShell session transcripts and logs to correlate individual users with their actions.
- The GMSA may have access to many network resources that the connecting user doesn't need access to. Always try to limit effective permissions in a JEA session to follow the principle of least privilege.

> ⓘ Note

Group managed service accounts are only available on domain-joined machines using PowerShell 5.1 or newer.

For more information about securing a JEA session, see the security considerations article.

Session transcripts

It's recommended that you configure a JEA endpoint to automatically record transcripts of users' sessions. PowerShell session transcripts contain information about the connecting user, the run as identity assigned to them, and the commands run by the user. They can be useful to an auditing team who needs to understand who made a specific change to a system.

To configure automatic transcription in the session configuration file, provide a path to a folder where the transcripts should be stored.

PowerShell

```
TranscriptDirectory = 'C:\ProgramData\JEAConfiguration\Transcripts'
```

Transcripts are written to the folder by the **Local System** account, which requires read and write access to the directory. Standard users should have no access to the folder. Limit the number of security administrators that have access to audit the transcripts.

User drive

If your connecting users need to copy files to or from the JEA endpoint, you can enable the user drive in the session configuration file. The user drive is a **PSDrive** that's mapped to a unique folder for each connecting user. This folder allows users to copy files to or from the system without giving them access to the full file system or exposing the FileSystem provider. The user drive contents are persistent across sessions to accommodate situations where network connectivity may be interrupted.

PowerShell

```
MountUserDrive = $true
```

By default, the user drive allows you to store a maximum of 50MB of data per user. You can limit the amount of data a user can consume with the *UserDriveMaximumSize* field.

PowerShell

```
# Enables the user drive with a per-user limit of 500MB (524288000 bytes)
MountUserDrive = $true
UserDriveMaximumSize = 524288000
```

If you don't want data in the user drive to be persistent, you can configure a scheduled task on the system to automatically clean up the folder every night.

> **Note**
>
> The user drive is only available in PowerShell 5.1 or newer.

For more information about PSDrives, see Managing PowerShell drives.

Role definitions

Role definitions in a session configuration file define the mapping of **users** to **roles**. Every user or group included in this field is granted permission to the JEA endpoint when it's registered. Each user or group can be included as a key in the hashtable only once, but can be assigned multiple roles. The name of the role capability should be the name of the role capability file, without the `.psrc` extension.

PowerShell

```
RoleDefinitions = @{
    'CONTOSO\JEA_DNS_ADMINS'     = @{ RoleCapabilities = 'DnsAdmin',
'DnsOperator', 'DnsAuditor' }
    'CONTOSO\JEA_DNS_OPERATORS' = @{ RoleCapabilities = 'DnsOperator',
'DnsAuditor' }
    'CONTOSO\JEA_DNS_AUDITORS'   = @{ RoleCapabilities = 'DnsAuditor' }
}
```

If a user belongs to more than one group in the role definition, they get access to the roles of each. When two roles grant access to the same cmdlets, the most permissive parameter set is granted to the user.

When specifying local users or groups in the role definitions field, be sure to use the computer name, not **localhost** or wildcards. You can check the computer name by inspecting the `$env:COMPUTERNAME` variable.

PowerShell

```
RoleDefinitions = @{
    'MyComputerName\MyLocalGroup' = @{ RoleCapabilities = 'DnsAuditor' }
}
```

Role capability search order

As shown in the example above, role capabilities are referenced by the base name of the role capability file. The base name of a file is the filename without the extension. If multiple role capabilities are available on the system with the same name, PowerShell uses its implicit search order to select the effective role capability file. JEA does **not** give access to all role capability files with the same name.

JEA uses the `$env:PSModulePath` environment variable to determine which paths to scan for role capability files. Within each of those paths, JEA looks for valid PowerShell modules that contain a "RoleCapabilities" subfolder. As with importing modules, JEA prefers role capabilities that are shipped with Windows to custom role capabilities with the same name.

For all other naming conflicts, precedence is determined by the order in which Windows enumerates the files in the directory. The order isn't guaranteed to be alphabetical. The first role capability file found that matches the specified name is used for the connecting user. Since the role capability search order isn't deterministic, it's **strongly recommended** that role capabilities have unique filenames.

Conditional access rules

All users and groups included in the **RoleDefinitions** field are automatically granted access to JEA endpoints. Conditional access rules allow you to refine this access and require users to belong to additional security groups that don't impact the roles to which they're assigned. This is useful when you want to integrate a just-in-time privileged access management solution, smartcard authentication, or other multifactor authentication solution with JEA.

Conditional access rules are defined in the RequiredGroups field in a session configuration file. There, you can provide a hashtable (optionally nested) that uses 'And' and 'Or' keys to construct your rules. Here are some examples of how to use this field:

PowerShell

```
# Example 1: Connecting users must belong to a security group called
"elevated-jea"
RequiredGroups = @{ And = 'elevated-jea' }
```

```
# Example 2: Connecting users must have signed on with 2 factor
authentication or a smart card
# The 2 factor authentication group name is "2FA-logon" and the smart card
group
# name is "smartcard-logon"
RequiredGroups = @{ Or = '2FA-logon', 'smartcard-logon' }

# Example 3: Connecting users must elevate into "elevated-jea" with their
JIT system and
# have logged on with 2FA or a smart card
RequiredGroups = @{ And = 'elevated-jea', @{ Or = '2FA-logon', 'smartcard-
logon' }}
```

> **Note**
>
> Conditional access rules are only available in PowerShell 5.1 or newer.

Other properties

Session configuration files can also do everything a role capability file can do, just without the ability to give connecting users access to different commands. If you want to allow all users access to specific cmdlets, functions, or providers, you can do so right in the session configuration file. For a full list of supported properties in the session configuration file, run `Get-Help New-PSSessionConfigurationFile -Full`.

Testing a session configuration file

You can test a session configuration using the Test-PSSessionConfigurationFile cmdlet. It's recommended that you test your session configuration file if you've manually edited the `.pssc` file. Testing ensures the syntax is correct. If a session configuration file fails this test, it can't be registered on the system.

Sample session configuration file

The following example shows how to create and validate a session configuration for JEA. The role definitions are created and stored in the `$roles` variable for convenience and readability. it isn't a requirement to do so.

PowerShell

```
$roles = @{
    'CONTOSO\JEA_DNS_ADMINS'     = @{ RoleCapabilities = 'DnsAdmin',
```

```
'DnsOperator', 'DnsAuditor' }
    'CONTOSO\JEA_DNS_OPERATORS' = @{ RoleCapabilities = 'DnsOperator',
'DnsAuditor' }
    'CONTOSO\JEA_DNS_AUDITORS'  = @{ RoleCapabilities = 'DnsAuditor' }
}

$parameters = @{
    SessionType = 'RestrictedRemoteServer'
    Path = '.\JEAConfig.pssc'
    RunAsVirtualAccount = $true
    TranscriptDirectory = 'C:\ProgramData\JEAConfiguration\Transcripts'
    RoleDefinitions = $roles
    RequiredGroups = @{ Or = '2FA-logon', 'smartcard-logon' }
}
New-PSSessionConfigurationFile @parameters
Test-PSSessionConfigurationFile -Path .\JEAConfig.pssc # should yield True
```

Updating session configuration files

To change the properties of a JEA session configuration, including the mapping of users to roles, you must unregister. Then, re-register the JEA session configuration using an updated session configuration file.

Next steps

- Register a JEA configuration
- Author JEA roles

Registering JEA Configurations

Article • 11/17/2022

Once you have your role capabilities and session configuration file created, the last step is to register the JEA endpoint. Registering the JEA endpoint with the system makes the endpoint available for use by users and automation engines.

Single machine configuration

For small environments, you can deploy JEA by registering the session configuration file using the Register-PSSessionConfiguration cmdlet.

Before you begin, ensure that the following prerequisites have been met:

- One or more roles has been created and placed in the **RoleCapabilities** folder of a PowerShell module.
- A session configuration file has been created and tested.
- The user registering the JEA configuration has administrator rights on the system.
- You've selected a name for your JEA endpoint.

The name of the JEA endpoint is required when users connect to the system using JEA. The Get-PSSessionConfiguration cmdlet lists the names of the endpoints on a system. Endpoints that start with `microsoft` are typically shipped with Windows. The `microsoft.powershell` endpoint is the default endpoint used when connecting to a remote PowerShell endpoint.

PowerShell

```
Get-PSSessionConfiguration | Select-Object Name
```

Output

```
Name
----
microsoft.powershell
microsoft.powershell.workflow
microsoft.powershell32
```

Run the following command to register the endpoint.

PowerShell

```
Register-PSSessionConfiguration -Path .\MyJEAConfig.pssc -Name
'JEAMaintenance' -Force
```

> ⚠ **Warning**
>
> The previous command restarts the WinRM service on the system. This terminates all PowerShell remoting sessions and any ongoing DSC configurations. We recommended you take production machines offline before running the command to avoid disrupting business operations.

After registration, you're ready to use JEA. You may delete the session configuration file at any time. The configuration file isn't used after registration of the endpoint.

Multi-machine configuration with DSC

When deploying JEA on multiple machines, the simplest deployment model uses the JEA Desired State Configuration (DSC) resource to quickly and consistently deploy JEA on each machine.

To deploy JEA with DSC, ensure the following prerequisites are met:

- One or more role capabilities have been authored and added to a PowerShell module.
- The PowerShell module containing the roles is stored on a (read-only) file share accessible by each machine.
- Settings for the session configuration have been determined. You don't need to create a session configuration file when using the JEA DSC resource.
- You have credentials that allow administrative actions on each machine or access to the DSC pull server used to manage the machines.
- You've downloaded the JEA DSC resource.

Create a DSC configuration for your JEA endpoint on a target machine or pull server. In this configuration, the **JustEnoughAdministration** DSC resource defines the session configuration file and the **File** resource copies the role capabilities from the file share.

The following properties are configurable using the DSC resource:

- Role Definitions
- Virtual account groups
- Group-managed service account name
- Transcript directory

- User drive
- Conditional access rules
- Startup scripts for the JEA session

The syntax for each of these properties in a DSC configuration is consistent with the PowerShell session configuration file.

Below is a sample DSC configuration for a general server maintenance module. It assumes that a valid PowerShell module containing role capabilities is located on the `\\myfileshare\JEA` file share.

PowerShell

```
Configuration JEAMaintenance
{
    Import-DscResource -Module JustEnoughAdministration,
PSDesiredStateConfiguration

    File MaintenanceModule
    {
        SourcePath = "\\myfileshare\JEA\ContosoMaintenance"
        DestinationPath = "C:\Program
Files\WindowsPowerShell\Modules\ContosoMaintenance"
        Checksum = "SHA-256"
        Ensure = "Present"
        Type = "Directory"
        Recurse = $true
    }

    JeaEndpoint JEAMaintenanceEndpoint
    {
        EndpointName = "JEAMaintenance"
        RoleDefinitions = "@{ 'CONTOSO\JEAMaintenanceAuditors' = @{
RoleCapabilities = 'GeneralServerMaintenance-Audit' };
'CONTOSO\JEAMaintenanceAdmins' = @{ RoleCapabilities =
'GeneralServerMaintenance-Audit', 'GeneralServerMaintenance-Admin' } }"
        TranscriptDirectory = 'C:\ProgramData\JEAConfiguration\Transcripts'
        DependsOn = '[File]MaintenanceModule'
    }
}
```

Next, the configuration is applied on a system by directly invoking the Local Configuration Manager or updating the pull server configuration.

The DSC resource also allows you to replace the default **Microsoft.PowerShell** endpoint. When replaced, the resource automatically registers a backup endpoint named **Microsoft.PowerShell.Restricted**. The backup endpoint has the default WinRM ACL that allows Remote Management Users and local Administrators group members to access it.

Unregistering JEA configurations

The Unregister-PSSessionConfiguration cmdlet removes a JEA endpoint. Unregistering a JEA endpoint prevents new users from creating new JEA sessions on the system. It also allows you to update a JEA configuration by re-registering an updated session configuration file using the same endpoint name.

PowerShell

```
# Unregister the JEA endpoint called "ContosoMaintenance"
Unregister-PSSessionConfiguration -Name 'ContosoMaintenance' -Force
```

> ⚠ **Warning**
>
> Unregistering a JEA endpoint causes the WinRM service to restart. This interrupts most remote management operations in progress, including other PowerShell sessions, WMI invocations, and some management tools. Only unregister PowerShell endpoints during planned maintenance windows.

Next steps

Test the JEA endpoint

Using JEA

Article • 02/08/2023

This article describes the various ways you can connect to and use a JEA endpoint.

Using JEA interactively

If you're testing your JEA configuration or have simple tasks for users, you can use JEA the same way you would a regular PowerShell remoting session. For complex remoting tasks, it's recommended to use implicit remoting. Implicit remoting allows users to operate with the data objects locally.

To use JEA interactively, you need:

- The name of the computer you're connecting to (can be the local machine)
- The name of the JEA endpoint registered on that computer
- Credentials that have access to the JEA endpoint on that computer

Given that information, you can start a JEA session using the New-PSSession or Enter-PSSession cmdlets.

PowerShell

```
$sessionParams = @{
    ComputerName      = 'localhost'
    ConfigurationName = 'JEAMaintenance'
    Credential        = Get-Credential
}
Enter-PSSession @sessionParams
```

If the current user account has access to the JEA endpoint, you can omit the **Credential** parameter.

When the PowerShell prompt changes to `[localhost]: PS>` you know that you're now interacting with the remote JEA session. You can run `Get-Command` to check which commands are available. Consult with your administrator to learn if there are any restrictions on the available parameters or allowed parameter values.

Remember, JEA sessions operate in `NoLanguage` mode. Some of the ways you typically use PowerShell may not be available. For instance, you can't use variables to store data or inspect the properties on objects returned from cmdlets. The following example shows two approaches to get the same commands to work in `NoLanguage` mode.

PowerShell

```powershell
# Using variables is prohibited in NoLanguage mode. The following will not
work:
# $vm = Get-VM -Name 'SQL01'
# Start-VM -VM $vm

# You can use pipes to pass data through to commands that accept input from
the pipeline
Get-VM -Name 'SQL01' | Start-VM

# You can also wrap subcommands in parentheses and enter them inline as
arguments
Start-VM -VM (Get-VM -Name 'SQL01')

# You can also use parameter sets that don't require extra data to be passed
in
Start-VM -VMName 'SQL01'
```

For more complex command invocations that make this approach difficult, consider using implicit remoting or creating custom functions that wrap the functionality you require. For more information on `NoLanguageMode`, see about_Language_Modes.

Using JEA with implicit remoting

PowerShell has an implicit remoting model that lets you import proxy cmdlets from a remote machine and interact with them as if they were local commands. Implicit remoting is explained in this *Hey, Scripting Guy!* blog post. Implicit remoting is useful when working with JEA because it allows you to work with JEA cmdlets in a full language mode. You can use tab completion, variables, manipulate objects, and even use local scripts to automate tasks against a JEA endpoint. Anytime you invoke a proxy command, the data is sent to the JEA endpoint on the remote machine and executed there.

Implicit remoting works by importing cmdlets from an existing PowerShell session. You can optionally choose to prefix the nouns of each proxy cmdlet with a string of your choosing. The prefix allows you to distinguish the commands that are for the remote system. A temporary script module containing all the proxy commands is created and imported for the duration of your local PowerShell session.

PowerShell

```powershell
# Create a new PSSession to your JEA endpoint
$jeaSession = New-PSSession -ComputerName 'SERVER01' -ConfigurationName
'JEAMaintenance'

# Import the entire PSSession and prefix each imported cmdlet with "JEA"
```

```
Import-PSSession -Session $jeaSession -Prefix 'JEA'

# Invoke "Get-Command" on the remote JEA endpoint using the proxy cmdlet
Get-JEACommand
```

> **ⓘ Important**
>
> Some systems may not be able to import an entire JEA session due to constraints in the default JEA cmdlets. To get around this, only import the commands you need from the JEA session by explicitly providing their names to the `-CommandName` parameter. A future update will address the issue with importing entire JEA sessions on affected systems.

If you're unable to import a JEA session because of JEA constraints on the default parameters, follow the steps below to filter out the default commands from the imported set. You can continue use commands like `Select-Object`, but you'll just use the local version installed on your computer instead of the one imported from the remote JEA session.

PowerShell

```
# Create a new PSSession to your JEA endpoint
$jeaSession = New-PSSession -ComputerName 'SERVER01' -ConfigurationName
'JEAMaintenance'

# Get a list of all the commands on the JEA endpoint
$commands = Invoke-Command -Session $jeaSession -ScriptBlock { Get-Command }

# Filter out the default cmdlets
$jeaDefaultCmdlets = @(
    'Clear-Host'
    'Exit-PSSession'
    'Get-Command'
    'Get-FormatData'
    'Get-Help'
    'Measure-Object'
    'Out-Default'
    'Select-Object'
)
$filteredCommands = $commands.Name | Where-Object { $jeaDefaultCmdlets -
notcontains $_ }

# Import only commands explicitly added in role capabilities and prefix each
# imported cmdlet with "JEA"
Import-PSSession -Session $jeaSession -Prefix 'JEA' -CommandName
$filteredCommands
```

You can also persist the proxied cmdlets from implicit remoting using Export-PSSession. For more information about implicit remoting, see the documentation for Import-PSSession and Import-Module.

Using JEA programmatically

JEA can also be used in automation systems and in user applications, such as in-house helpdesk apps and websites. The approach is the same as that for building apps that talk to unconstrained PowerShell endpoints. Ensure the program is designed to work with limitation imposed by JEA.

For simple, one-off tasks, you can use Invoke-Command to run commands in a JEA session.

PowerShell

```
Invoke-Command -ComputerName 'SERVER01' -ConfigurationName 'JEAMaintenance'
-ScriptBlock {
    Get-Process
    Get-Service
}
```

To check which commands are available for use when you connect to a JEA session, run `Get-Command` and iterate through the results to check for the allowed parameters.

PowerShell

```
$commandParameters = @{
    ComputerName      = 'SERVER01'
    ConfigurationName = 'JEAMaintenance'
    ScriptBlock       = { Get-Command }
}
Invoke-Command @commandParameters |
    Where-Object { $_.CommandType -in @('Function', 'Cmdlet') } |
    Format-Table Name, Parameters
```

If you're building a C# app, you can create a PowerShell runspace that connects to a JEA session by specifying the configuration name in a WSManConnectionInfo object.

C#

```
// using System.Management.Automation;
var computerName = "SERVER01";
var configName   = "JEAMaintenance";
// See
https://learn.microsoft.com/dotnet/api/system.management.automation.pscreden
```

```
tial
var creds        = // create a PSCredential object here

WSManConnectionInfo connectionInfo = new WSManConnectionInfo(
    false,                  // Use SSL
    computerName,           // Computer name
    5985,                   // WSMan Port
    "/wsman",               // WSMan Path
                            // Connection URI with config name
    string.Format(
        CultureInfo.InvariantCulture,
        "http://schemas.microsoft.com/powershell/{0}",
        configName
    ),
    creds                   // Credentials
);

// Now, use the connection info to create a runspace where you can run the
commands
using (Runspace runspace = RunspaceFactory.CreateRunspace(connectionInfo))
{
    // Open the runspace
    runspace.Open();

    using (PowerShell ps = PowerShell.Create())
    {
        // Set the PowerShell object to use the JEA runspace
        ps.Runspace = runspace;

        // Now you can add and invoke commands
        ps.AddCommand("Get-Command");
        foreach (var result in ps.Invoke())
        {
            Console.WriteLine(result);
        }
    }

    // Close the runspace
    runspace.Close();
}
```

Using JEA with PowerShell Direct

Hyper-V in Windows 10 and Windows Server 2016 offers PowerShell Direct, a feature that allows Hyper-V administrators to manage virtual machines with PowerShell regardless of the network configuration or remote management settings on the virtual machine.

You can use PowerShell Direct with JEA to give a Hyper-V administrator limited access to your VM. This can be useful if you lose network connectivity to your VM and need a

datacenter admin to fix the network settings.

No additional configuration is required to use JEA over PowerShell Direct. However, the guest operating system running inside the virtual machine must be Windows 10, Windows Server 2016, or higher. The Hyper-V admin can connect to the JEA endpoint by using the `-VMName` or `-VMId` parameters on PSRemoting cmdlets:

PowerShell

```
$sharedParams = @{
    ConfigurationName = 'NICMaintenance'
    Credential        = Get-Credential -UserName 'localhost\JEAformyHoster'
}
# Entering a JEA session using PowerShell Direct when the VM name is unique
Enter-PSSession -VMName 'SQL01' @sharedParams

# Entering a JEA session using PowerShell Direct using VM ids
$vm = Get-VM -VMName 'MyVM' | Select-Object -First 1
Enter-PSSession -VMId $vm.VMId @sharedParams
```

It's recommended you create a dedicated user account with the minimum rights needed to manage the system for use by a Hyper-V administrator. Remember, even an unprivileged user can sign into a Windows machine by default, including using unconstrained PowerShell. That allows them to browse the file system and learn more about your OS environment. To lock down a Hyper-V administrator and limit them to only access a VM using PowerShell Direct with JEA, you must deny local logon rights to the Hyper-V admin's JEA account.

JEA Security Considerations

Article • 11/17/2022

JEA helps you improve your security posture by reducing the number of permanent administrators on your machines. JEA uses a PowerShell session configuration to create a new entry point for users to manage the system. Users who need elevated, but not unlimited, access to the machine to do administrative tasks can be granted access to the JEA endpoint. Since JEA allows these users to run admin commands without having full admin access, you can then remove those users from highly privileged security groups.

Run-As account

Each JEA endpoint has a designated **run-as** account. This is the account under which the connecting user's actions are executed. This account is configurable in the session configuration file, and the account you choose has a significant bearing on the security of your endpoint.

Virtual accounts are the recommended way of configuring the **run-as** account. Virtual accounts are one-time, temporary local accounts that are created for the connecting user to use during the duration of their JEA session. As soon as their session is terminated, the virtual account is destroyed and can't be used anymore. The connecting user doesn't know the credentials for the virtual account. The virtual account can't be used to access the system via other means like Remote Desktop or an unconstrained PowerShell endpoint.

By default, virtual accounts belong to the local **Administrators** group on the machine. This gives them full rights to manage anything on the system, but no rights to manage resources on the network. When authenticating with other machines, the user context is that of the local computer account, not the virtual account.

Domain controllers are a special case since there isn't a local **Administrators** group. Instead, virtual accounts belong to **Domain Admins** and can manage the directory services on the domain controller. The domain identity is still restricted for use on the domain controller where the JEA session was instantiated. Any network access appears to come from the domain controller computer object instead.

In both cases, you may explicitly define which security groups the virtual account belongs to. This is a good practice when the task can be done without local or domain admin privileges. If you already have a security group defined for your admins, grant the virtual account membership to that group. Virtual account group membership is limited to local security groups on workstation and member servers. On domain controllers,

virtual accounts must be members of domain security groups. Once the virtual account has been added to one or more security groups, it no longer belongs to the default groups (local or domain admins).

The following table summarizes the possible configuration options and resulting permissions for virtual accounts:

Computer type	Virtual account group configuration	Local user context	Network user context
Domain controller	Default	Domain user, member of '*DOMAIN*\Domain Admins'	Computer account
Domain controller	Domain groups A and B	Domain user, member of '*DOMAIN*\A', '*DOMAIN*\B'	Computer account
Member server or workstation	Default	Local user, member of '*BUILTIN*\Administrators'	Computer account
Member server or workstation	Local groups C and D	Local user, member of '*COMPUTER*\C' and '*COMPUTER*\D'	Computer account

When you look at security audit events and application event logs, you see that each JEA user session has a unique virtual account. This unique account helps you track user actions in a JEA endpoint back to the original user who ran the command. Virtual account names follow the format `WinRM Virtual Users\WinRM_VA_<ACCOUNTNUMBER>_<DOMAIN>_<sAMAccountName>` For example, if user **Alice** in domain **Contoso** restarts a service in a JEA endpoint, the username associated with any service control manager events would be `WinRM Virtual Users\WinRM_VA_1_contoso_alice`.

Group-managed service accounts (gMSAs) are useful when a member server needs to have access to network resources in the JEA session. For example, when a JEA endpoint is used to control access to a REST API service hosted on a different machine. It's easy to write functions to invoke the REST APIs, but you need a network identity to authenticate with the API. Using a group-managed service account makes the second hop possible while maintaining control over which computers can use the account. The effective permissions of the gMSA are defined by the security groups (local or domain) to which the gMSA account belongs.

When a JEA endpoint is configured to use a gMSA, the actions of all JEA users appear to come from the same gMSA. The only way to trace actions back to a specific user is to identify the set of commands run in a PowerShell session transcript.

Pass-thru credentials are used when you don't specify a **run-as** account. PowerShell uses the connecting user's credential to run commands on the remote server. This requires you to grant the connecting user direct access to privileged management groups. This configuration is **not** recommended for JEA. If the connecting user already has admin privileges, they can avoid JEA and manage the system via other, unconstrained means. For more information, see the section below on how JEA doesn't protect against admins.

Standard run-as accounts allow you to specify any user account under which the entire PowerShell session runs. Session configurations using fixed **run-as** accounts (with the `-RunAsCredential` parameter) aren't JEA-aware. Role definitions no longer function as expected. Every user authorized to access the endpoint is assigned the same role.

You shouldn't use a **RunAsCredential** on a JEA endpoint because it's difficult to trace actions back to specific users and lacks support for mapping users to roles.

WinRM Endpoint ACL

As with regular PowerShell remoting endpoints, each JEA endpoint has a separate access control list (ACL) that controls who can authenticate with the JEA endpoint. If improperly configured, trusted users may not be able to access the JEA endpoint and untrusted users may have access. The WinRM ACL doesn't affect the mapping of users to JEA roles. Mapping is controlled by the **RoleDefinitions** field in the session configuration file used to register the endpoint.

By default, when a JEA endpoint has multiple role capabilities, the WinRM ACL is configured to allow access to all mapped users. For example, a JEA session configured using the following commands grants full access to `CONTOSO\JEA_Lev1` and `CONTOSO\JEA_Lev2`.

PowerShell

```
$roles = @{ 'CONTOSO\JEA_Lev1' = 'Lev1Role'; 'CONTOSO\JEA_Lev2' = 'Lev2Role'
}
New-PSSessionConfigurationFile -Path '.\jea.pssc' -SessionType
RestrictedRemoteServer -RoleDefinitions $roles -RunAsVirtualAccount
Register-PSSessionConfiguration -Path '.\jea.pssc' -Name 'MyJEAEndpoint'
```

You can audit user permissions with the Get-PSSessionConfiguration cmdlet.

PowerShell

```
Get-PSSessionConfiguration -Name 'MyJEAEndpoint' | Select-Object Permission
```

Output

```
Permission
----------
CONTOSO\JEA_Lev1 AccessAllowed
CONTOSO\JEA_Lev2 AccessAllowed
```

To change which users have access, run either `Set-PSSessionConfiguration -Name 'MyJEAEndpoint' -ShowSecurityDescriptorUI` for an interactive prompt or `Set-PSSessionConfiguration -Name 'MyJEAEndpoint' -SecurityDescriptorSddl <SDDL string>` to update the permissions. Users need at least *Invoke* rights to access the JEA endpoint.

It's possible to create a JEA endpoint that doesn't map a defined role to every user that has access. These users can start a JEA session, but only have access to the default cmdlets. You can audit user permissions in a JEA endpoint by running `Get-PSSessionCapability`. For more information, see Auditing and Reporting on JEA.

Least privilege roles

When designing JEA roles, it's important to remember that the virtual and group-managed service accounts running behind the scenes can have unrestricted access to the local machine. JEA role capabilities help limit the commands and applications that can be run in that privileged context. Improperly designed roles can allow dangerous commands that may permit a user to break out of the JEA boundaries or obtain access to sensitive information.

For example, consider the following role capability entry:

PowerShell

```
@{
    VisibleCmdlets = 'Microsoft.PowerShell.Management\*-Process'
}
```

This role capability allows users to run any PowerShell cmdlet with the noun **Process** from the **Microsoft.PowerShell.Management** module. Users may need to access cmdlets like `Get-Process` to see what applications are running on the system and `Stop-Process` to kill applications that aren't responding. However, this entry also allows `Start-Process`, which can be used to start up an arbitrary program with full administrator permissions. The program doesn't need to be installed locally on the

system. A connected user could start a program from a file share that gives the user local admin privileges, runs malware, and more.

A more secure version of this same role capability would look like:

```PowerShell
@{
    VisibleCmdlets = 'Microsoft.PowerShell.Management\Get-Process',
'Microsoft.PowerShell.Management\Stop-Process'
}
```

Avoid using wildcards in role capabilities. Be sure to regularly audit effective user permissions to understand which commands are accessible to the user.

JEA doesn't protect against admins

One of the core principles of JEA is that it allows non-admins to do some admin tasks. JEA doesn't protect against users who already have administrator privileges. Users who belong **Domain Admins**, local **Administrators**, or other highly privileged groups can circumvent JEA's protections via another means. For example, they could sign in with RDP, use remote MMC consoles, or connect to unconstrained PowerShell endpoints. Also, local admins on a system can modify JEA configurations to allow additional users or change a role capability to extend the scope of what a user can do in their JEA session. It's important to evaluate your JEA users' extended permissions to see if there are other ways to gain privileged access to the system.

A common practice is to use JEA for regular day-to-day maintenance and have a just-in-time, privileged access management solution that allows users to temporarily become local admins in emergency situations. This helps ensure users aren't permanent admins on the system, but can get those rights if, and only when, they complete a workflow that documents their use of those permissions.

Auditing and Reporting on JEA

Article • 11/17/2022

After you've deployed JEA, you need to regularly audit the JEA configuration. Auditing helps you assess that the correct people have access to the JEA endpoint and their assigned roles are still appropriate.

Find registered JEA sessions on a machine

To check which JEA sessions are registered on a machine, use the Get-PSSessionConfiguration cmdlet.

PowerShell

```
# Filter for sessions that are configured as 'RestrictedRemoteServer' to
# find JEA-like session configurations
Get-PSSessionConfiguration | Where-Object { $_.SessionType -eq
'RestrictedRemoteServer' }
```

Output

```
Name          : JEAMaintenance
PSVersion     : 5.1
StartupScript :
RunAsUser     :
Permission    : CONTOSO\JEA_DNS_ADMINS AccessAllowed,
CONTOSO\JEA_DNS_OPERATORS AccessAllowed,
                CONTOSO\JEA_DNS_AUDITORS AccessAllowed
```

The effective rights for the endpoint are listed in the **Permission** property. These users have the right to connect to the JEA endpoint. However, the roles and commands they have access to is determined by the **RoleDefinitions** property in the session configuration file that was used to register the endpoint. Expand the **RoleDefinitions** property to evaluate the role mappings in a registered JEA endpoint.

PowerShell

```
# Get the desired session configuration
$jea = Get-PSSessionConfiguration -Name 'JEAMaintenance'

# Enumerate users/groups and which roles they have access to
$jea.RoleDefinitions.GetEnumerator() | Select-Object Name, @{
  Name = 'Role Capabilities'
```

```
  Expression = { $_.Value.RoleCapabilities }
}
```

Find available role capabilities on the machine

JEA gets role capabilities from the `.psrc` files stored in the **RoleCapabilities** folder inside a PowerShell module. The following function finds all role capabilities available on a computer.

PowerShell

```
function Find-LocalRoleCapability {
    $results = @()

    # Find modules with a "RoleCapabilities" subfolder and add any PSRC
files to the result set
    Get-Module -ListAvailable | ForEach-Object {
        $psrcpath = Join-Path -Path $_.ModuleBase -ChildPath
'RoleCapabilities'
        if (Test-Path $psrcpath) {
            $results += Get-ChildItem -Path $psrcpath -Filter *.psrc
        }
    }

    # Format the results nicely to make it easier to read
    $results | Select-Object @{ Name = 'Name'; Expression = {
$_.Name.TrimEnd('.psrc') }}, @{
        Name = 'Path'; Expression = { $_.FullName }
    } | Sort-Object Name
}
```

> **Note**
>
> The order of results from this function isn't necessarily the order in which the role capabilities will be selected if multiple role capabilities share the same name.

Check effective rights for a specific user

The Get-PSSessionCapability cmdlet enumerates all the commands available on a JEA endpoint based on a user's group memberships. The output of `Get-PSSessionCapability` is identical to that of the specified user running `Get-Command -CommandType All` in a JEA session.

PowerShell

```
Get-PSSessionCapability -ConfigurationName 'JEAMaintenance' -Username
'CONTOSO\Alice'
```

If your users aren't permanent members of groups that would grant them additional JEA rights, this cmdlet may not reflect those extra permissions. This happens when using just-in-time privileged access management systems to allow users to temporarily belong to a security group. Carefully evaluate the mapping of users to roles and capabilities to ensure that users only get the level of access needed to do their jobs successfully.

PowerShell event logs

If you enabled module or script block logging on the system, you can see events in the Windows event logs for each command a user runs in a JEA session. To find these events, open **Microsoft-Windows-PowerShell/Operational** event log and look for events with event ID **4104**.

Each event log entry includes information about the session in which the command was run. For JEA sessions, the event includes information about the **ConnectedUser** and the **RunAsUser**. The **ConnectedUser** is the actual user who created the JEA session. The **RunAsUser** is the account JEA used to execute the command.

Application event logs show changes being made by the **RunAsUser**. So having module and script logging enabled is required to trace a specific command invocation back to the **ConnectedUser**.

Application event logs

Commands run in a JEA session that interact with external applications or services may log events to their own event logs. Unlike PowerShell logs and transcripts, other logging mechanisms don't capture the connected user of the JEA session. Instead, those applications only log the virtual run-as user. To determine who ran the command, you need to consult a session transcript or correlate PowerShell event logs with the time and user shown in the application event log.

The WinRM log can also help you correlate run-as users to the connecting user in an application event log. Event ID **193** in the **Microsoft-Windows-Windows Remote Management/Operational** log records the security identifier (SID) and account name for both the connecting user and run as user for every new JEA session.

Session transcripts

If you configured JEA to create a transcript for each user session, a text copy of every user's actions are stored in the specified folder.

The following command (as an administrator) finds all transcript directories.

PowerShell

```
Get-PSSessionConfiguration |
  Where-Object { $_.TranscriptDirectory -ne $null } |
    Format-Table Name, TranscriptDirectory
```

Each transcript starts with information about the time the session started, which user connected to the session, and which JEA identity was assigned to them.

```
**********************
Windows PowerShell transcript start
Start time: 20160710144736
Username: CONTOSO\Alice
RunAs User: WinRM Virtual Users\WinRM VA_1_CONTOSO_Alice
Machine: SERVER01 (Microsoft Windows NT 10.0.14393.0)
[...]
```

The body of the transcript contains information about each command the user invoked. The exact syntax of the command used is unavailable in JEA sessions because of the way commands are transformed for PowerShell remoting. However, you can still determine the effective command that was executed. Below is an example transcript snippet from a user running `Get-Service Dns` in a JEA session:

```
PS>CommandInvocation(Get-Service): "Get-Service"
>> ParameterBinding(Get-Service): name="Name"; value="Dns"
>> CommandInvocation(Out-Default): "Out-Default"
>> ParameterBinding(Out-Default): name="InputObject"; value="Dns"

Running  Dns                DNS Server
```

A **CommandInvocation** line is written for each command a user runs. **ParameterBindings** record each parameter and value supplied with the command. In the previous example, you can see that the parameter **Name** was supplied the with value **Dns** for the `Get-Service` cmdlet.

The output of each command also triggers a **CommandInvocation**, usually to `Out-Default`. The **InputObject** of `Out-Default` is the PowerShell object returned from the command. The details of that object are printed a few lines below, closely mimicking what the user would have seen.

See also

PowerShell ♥ the Blue Team blog post on security

Running Remote Commands

Article • 07/03/2023

You can run commands on one or hundreds of computers with a single PowerShell command. Windows PowerShell supports remote computing using various technologies, including WMI, RPC, and WS-Management.

PowerShell supports WMI, WS-Management, and SSH remoting. In PowerShell 7 and higher, RPC is supported only on Windows.

For more information about remoting in PowerShell, see the following articles:

- SSH Remoting in PowerShell
- WSMan Remoting in PowerShell

Windows PowerShell remoting without configuration

Many Windows PowerShell cmdlets have the **ComputerName** parameter that enables you to collect data and change settings on one or more remote computers. These cmdlets use varying communication protocols and work on all Windows operating systems without any special configuration.

These cmdlets include:

- Restart-Computer
- Test-Connection
- Clear-EventLog
- Get-EventLog
- Get-HotFix
- Get-Process
- Get-Service
- Set-Service
- Get-WinEvent
- Get-WmiObject

Typically, cmdlets that support remoting without special configuration have the **ComputerName** parameter and don't have the **Session** parameter. To find these cmdlets in your session, type:

```
PowerShell
```

```
Get-Command | Where-Object {
    $_.Parameters.Keys -contains "ComputerName" -and
    $_.Parameters.Keys -notcontains "Session"
}
```

Windows PowerShell remoting

Using the WS-Management protocol, Windows PowerShell remoting lets you run any Windows PowerShell command on one or more remote computers. You can establish persistent connections, start interactive sessions, and run scripts on remote computers.

To use Windows PowerShell remoting, the remote computer must be configured for remote management. For more information, including instructions, see About Remote Requirements.

Once you have configured Windows PowerShell remoting, many remoting strategies are available to you. This article lists just a few of them. For more information, see About Remote.

Start an interactive session

To start an interactive session with a single remote computer, use the Enter-PSSession cmdlet. For example, to start an interactive session with the Server01 remote computer, type:

PowerShell

```
Enter-PSSession Server01
```

The command prompt changes to display the name of the remote computer. Any commands that you type at the prompt run on the remote computer and the results are displayed on the local computer.

To end the interactive session, type:

PowerShell

```
Exit-PSSession
```

For more information about the `Enter-PSSession` and `Exit-PSSession` cmdlets, see:

- Enter-PSSession
- Exit-PSSession

Run a Remote Command

To run a command on one or more computers, use the Invoke-Command cmdlet. For example, to run a Get-UICulture command on the Server01 and Server02 remote computers, type:

PowerShell

```
Invoke-Command -ComputerName Server01, Server02 -ScriptBlock {Get-UICulture}
```

The output is returned to your computer.

Output

```
LCID    Name     DisplayName               PSComputerName
----    ----     -----------               --------------
1033    en-US    English (United States)   server01.corp.fabrikam.com
1033    en-US    English (United States)   server02.corp.fabrikam.com
```

Run a Script

To run a script on one or many remote computers, use the **FilePath** parameter of the `Invoke-Command` cmdlet. The script must be on or accessible to your local computer. The results are returned to your local computer.

For example, the following command runs the `DiskCollect.ps1` script on the remote computers, Server01 and Server02.

PowerShell

```
Invoke-Command -ComputerName Server01, Server02 -FilePath
c:\Scripts\DiskCollect.ps1
```

Establish a Persistent Connection

Use the `New-PSSession` cmdlet to create a persistent session on a remote computer. The following example creates remote sessions on Server01 and Server02. The session objects are stored in the `$s` variable.

PowerShell

```
$s = New-PSSession -ComputerName Server01, Server02
```

Now that the sessions are established, you can run any command in them. And because the sessions are persistent, you can collect data from one command and use it in another command.

For example, the following command runs a `Get-HotFix` command in the sessions in the `$s` variable and it saves the results in the `$h` variable. The `$h` variable is created in each of the sessions in `$s`, but it doesn't exist in the local session.

PowerShell

```
Invoke-Command -Session $s {$h = Get-HotFix}
```

Now you can use the data in the `$h` variable with other commands in the same session. The results are displayed on the local computer. For example:

PowerShell

```
Invoke-Command -Session $s {$h | where {$_.InstalledBy -ne "NT
AUTHORITY\SYSTEM"}}
```

Advanced Remoting

PowerShell includes cmdlets that allow you to:

- Configure and create remote sessions both from the local and remote ends
- Create customized and restricted sessions
- Import commands from a remote session that actually run implicitly on the remote session
- Configure the security of a remote session

PowerShell on Windows includes a WSMan provider. The provider creates a `WSMAN:` drive that lets you navigate through a hierarchy of configuration settings on the local computer and remote computers.

For more information about the WSMan provider, see WSMan Provider and About WS-Management Cmdlets, or in the Windows PowerShell console, type `Get-Help wsman`.

For more information, see:

- PowerShell Remoting FAQ
- Register-PSSessionConfiguration
- Import-PSSession

For help with remoting errors, see about_Remote_Troubleshooting.

See Also

- about_Remote
- about_Remote_Requirements
- about_Remote_Troubleshooting
- about_PSSessions
- about_WS-Management_Cmdlets
- Invoke-Command
- Import-PSSession
- New-PSSession
- Register-PSSessionConfiguration
- WSMan Provider

PowerShell remoting over SSH

Article • 05/01/2023

Overview

PowerShell remoting normally uses WinRM for connection negotiation and data transport. SSH is now available for Linux and Windows platforms and allows true multiplatform PowerShell remoting.

WinRM provides a robust hosting model for PowerShell remote sessions. SSH-based remoting doesn't currently support remote endpoint configuration and Just Enough Administration (JEA).

SSH remoting lets you do basic PowerShell session remoting between Windows and Linux computers. SSH remoting creates a PowerShell host process on the target computer as an SSH subsystem. Eventually we'll implement a general hosting model, similar to WinRM, to support endpoint configuration and JEA.

The `New-PSSession`, `Enter-PSSession`, and `Invoke-Command` cmdlets now have a new parameter set to support this new remoting connection.

```
[-HostName <string>]  [-UserName <string>]  [-KeyFilePath <string>]
```

To create a remote session, you specify the target computer with the **HostName** parameter and provide the user name with **UserName**. When running the cmdlets interactively, you're prompted for a password. You can also use SSH key authentication using a private key file with the **KeyFilePath** parameter. Creating keys for SSH authentication varies by platform.

General setup information

PowerShell 6 or higher, and SSH must be installed on all computers. Install both the SSH client (`ssh.exe`) and server (`sshd.exe`) so that you can remote to and from the computers. OpenSSH for Windows is now available in Windows 10 build 1809 and Windows Server 2019. For more information, see Manage Windows with OpenSSH. For Linux, install SSH, including sshd server, that's appropriate for your platform. You also need to install PowerShell from GitHub to get the SSH remoting feature. The SSH server

must be configured to create an SSH subsystem to host a PowerShell process on the remote computer. And, you must enable **password** or **key-based** authentication.

Install the SSH service on a Windows computer

1. Install the latest version of PowerShell. For more information, see Installing PowerShell on Windows.

   You can confirm that PowerShell has SSH remoting support by listing the `New-PSSession` parameter sets. You'll notice there are parameter set names that begin with **SSH**. Those parameter sets include **SSH** parameters.

   PowerShell

   ```
   (Get-Command New-PSSession).ParameterSets.Name
   ```

   Output

   ```
   Name
   ----
   SSHHost
   SSHHostHashParam
   ```

2. Install the latest Win32 OpenSSH. For installation instructions, see Getting started with OpenSSH.

   > **Note**
   >
   > If you want to set PowerShell as the default shell for OpenSSH, see **Configuring Windows for OpenSSH**.

3. Edit the `sshd_config` file located at `$env:ProgramData\ssh`.

   Make sure password authentication is enabled:

   ```
   PasswordAuthentication yes
   ```

   Create the SSH subsystem that hosts a PowerShell process on the remote computer:

```
Subsystem powershell c:/progra~1/powershell/7/pwsh.exe -sshs -nologo
```

> **Note**
>
> Starting in PowerShell 7.4, you no longer need to use the `-nologo` parameter when running PowerShell in SSH server mode.

> **Note**
>
> The default location of the PowerShell executable is `c:/progra~1/powershell/7/pwsh.exe`. The location can vary depending on how you installed PowerShell.
>
> You must use the 8.3 short name for any file paths that contain spaces. There's a bug in OpenSSH for Windows that prevents spaces from working in subsystem executable paths. For more information, see this **GitHub issue**.
>
> The 8.3 short name for the `Program Files` folder in Windows is usually `Progra~1`. However, you can use the following command to make sure:
>
> PowerShell
>
> ```powershell
> Get-CimInstance Win32_Directory -Filter 'Name="C:\\Program Files"'
> |
>   Select-Object EightDotThreeFileName
> ```
>
> Output
>
> ```
> EightDotThreeFileName
> ---------------------
> c:\progra~1
> ```

Optionally, enable key authentication:

```
PubkeyAuthentication yes
```

For more information, see Managing OpenSSH Keys.

4. Restart the **sshd** service.

```PowerShell
Restart-Service sshd
```

5. Add the path where OpenSSH is installed to your Path environment variable. For example, `C:\Program Files\OpenSSH\`. This entry allows for the `ssh.exe` to be found.

Install the SSH service on an Ubuntu Linux computer

1. Install the latest version of PowerShell, see Installing PowerShell on Ubuntu.
2. Install Ubuntu OpenSSH Server.

```Bash
sudo apt install openssh-client
sudo apt install openssh-server
```

3. Edit the `sshd_config` file at location `/etc/ssh`.

   Make sure password authentication is enabled:

```
PasswordAuthentication yes
```

   Optionally, enable key authentication:

```
PubkeyAuthentication yes
```

   For more information about creating SSH keys on Ubuntu, see the manpage for ssh-keygen.

   Add a PowerShell subsystem entry:

```
Subsystem powershell /usr/bin/pwsh -sshs -nologo
```

> **Note**
>
> The default location of the PowerShell executable is `/usr/bin/pwsh`. The location can vary depending on how you installed PowerShell.

> **Note**
>
> Starting in PowerShell 7.4, you no longer need to use the `-nologo` parameter when running PowerShell in SSH server mode.

4. Restart the **ssh** service.

```
Bash

sudo systemctl restart sshd.service
```

Install the SSH service on a macOS computer

1. Install the latest version of PowerShell. For more information, Installing PowerShell on macOS.

   Make sure SSH Remoting is enabled by following these steps:
   a. Open `System Preferences`.
   b. Click on `General`
   c. Click on `Sharing`.
   d. Check `Remote Login` to set `Remote Login: On`.
   e. Allow access to the appropriate users.

2. Edit the `sshd_config` file at location `/private/etc/ssh/sshd_config`.

   Use a text editor such as **nano**:

```
Bash

sudo nano /private/etc/ssh/sshd_config
```

   Make sure password authentication is enabled:

```

PasswordAuthentication yes
```

Add a PowerShell subsystem entry:

```
Subsystem powershell /usr/local/bin/pwsh -sshs -nologo
```

> **Note**
>
> The default location of the PowerShell executable is `/usr/local/bin/pwsh`. The location can vary depending on how you installed PowerShell.

> **Note**
>
> Starting in PowerShell 7.4, you no longer need to use the `-nologo` parameter when running PowerShell in SSH server mode.

Optionally, enable key authentication:

```
PubkeyAuthentication yes
```

3. Restart the **sshd** service.

```Bash
sudo launchctl stop com.openssh.sshd
sudo launchctl start com.openssh.sshd
```

Authentication

PowerShell remoting over SSH relies on the authentication exchange between the SSH client and SSH service and doesn't implement any authentication schemes itself. The result is that any configured authentication schemes including multi-factor authentication are handled by SSH and independent of PowerShell. For example, you can configure the SSH service to require public key authentication and a one-time password for added security. Configuration of multi-factor authentication is outside the scope of this documentation. Refer to documentation for SSH on how to correctly

configure multi-factor authentication and validate it works outside of PowerShell before attempting to use it with PowerShell remoting.

> ⓘ **Note**
>
> Users retain the same privileges in remote sessions. Meaning, Administrators have access to an elevated shell, and normal users will not.

PowerShell remoting example

The easiest way to test remoting is to try it on a single computer. In this example, we create a remote session back to the same Linux computer. We're using PowerShell cmdlets interactively so we see prompts from SSH asking to verify the host computer and prompting for a password. You can do the same thing on a Windows computer to ensure remoting is working. Then, remote between computers by changing the host name.

Linux to Linux

PowerShell

```
$session = New-PSSession -HostName UbuntuVM1 -UserName TestUser
```

Output

```
The authenticity of host 'UbuntuVM1 (9.129.17.107)' can't be established.
ECDSA key fingerprint is SHA256:2kCbnhT2dUE6WCGgVJ8Hyfu1z2wE4lifaJXLO7QJy0Y.
Are you sure you want to continue connecting (yes/no)?
TestUser@UbuntuVM1s password:
```

PowerShell

```
$session
```

Output

```
 Id Name   ComputerName    ComputerType    State    ConfigurationName
Availability
 -- ----   ------------    ------------    -----    -----------------     --
----------
  1 SSH1   UbuntuVM1       RemoteMachine   Opened   DefaultShell
Available
```

PowerShell

```
Enter-PSSession $session
```

Output

```
[UbuntuVM1]: PS /home/TestUser> uname -a
Linux TestUser-UbuntuVM1 4.2.0-42-generic 49~16.04.1-Ubuntu SMP Wed Jun 29
20:22:11 UTC 2016 x86_64 x86_64 x86_64 GNU/Linux

[UbuntuVM1]: PS /home/TestUser> Exit-PSSession
```

PowerShell

```
Invoke-Command $session -ScriptBlock { Get-Process pwsh }
```

Output

```
Handles  NPM(K)    PM(K)      WS(K)     CPU(s)     Id  SI ProcessName
PSComputerName
-------  ------    -----      -----     ------     --  -- -----------    ---
-----------
      0       0        0         19       3.23  10635 635 pwsh
UbuntuVM1
      0       0        0         21       4.92  11033 017 pwsh
UbuntuVM1
      0       0        0         20       3.07  11076 076 pwsh
UbuntuVM1
```

Linux to Windows

PowerShell

```
Enter-PSSession -HostName WinVM1 -UserName PTestName
```

```

PTestName@WinVM1s password:
```

PowerShell

```
[WinVM1]: PS C:\Users\PTestName\Documents> cmd /c ver
```

Output

```
Microsoft Windows [Version 10.0.10586]
```

Windows to Windows

PowerShell

```
C:\Users\PSUser\Documents>pwsh.exe
```

Output

```
PowerShell
Copyright (c) Microsoft Corporation. All rights reserved.
```

PowerShell

```
$session = New-PSSession -HostName WinVM2 -UserName PSRemoteUser
```

Output

```
The authenticity of host 'WinVM2 (10.13.37.3)' can't be established.
ECDSA key fingerprint is SHA256:kSU6slAROyQVMEynVIXAdxSiZpwDBigpAF/TXjjWjmw.
Are you sure you want to continue connecting (yes/no)?
Warning: Permanently added 'WinVM2,10.13.37.3' (ECDSA) to the list of known
hosts.
PSRemoteUser@WinVM2's password:
```

PowerShell

```
$session
```

Output

```
 Id Name            ComputerName    ComputerType    State
ConfigurationName     Availability
 -- ----            ------------    ------------    -----         ----------
-------     ------------
  1 SSH1            WinVM2          RemoteMachine   Opened
DefaultShell             Available
```

PowerShell

```
Enter-PSSession -Session $session
```

Output

```
[WinVM2]: PS C:\Users\PSRemoteUser\Documents> $PSVersionTable

Name                           Value
----                           -----
PSEdition                      Core
PSCompatibleVersions           {1.0, 2.0, 3.0, 4.0...}
SerializationVersion           1.1.0.1
BuildVersion                   3.0.0.0
CLRVersion
PSVersion                      6.0.0-alpha
WSManStackVersion              3.0
PSRemotingProtocolVersion      2.3
GitCommitId                    v6.0.0-alpha.17


[WinVM2]: PS C:\Users\PSRemoteUser\Documents>
```

Limitations

- The **sudo** command doesn't work in a remote session to a Linux computer.
- PSRemoting over SSH doesn't support Profiles and doesn't have access to `$PROFILE`. Once in a session, you can load a profile by dot sourcing the profile with the full filepath. This isn't related to SSH profiles. You can configure the SSH server to use PowerShell as the default shell and to load a profile through SSH. See the SSH documentation for more information.
- Prior to PowerShell 7.1, remoting over SSH didn't support second-hop remote sessions. This capability was limited to sessions using WinRM. PowerShell 7.1 allows `Enter-PSSession` and `Enter-PSHostProcess` to work from within any interactive remote session.

See also

- Installing PowerShell on Linux
- Installing PowerShell on macOS
- Installing PowerShell on Windows
- Manage Windows with OpenSSH
- Managing OpenSSH Keys

- Ubuntu SSH

WS-Management (WSMan) Remoting in PowerShell

Article • 11/17/2022

Instructions to Create a Remoting Endpoint

The PowerShell package for Windows includes a WinRM plug-in (`pwrshplugin.dll`) and an installation script (`Install-PowerShellRemoting.ps1`) in `$PSHome`. These files enable PowerShell to accept incoming PowerShell remote connections when its endpoint is specified.

Motivation

An installation of PowerShell can establish PowerShell sessions to remote computers using `New-PSSession` and `Enter-PSSession`. To enable it to accept incoming PowerShell remote connections, the user must create a WinRM remoting endpoint. This is an explicit opt-in scenario where the user runs Install-PowerShellRemoting.ps1 to create the WinRM endpoint. The installation script is a short-term solution until we add additional functionality to `Enable-PSRemoting` to perform the same action. For more details, please see issue #1193 .

Script Actions

The script

1. Creates a directory for the plug-in within `$env:windir\System32\PowerShell`
2. Copies pwrshplugin.dll to that location
3. Generates a configuration file
4. Registers that plug-in with WinRM

Registration

The script must be executed within an Administrator-level PowerShell session and runs in two modes.

Executed by the instance of PowerShell that it will register

```
PowerShell
```

```
Install-PowerShellRemoting.ps1
```

Executed by another instance of PowerShell on behalf of the instance that it will register

PowerShell

```
<path to powershell>\Install-PowerShellRemoting.ps1 -PowerShellHome "
<absolute path to the instance's $PSHOME>"
```

For Example:

PowerShell

```
Set-Location -Path 'C:\Program Files\PowerShell\6.0.0\'
.\Install-PowerShellRemoting.ps1 -PowerShellHome "C:\Program
Files\PowerShell\6.0.0\"
```

> **Note**
>
> The remoting registration script restarts WinRM. All existing PSRP sessions are terminated immediately after the script is run. If run during a remote session, the script terminates the connection.

How to Connect to the New Endpoint

Create a PowerShell session to the new PowerShell endpoint by specifying `-ConfigurationName "some endpoint name"`. To connect to the PowerShell instance from the example above, use either:

PowerShell

```
New-PSSession ... -ConfigurationName "powershell.6.0.0"
Enter-PSSession ... -ConfigurationName "powershell.6.0.0"
```

Note that `New-PSSession` and `Enter-PSSession` invocations that don't specify `-ConfigurationName` will target the default PowerShell endpoint, `microsoft.powershell`.

WSMan remoting is not supported on non-Windows platforms

Article • 06/28/2023

Since the release of PowerShell 6, support for remoting over WS-Management (WSMan) on non-Windows platforms has only been available to a limited set of Linux distributions. All versions of those distributions that supported WSMan are no longer supported by the Linux vendors that created them.

On non-Windows, WSMan relied on the Open Management Infrastructure (OMI) project, which no longer supports PowerShell remoting. The OMI WSMan client is dependent on **OpenSSL 1.0**. Most Linux distributions have moved to **OpenSSL 2.0**, which is not backward-compatible. At this time, there is no supported distribution that has the dependencies needed for the OMI WSMan client to work.

Our plan for PowerShell 7.3 is to remove outdated libraries and supporting code for non-Windows platforms. WSMan-based remoting is still supported between Windows systems. Remoting over SSH is supported for all platforms. For more information, see PowerShell remoting over SSH.

> **Note**
>
> Users may be able to get WSMan remoting to work using the **PSWSMan** module. This module is not supported or maintained by Microsoft.

Security Considerations for PowerShell Remoting using WinRM

Article • 11/17/2022

PowerShell Remoting is the recommended way to manage Windows systems. PowerShell Remoting is enabled by default in Windows Server 2012 R2. This document covers security concerns, recommendations, and best practices when using PowerShell Remoting.

What is PowerShell Remoting?

PowerShell Remoting uses Windows Remote Management (WinRM), which is the Microsoft implementation of the Web Services for Management (WS-Management) protocol, to allow users to run PowerShell commands on remote computers. You can find more information about using PowerShell Remoting at Running Remote Commands.

PowerShell Remoting isn't the same as using the **ComputerName** parameter of a cmdlet to run it on a remote computer, which uses Remote Procedure Call (RPC) as its underlying protocol.

PowerShell Remoting default settings

PowerShell Remoting (and WinRM) listen on the following ports:

- HTTP: 5985
- HTTPS: 5986

By default, PowerShell Remoting only allows connections from members of the Administrators group. Sessions are launched under the user's context, so all operating system access controls applied to individual users and groups continue to apply to them while connected over PowerShell Remoting.

On private networks, the default Windows Firewall rule for PowerShell Remoting accepts all connections. On public networks, the default Windows Firewall rule allows PowerShell Remoting connections only from within the same subnet. You have to explicitly change that rule to open PowerShell Remoting to all connections on a public network.

> ⚠ **Warning**

The firewall rule for public networks is meant to protect the computer from potentially malicious external connection attempts. Use caution when removing this rule.

Process isolation

PowerShell Remoting uses WinRM for communication between computers. WinRM runs as a service under the Network Service account, and spawns isolated processes running as user accounts to host PowerShell instances. An instance of PowerShell running as one user has no access to a process running an instance of PowerShell as another user.

Event logs generated by PowerShell Remoting

FireEye has provided a good summary of the event logs and other security evidence generated by PowerShell Remoting sessions, available at Investigating PowerShell Attacks .

Encryption and transport protocols

It's helpful to consider the security of a PowerShell Remoting connection from two perspectives: initial authentication, and ongoing communication.

Regardless of the transport protocol used (HTTP or HTTPS), WinRM always encrypts all PowerShell remoting communication after initial authentication.

Initial authentication

Authentication confirms the identity of the client to the server - and ideally - the server to the client.

When a client connects to a domain server using its computer name, the default authentication protocol is Kerberos. Kerberos guarantees both the user identity and server identity without sending any sort of reusable credential.

When a client connects to a domain server using its IP address, or connects to a workgroup server, Kerberos authentication isn't possible. In that case, PowerShell Remoting relies on the NTLM authentication protocol. The NTLM authentication protocol guarantees the user identity without sending any sort of delegable credential. To prove user identity, the NTLM protocol requires that both the client and server compute a session key from the user's password without ever exchanging the password

itself. The server typically doesn't know the user's password, so it communicates with the domain controller, which does know the user's password and calculates the session key for the server.

The NTLM protocol doesn't, however, guarantee server identity. As with all protocols that use NTLM for authentication, an attacker with access to a domain-joined computer's machine account could invoke the domain controller to compute an NTLM session-key and thereby impersonate the server.

NTLM-based authentication is disabled by default, but may be permitted by either configuring SSL on the target server, or by configuring the WinRM TrustedHosts setting on the client.

Using SSL certificates to validate server identity during NTLM-based connections

Since the NTLM authentication protocol can't ensure the identity of the target server (only that it already knows your password), you can configure target servers to use SSL for PowerShell Remoting. Assigning a SSL certificate to the target server (if issued by a Certificate Authority that the client also trusts) enables NTLM-based authentication that guarantees both the user identity and server identity.

Ignoring NTLM-based server identity errors

If deploying a SSL certificate to a server for NTLM connections is infeasible, you may suppress the resulting identity errors by adding the server to the WinRM **TrustedHosts** list. Please note that adding a server name to the **TrustedHosts** list shouldn't be considered as any form of statement of the trustworthiness of the hosts themselves - as the NTLM authentication protocol can't guarantee that you are in fact connecting to the host you are intending to connect to. Instead, you should consider the TrustedHosts setting to be the list of hosts for which you wish to suppress the error generated by being unable to verify the server's identity.

Ongoing Communication

Once initial authentication is complete, the WinRM encrypts the ongoing communication. When connecting over HTTPS, the TLS protocol is used to negotiate the encryption used to transport data. When connecting over HTTP, message-level encryption is determined by initial authentication protocol used.

- Basic authentication provide no encryption.

- NTLM authentication uses an RC4 cipher with a 128-bit key.
- Kerberos authentication encryption is determined by the `etype` in the TGS ticket. This is AES-256 on modern systems.
- CredSSP encryption is uses the TLS cipher suite that was negotiated in the handshake.

Making the second hop

By default, PowerShell Remoting uses Kerberos (if available) or NTLM for authentication. Both of these protocols authenticate to the remote machine without sending credentials to it. This is the most secure way to authenticate, but because the remote machine doesn't have the user's credentials, it can't access other computers and services on the user's behalf. This is known as the "second hop problem".

There are several ways to avoid this problem. For descriptions of these methods, and the pros and cons of each, see Making the second hop in PowerShell Remoting.

References

- Windows Remote Management (WinRM)
- Web Services for Management (WS-Management)
- 2.2.9.1 Encrypted Message Types
- Kerberos
- NTLM authentication protocol
- Investigating PowerShell Attacks

Making the second hop in PowerShell Remoting

Article • 12/16/2022

The "second hop problem" refers to a situation like the following:

1. You are logged in to *ServerA*.
2. From *ServerA*, you start a remote PowerShell session to connect to *ServerB*.
3. A command you run on *ServerB* via your PowerShell Remoting session attempts to access a resource on *ServerC*.
4. Access to the resource on *ServerC* is denied, because the credentials you used to create the PowerShell Remoting session aren't passed from *ServerB* to *ServerC*.

There are several ways to address this problem. The following table lists the methods in order of preference.

Configuration	**Note**
CredSSP	Balances ease of use and security
Resource-based Kerberos constrained delegation	Higher security with simpler configuration
Kerberos constrained delegation	High security but requires Domain Administrator
Kerberos delegation (unconstrained)	Not recommended
Just Enough Administration (JEA)	Can provide the best security but requires more detailed configuration
PSSessionConfiguration using RunAs	Simpler to configure but requires credential management
Pass credentials inside an `Invoke-Command` script block	Simplest to use but you must provide credentials

CredSSP

You can use the Credential Security Support Provider (CredSSP) for authentication. CredSSP caches credentials on the remote server (*ServerB*), so using it opens you up to credential theft attacks. If the remote computer is compromised, the attacker has access to the user's credentials. CredSSP is disabled by default on both client and server computers. You should enable CredSSP only in the most trusted environments. For

example, a domain administrator connecting to a domain controller because the domain controller is highly trusted.

For more information about security concerns when using CredSSP for PowerShell Remoting, see Accidental Sabotage: Beware of CredSSP.

For more information about credential theft attacks, see Mitigating Pass-the-Hash (PtH) Attacks and Other Credential Theft.

For an example of how to enable and use CredSSP for PowerShell remoting, see Enable PowerShell "Second-Hop" Functionality with CredSSP.

Pros

- It works for all servers with Windows Server 2008 or later.

Cons

- Has security vulnerabilities.
- Requires configuration of both client and server roles.
- doesn't work with the Protected Users group. For more information, see Protected Users Security Group.

Kerberos constrained delegation

You can use legacy constrained delegation (not resource-based) to make the second hop. Configure Kerberos constrained delegation with the option "Use any authentication protocol" to allow protocol transition.

Pros

- Requires no special coding
- Credentials aren't stored.

Cons

- Doesn't support the second hop for WinRM.
- Requires Domain Administrator access to configure.
- Must be configured on the Active Directory object of the remote server (*ServerB*).
- Limited to one domain. Can't cross domains or forests.
- Requires rights to update objects and Service Principal Names (SPNs).

- *ServerB* can acquire a Kerberos ticket to *ServerC* on behalf of the user without user intervention.

> ⓘ **Note**
>
> Active Directory accounts that have the **Account is sensitive and can't be delegated** property set can't be delegated. For more information, see **Security Focus: Analysing 'Account is sensitive and can't be delegated' for Privileged Accounts** and **Kerberos Authentication Tools and Settings**.

Resource-based Kerberos constrained delegation

Using resource-based Kerberos constrained delegation (introduced in Windows Server 2012), you configure credential delegation on the server object where resources reside. In the second hop scenario described above, you configure *ServerC* to specify from where it accepts delegated credentials.

Pros

- Credentials aren't stored.
- Configured using PowerShell cmdlets. No special coding required.
- Doesn't require Domain Administrator access to configure.
- Works across domains and forests.

Cons

- Requires Windows Server 2012 or later.
- Doesn't support the second hop for WinRM.
- Requires rights to update objects and Service Principal Names (SPNs).

> ⓘ **Note**
>
> Active Directory accounts that have the **Account is sensitive and can't be delegated** property set can't be delegated. For more information, see **Security Focus: Analysing 'Account is sensitive and can't be delegated' for Privileged Accounts** and **Kerberos Authentication Tools and Settings**.

Example

Let's look at a PowerShell example that configures resource-based constrained delegation on *ServerC* to allow delegated credentials from a *ServerB*. This example assumes that all servers are running Windows Server 2012 or later, and that there is at least one Windows Server 2012 domain controller each domain to which any of the servers belong.

Before you can configure constrained delegation, you must add the `RSAT-AD-PowerShell` feature to install the Active Directory PowerShell module, and then import that module into your session:

PowerShell

```
Add-WindowsFeature RSAT-AD-PowerShell
Import-Module ActiveDirectory
Get-Command -ParameterName PrincipalsAllowedToDelegateToAccount
```

Several available cmdlets now have a **PrincipalsAllowedToDelegateToAccount** parameter:

Output

```
CommandType Name                  ModuleName
----------- ----                  ----------
Cmdlet      New-ADComputer        ActiveDirectory
Cmdlet      New-ADServiceAccount  ActiveDirectory
Cmdlet      New-ADUser            ActiveDirectory
Cmdlet      Set-ADComputer        ActiveDirectory
Cmdlet      Set-ADServiceAccount  ActiveDirectory
Cmdlet      Set-ADUser            ActiveDirectory
```

The **PrincipalsAllowedToDelegateToAccount** parameter sets the Active Directory object attribute **msDS-AllowedToActOnBehalfOfOtherIdentity**, which contains an access control list (ACL) that specifies which accounts have permission to delegate credentials to the associated account (in our example, it will be the machine account for *ServerA*).

Now let's set up the variables we'll use to represent the servers:

PowerShell

```
# Set up variables for reuse
$ServerA = $env:COMPUTERNAME
$ServerB = Get-ADComputer -Identity ServerB
$ServerC = Get-ADComputer -Identity ServerC
```

WinRM (and therefore PowerShell remoting) runs as the computer account by default. You can see this by looking at the **StartName** property of the `winrm` service:

PowerShell

```
Get-CimInstance Win32_Service -Filter 'Name="winrm"' | Select-Object
StartName
```

Output

```
StartName
---------
NT AUTHORITY\NetworkService
```

For *ServerC* to allow delegation from a PowerShell remoting session on *ServerB*, we must set the **PrincipalsAllowedToDelegateToAccount** parameter on *ServerC* to the computer object of *ServerB*:

PowerShell

```
# Grant resource-based Kerberos constrained delegation
Set-ADComputer -Identity $ServerC -PrincipalsAllowedToDelegateToAccount
$ServerB

# Check the value of the attribute directly
$x = Get-ADComputer -Identity $ServerC -Properties msDS-
AllowedToActOnBehalfOfOtherIdentity
$x.'msDS-AllowedToActOnBehalfOfOtherIdentity'.Access

# Check the value of the attribute indirectly
Get-ADComputer -Identity $ServerC -Properties
PrincipalsAllowedToDelegateToAccount
```

The Kerberos Key Distribution Center (KDC) caches denied-access attempts (negative cache) for 15 minutes. If *ServerB* has previously attempted to access *ServerC*, you need to clear the cache on *ServerB* by invoking the following command:

PowerShell

```
Invoke-Command -ComputerName $ServerB.Name -Credential $cred -ScriptBlock {
    klist purge -li 0x3e7
}
```

You could also restart the computer, or wait at least 15 minutes to clear the cache.

After clearing the cache, you can successfully run code from *ServerA* through *ServerB* to *ServerC*:

PowerShell

```
# Capture a credential
$cred = Get-Credential Contoso\Alice

# Test kerberos double hop
Invoke-Command -ComputerName $ServerB.Name -Credential $cred -ScriptBlock {
    Test-Path \\$($using:ServerC.Name)\C$
    Get-Process lsass -ComputerName $($using:ServerC.Name)
    Get-EventLog -LogName System -Newest 3 -ComputerName
$($using:ServerC.Name)
}
```

In this example, the `$using` variable is used to make the `$ServerC` variable visible to *ServerB*. For more information about the `$using` variable, see about_Remote_Variables.

To allow multiple servers to delegate credentials to *ServerC*, set the value of the **PrincipalsAllowedToDelegateToAccount** parameter on *ServerC* to an array:

PowerShell

```
# Set up variables for each server
$ServerB1 = Get-ADComputer -Identity ServerB1
$ServerB2 = Get-ADComputer -Identity ServerB2
$ServerB3 = Get-ADComputer -Identity ServerB3
$ServerC  = Get-ADComputer -Identity ServerC

$servers = @(
    $ServerB1,
    $ServerB2,
    $ServerB3
)

# Grant resource-based Kerberos constrained delegation
Set-ADComputer -Identity $ServerC -PrincipalsAllowedToDelegateToAccount
$servers
```

If you want to make the second hop across domains, use the **Server** parameter to specify fully-qualified domain name (FQDN) of the domain controller of the domain to which *ServerB* belongs:

PowerShell

```
# For ServerC in Contoso domain and ServerB in other domain
$ServerB = Get-ADComputer -Identity ServerB -Server dc1.alpineskihouse.com
$ServerC = Get-ADComputer -Identity ServerC
```

```
Set-ADComputer -Identity $ServerC -PrincipalsAllowedToDelegateToAccount
$ServerB
```

To remove the ability to delegate credentials to ServerC, set the value of the **PrincipalsAllowedToDelegateToAccount** parameter on *ServerC* to `$null`:

PowerShell

```
Set-ADComputer -Identity $ServerC -PrincipalsAllowedToDelegateToAccount
$null
```

Information on resource-based Kerberos constrained delegation

- What's New in Kerberos Authentication
- How Windows Server 2012 Eases the Pain of Kerberos Constrained Delegation, Part 1
- How Windows Server 2012 Eases the Pain of Kerberos Constrained Delegation, Part 2
- Understanding Kerberos Constrained Delegation for Azure Active Directory Application Proxy Deployments with Integrated Windows Authentication
- [MS-ADA2 Active Directory Schema Attributes M2.210 Attribute msDS-AllowedToActOnBehalfOfOtherIdentity]MS-ADA2
- [MS-SFU Kerberos Protocol Extensions: Service for User and Constrained Delegation Protocol 1.3.2 S4U2proxy]MS-SFU
- Remote Administration Without Constrained Delegation Using PrincipalsAllowedToDelegateToAccount

Kerberos delegation (unconstrained)

You can also use Kerberos unconstrained delegation to make the second hop. Like all Kerberos scenarios, credentials aren't stored. This method doesn't support the second hop for WinRM.

> ⚠ **Warning**
>
> This method provides no control of where delegated credentials are used. It's less secure than CredSSP. This method should only be used for testing scenarios.

Just Enough Administration (JEA)

JEA allows you to restrict what commands an administrator can run during a PowerShell session. It can be used to solve the second hop problem.

For information about JEA, see Just Enough Administration.

Pros

- No password maintenance when using a virtual account.

Cons

- Requires WMF 5.0 or later.
- Requires configuration on every intermediate server (*ServerB*).

PSSessionConfiguration using RunAs

You can create a session configuration on *ServerB* and set its **RunAsCredential** parameter.

For information about using **PSSessionConfiguration** and **RunAs** to solve the second hop problem, see Another solution to multi-hop PowerShell remoting.

Pros

- Works with any server with WMF 3.0 or later.

Cons

- Requires configuration of **PSSessionConfiguration** and **RunAs** on every intermediate server (*ServerB*).
- Requires password maintenance when using a domain **RunAs** account

Pass credentials inside an Invoke-Command script block

You can pass credentials inside the **ScriptBlock** parameter of a call to the Invoke-Command cmdlet.

Pros

- Doesn't require special server configuration.
- Works on any server running WMF 2.0 or later.

Cons

- Requires an awkward code technique.
- If running WMF 2.0, requires different syntax for passing arguments to a remote session.

Example

The following example shows how to pass credentials in an script block:

PowerShell

```
# This works without delegation, passing fresh creds
# Note $Using:Cred in nested request
$cred = Get-Credential Contoso\Administrator
Invoke-Command -ComputerName ServerB -Credential $cred -ScriptBlock {
    hostname
    Invoke-Command -ComputerName ServerC -Credential $Using:cred -
ScriptBlock {hostname}
}
```

See also

PowerShell Remoting Security Considerations

PowerShell Remoting FAQ

FAQ

When you work remotely, you type commands in PowerShell on one computer (known as the "local computer"), but the commands run on another computer (known as the "remote computer"). The experience of working remotely should be as much like working directly at the remote computer as possible.

> **Note**
>
> To use PowerShell remoting, the remote computer must be configured for remoting. For more information, see **about_Remote_Requirements**.

Must both computers have PowerShell installed?

Yes. To work remotely, the local and remote computers must have PowerShell, the Microsoft .NET Framework, and the Web Services for Management (WS-Management) protocol. Any files and other resources that are needed to execute a particular command must be on the remote computer.

Computers running Windows PowerShell 3.0 and computers running Windows PowerShell 2.0 can connect to each other remotely and run remote commands. However, some features, such as the ability to disconnect from a session and reconnect to it, work only when both computers are running Windows PowerShell 3.0.

You must have permission to connect to the remote computer, permission to run PowerShell, and permission to access data stores (such as files and folders), and the registry on the remote computer.

For more information, see about_Remote_Requirements.

How does remoting work?

When you submit a remote command, the command is transmitted across the network to the PowerShell engine on the remote computer, and it runs in the PowerShell client on the remote computer. The command results are sent back to the local computer and appear in the PowerShell session on the local computer.

To transmit the commands and receive the output, PowerShell uses the WS-Management protocol. For information about the WS-Management protocol, see WS-Management Protocol in the Windows documentation.

Beginning in Windows PowerShell 3.0, remote sessions are stored on the remote computer. This enables you to disconnect from the session and reconnect from a different session or a different computer without interrupting the commands or losing state.

Is PowerShell remoting secure?

When you connect to a remote computer, the system uses the username and password credentials on the local computer or the credentials that you supply in the command to log you in to the remote computer. The credentials and the rest of the transmission are encrypted.

To add additional protection, you can configure the remote computer to use Secure Sockets Layer (SSL) instead of HTTP to listen for Windows Remote Management (WinRM) requests. Then, users can use the **UseSSL** parameter of the `Invoke-Command`, `New-PSSession`, and `Enter-PSSession` cmdlets when establishing a connection. This option uses the more secure HTTPS channel instead of HTTP.

Do all remote commands require PowerShell remoting?

No. Some cmdlets have a **ComputerName** parameter that lets you get objects from the remote computer.

These cmdlets do not use PowerShell remoting. So, you can use them on any computer that is running PowerShell, even if the computer is not configured for PowerShell remoting or if the computer does not meet the requirements for PowerShell remoting.

These cmdlets include the following:

- `Get-Hotfix`
- `Rename-Computer`
- `Restart-Computer`
- `Stop-Computer`

To find all the cmdlets with a **ComputerName** parameter, type:

PowerShell

```
Get-Help * -Parameter ComputerName
# or
Get-Command -ParameterName ComputerName
```

To determine whether the **ComputerName** parameter of a particular cmdlet requires PowerShell remoting, see the parameter description. To display the parameter description, type:

PowerShell

```
Get-Help <cmdlet-name> -Parameter ComputerName
```

For example:

PowerShell

```
Get-Help Get-Hotfix -Parameter ComputerName
```

For all other commands, use the `Invoke-Command` cmdlet.

How do I run a command on a remote computer?

To run a command on a remote computer, use the `Invoke-Command` cmdlet.

Enclose your command in braces (`{}`) to make it a script block. Use the **ScriptBlock** parameter of `Invoke-Command` to specify the command.

You can use the **ComputerName** parameter of `Invoke-Command` to specify a remote computer. Or, you can create a persistent connection to a remote computer (a session) and then use the **Session** parameter of `Invoke-Command` to run the command in the session.

For example, the following commands run a `Get-Process` command remotely.

PowerShell

```
Invoke-Command -ComputerName Server01, Server02 -ScriptBlock {Get-Process}

#  - OR -
```

```
Invoke-Command -Session $s -ScriptBlock {Get-Process}
```

To interrupt a remote command, type CTRL+C. The interruption request is passed to the remote computer, where it terminates the remote command.

For more information about remote commands, see about_Remote and the Help topics for the cmdlets that support remoting.

Can I just telnet into a remote computer?

You can use the `Enter-PSSession` cmdlet to start an interactive session with a remote computer.

At the PowerShell prompt, type:

PowerShell

```
Enter-PSSession <ComputerName>
```

The command prompt changes to show that you are connected to the remote computer.

```
<ComputerName>\C:>
```

Now, the commands that you type run on the remote computer just as though you typed them directly on the remote computer.

To end the interactive session, type:

PowerShell

```
Exit-PSSession
```

An interactive session is a persistent session that uses the WS-Management protocol. It is not the same as using Telnet, but it provides a similar experience.

For more information, see `Enter-PSSession`.

Can I create a persistent connection?

Yes. You can run remote commands by specifying the name of the remote computer, its NetBIOS name, or its IP address. Or, you can run remote commands by specifying a PowerShell session (PSSession) that is connected to the remote computer.

When you use the **ComputerName** parameter of `Invoke-Command` or `Enter-PSSession`, PowerShell establishes a temporary connection. PowerShell uses the connection to run only the current command, and then it closes the connection. This is a very efficient method for running a single command or several unrelated commands, even on many remote computers.

When you use the `New-PSSession` cmdlet to create a PSSession, PowerShell establishes a persistent connection for the PSSession. Then, you can run multiple commands in the PSSession, including commands that share data.

Typically, you create a PSSession to run a series of related commands that share data. Otherwise, the temporary connection created by the **ComputerName** parameter is sufficient for most commands.

For more information about sessions, see about_PSSessions.

Can I run commands on more than one computer at a time?

Yes. The **ComputerName** parameter of the `Invoke-Command` cmdlet accepts multiple computer names, and the **Session** parameter accepts multiple PSSessions.

When you run an `Invoke-Command` command, PowerShell runs the commands on all of the specified computers or in all of the specified PSSessions.

PowerShell can manage hundreds of concurrent remote connections. However, the number of remote commands that you can send might be limited by the resources of your computer and its capacity to establish and maintain multiple network connections.

For more information, see the example in the `Invoke-Command` Help topic.

Where are my profiles?

PowerShell profiles are not run automatically in remote sessions, so the commands that the profile adds are not present in the session. In addition, the `$profile` automatic

variable is not populated in remote sessions.

To run a profile in a session, use the `Invoke-Command` cmdlet.

For example, the following command runs the **CurrentUserCurrentHost** profile from the local computer in the session in `$s`.

```
Invoke-Command -Session $s -FilePath $profile
```

The following command runs the **CurrentUserCurrentHost** profile from the remote computer in the session in `$s`. Because the `$profile` variable is not populated, the command uses the explicit path to the profile.

PowerShell

```
Invoke-Command -Session $s {
  . "$home\Documents\WindowsPowerShell\Microsoft.PowerShell_profile.ps1"
}
```

After running this command, the commands that the profile adds to the session are available in `$s`.

You can also use a startup script in a session configuration to run a profile in every remote session that uses the session configuration.

For more information about PowerShell profiles, see about_Profiles. For more information about session configurations, see `Register-PSSessionConfiguration`.

How does throttling work on remote commands?

To help you manage the resources on your local computer, PowerShell includes a per-command throttling feature that lets you limit the number of concurrent remote connections that are established for each command.

The default is 32 concurrent connections, but you can use the **ThrottleLimit** parameter of the cmdlets to set a custom throttle limit for particular commands.

When you use the throttling feature, remember that it is applied to each command, not to the entire session or to the computer. If you are running commands concurrently in

several sessions or PSSessions, the number of concurrent connections is the sum of the concurrent connections in all the sessions.

To find cmdlets with a **ThrottleLimit** parameter, type:

```
Get-Help * -Parameter ThrottleLimit
-or-
Get-Command -ParameterName ThrottleLimit
```

Is the output of remote commands different from local output?

When you use PowerShell locally, you send and receive "live" .NET Framework objects; "live" objects are objects that are associated with actual programs or system components. When you invoke the methods or change the properties of live objects, the changes affect the actual program or component. And, when the properties of a program or component change, the properties of the object that represent them also change.

However, because most live objects cannot be transmitted over the network, PowerShell "serializes" most of the objects sent in remote commands, that is, it converts each object into a series of XML (Constraint Language in XML [CLiXML]) data elements for transmission.

When PowerShell receives a serialized object, it converts the XML into a deserialized object type. The deserialized object is an accurate record of the properties of the program or component at a previous time, but it is no longer "live", that is, it is no longer directly associated with the component. And, the methods are removed because they are no longer effective.

Typically, you can use deserialized objects just as you would use live objects, but you must be aware of their limitations. Also, the objects that are returned by the `Invoke-Command` cmdlet have additional properties that help you to determine the origin of the command.

Some object types, such as DirectoryInfo objects and GUIDs, are converted back into live objects when they are received. These objects do not need any special handling or formatting.

For information about interpreting and formatting remote output, see about_Remote_Output.

Can I run background jobs remotely?

Yes. A PowerShell background job is a PowerShell command that runs asynchronously without interacting with the session. When you start a background job, the command prompt returns immediately, and you can continue to work in the session while the job runs even if it runs for an extended period of time.

You can start a background job even while other commands are running because background jobs always run asynchronously in a temporary session.

You can run background jobs on a local or remote computer. By default, a background job runs on the local computer. However, you can use the **AsJob** parameter of the `Invoke-Command` cmdlet to run any remote command as a background job. And, you can use `Invoke-Command` to run a `Start-Job` command remotely.

For more information about background jobs in PowerShell , see about_Jobs and about_Remote_Jobs.

Can I run windows programs on a remote computer?

You can use PowerShell remote commands to run Windows-based programs on remote computers. For example, you can run `Shutdown.exe` or `Ipconfig.exe` on a remote computer.

However, you cannot use PowerShell commands to open the user interface for any program on a remote computer.

When you start a Windows program on a remote computer, the command is not completed, and the PowerShell command prompt does not return, until the program is finished or until you press CTRL+C to interrupt the command. For example, if you run the `Ipconfig.exe` program on a remote computer, the command prompt does not return until `Ipconfig.exe` is completed.

If you use remote commands to start a program that has a user interface, the program process starts, but the user interface does not appear. The PowerShell command is not completed, and the command prompt does not return until you stop the program

process or until you press CTRL+C, which interrupts the command and stops the process.

For example, if you use a PowerShell command to run `Notepad` on a remote computer, the Notepad process starts on the remote computer, but the Notepad user interface does not appear. To interrupt the command and restore the command prompt, press CTRL+C.

Can I limit the commands that users can run remotely on my computer?

Yes. Every remote session must use one of the session configurations on the remote computer. You can manage the session configurations on your computer (and the permissions to those session configurations) to determine who can run commands remotely on your computer and which commands they can run.

A session configuration configures the environment for the session. You can define the configuration by using an assembly that implements a new configuration class or by using a script that runs in the session. The configuration can determine the commands that are available in the session. And, the configuration can include settings that protect the computer, such as settings that limit the amount of data that the session can receive remotely in a single object or command. You can also specify a security descriptor that determines the permissions that are required to use the configuration.

The `Enable-PSRemoting` cmdlet creates the default session configurations on your computer: Microsoft.PowerShell, Microsoft.PowerShell.Workflow, and Microsoft.PowerShell32 (64-bit operating systems only). `Enable-PSRemoting` sets the security descriptor for the configuration to allow only members of the Administrators group on your computer to use them.

You can use the session configuration cmdlets to edit the default session configurations, to create new session configurations, and to change the security descriptors of all the session configurations.

Beginning in Windows PowerShell 3.0, the `New-PSSessionConfigurationFile` cmdlet lets you create custom session configurations by using a text file. The file includes options for setting the language mode and for specifying the cmdlets and modules that are available in sessions that use the session configuration.

When users use the `Invoke-Command`, `New-PSSession`, or `Enter-PSSession` cmdlets, they can use the **ConfigurationName** parameter to indicate the session configuration that is

used for the session. And, they can change the default configuration that their sessions use by changing the value of the `$PSSessionConfigurationName` preference variable in the session.

For more information about session configurations, see the Help for the session configuration cmdlets. To find the session configuration cmdlets, type:

```PowerShell
Get-Command *PSSessionConfiguration
```

What are fan in and fan out configurations?

The most common PowerShell remoting scenario involving multiple computers is the one-to-many configuration, in which one local computer (the administrator's computer) runs PowerShell commands on numerous remote computers. This is known as the "fan-out" scenario.

However, in some enterprises, the configuration is many-to-one, where many client computers connect to a single remote computer that is running PowerShell, such as a file server or a kiosk. This is known as the "fan-in" configuration.

PowerShell remoting supports both fan-out and fan-in configurations.

For the fan-out configuration, PowerShell uses the Web Services for Management (WS-Management) protocol and the WinRM service that supports the Microsoft implementation of WS-Management. When a local computer connects to a remote computer, WS-Management establishes a connection and uses a plug-in for PowerShell to start the PowerShell host process (Wsmprovhost.exe) on the remote computer. The user can specify an alternate port, an alternate session configuration, and other features to customize the remote connection.

To support the "fan-in" configuration, PowerShell uses internet Information Services (IIS) to host WS-Management, to load the PowerShell plug-in, and to start PowerShell. In this scenario, instead of starting each PowerShell session in a separate process, all PowerShell sessions run in the same host process.

IIS hosting and fan-in remote management is not supported in Windows XP or in Windows Server 2003.

In a fan-in configuration, the user can specify a connection URI and an HTTP endpoint, including the transport, computer name, port, and application name. IIS forwards all the requests with a specified application name to the application. The default is WS-Management, which can host PowerShell.

You can also specify an authentication mechanism and prohibit or allow redirection from HTTP and HTTPS endpoints.

Can I test remoting on a single computer not in a domain?

Yes. PowerShell remoting is available even when the local computer is not in a domain. You can use the remoting features to connect to sessions and to create sessions on the same computer. The features work the same as they do when you connect to a remote computer.

To run remote commands on a computer in a workgroup, change the following Windows settings on the computer.

Caution: These settings affect all users on the system and they can make the system more vulnerable to a malicious attack. Use caution when making these changes.

- Windows Vista, Windows 7, Windows 8:

  Create the following registry entry, and then set its value to 1: LocalAccountTokenFilterPolicy in `HKLM\SOFTWARE\Microsoft\Windows\CurrentVersion\Policies\System`

  You can use the following PowerShell command to add this entry:

  PowerShell

  ```
  $parameters = @{

  Path='HKLM:\SOFTWARE\Microsoft\Windows\CurrentVersion\Policies\System'
    Name='LocalAccountTokenFilterPolicy'
    propertyType='DWord'
    Value=1
  }
  New-ItemProperty @parameters
  ```

- Windows Server 2003, Windows Server 2008, Windows Server 2012, Windows Server 2012 R2:

No changes are needed because the default setting of the "Network Access: Sharing and security model for local accounts" policy is "Classic". Verify the setting in case it has changed.

Can I run remote commands on a computer in another domain?

Yes. Typically, the commands run without error, although you might need to use the **Credential** parameter of the `Invoke-Command`, `New-PSSession`, or `Enter-PSSession` cmdlets to provide the credentials of a member of the Administrators group on the remote computer. This is sometimes required even when the current user is a member of the Administrators group on the local and remote computers.

However, if the remote computer is not in a domain that the local computer trusts, the remote computer might not be able to authenticate the user's credentials.

To enable authentication, use the following command to add the remote computer to the list of trusted hosts for the local computer in WinRM. Type the command at the PowerShell prompt.

PowerShell

```
Set-Item WSMan:\localhost\Client\TrustedHosts -Value <Remote-computer-name>
```

For example, to add the Server01 computer to the list of trusted hosts on the local computer, type the following command at the PowerShell prompt:

PowerShell

```
Set-Item WSMan:\localhost\Client\TrustedHosts -Value Server01
```

Does PowerShell support remoting over SSH?

Yes. For more information, see PowerShell remoting over SSH.

See also

about_Remote

about_Profiles

about_PSSessions

about_Remote_Jobs

about_Remote_Variables

Invoke-Command

New-PSSession

PowerShell security features

Article • 05/26/2023

PowerShell has several features designed to improve the security of your scripting environment.

Execution policy

PowerShell's execution policy is a safety feature that controls the conditions under which PowerShell loads configuration files and runs scripts. This feature helps prevent the execution of malicious scripts. You can use a Group Policy setting to set execution policies for computers and users. Execution policies only apply to the Windows platform.

For more information see about_Execution_Policies.

Module and script block logging

Module Logging allows you to enable logging for selected PowerShell modules. This setting is effective in all sessions on the computer. Pipeline execution events for the specified modules are recorded in the Windows PowerShell log in Event Viewer.

Script Block Logging enables logging for the processing of commands, script blocks, functions, and scripts - whether invoked interactively, or through automation. This information is logged to the **Microsoft-Windows-PowerShell/Operational** event log.

For more information, see the following articles:

- about_Group_Policy_Settings
- about_Logging_Windows
- about_Logging_Non-Windows

AMSI Support

The Windows Antimalware Scan Interface (AMSI) is an API that allows application actions to be passed to an antimalware scanner, such as Windows Defender, to be scanned for malicious payloads. Beginning with PowerShell 5.1, PowerShell running on Windows 10 (and higher) passes all script blocks to AMSI.

PowerShell 7.3 extends the data that's sent to AMSI for inspection. It now includes all invocations of .NET method members.

For more information about AMSI, see How AMSI helps.

Constrained language mode

ConstrainedLanguage mode protects your system by limiting the cmdlets and .NET types that can be used in a PowerShell session. For a full description, see about_Language_Modes.

Application Control

Windows 10 includes two technologies, Windows Defender Application Control (WDAC) and AppLocker that you can use to control applications. They allow you to create a lockdown experience to help secure your PowerShell environment.

For more information about how PowerShell supports AppLocker and WDAC, see Using Windows Defender Application Control.

Changes in PowerShell 7.2

- There was a corner-case scenario in AppLocker where you only have **Deny** rules and constrained mode isn't used to enforce the policy that allows you to bypass the execution policy. Beginning in PowerShell 7.2, a change was made to ensure AppLocker rules take precedence over a `Set-ExecutionPolicy -ExecutionPolicy Bypass` command.
- PowerShell 7.2 now disallows the use of the `Add-Type` cmdlet in a **NoLanguage** mode PowerShell session on a locked down machine.
- PowerShell 7.2 now disallows scripts from using COM objects in AppLocker system lock down conditions. Cmdlet that use COM or DCOM internally aren't affected.

Changes in PowerShell 7.3

- PowerShell 7.3 now supports the ability to block or allow PowerShell script files via the WDAC API.

Security Servicing Criteria

PowerShell follows the Microsoft Security Servicing Criteria for Windows. The table below outlines the features that meet the servicing criteria and those that do not.

Feature	Type
System Lockdown - with WDAC	Security Feature
Constrained language mode - with WDAC	Security Feature
System Lockdown - with AppLocker	Defense in Depth
Constrained language mode - with AppLocker	Defense in Depth
Execution Policy	Defense in Depth

Software Bill of Materials (SBOM)

Beginning with PowerShell 7.2, all install packages contain a Software Bill of Materials (SBOM). The SBOM is found at `$PSHOME/_manifest/spdx_2.2/manifest.spdx.json`. The creation and publishing of the SBOM is the first step to modernize Federal Government cybersecurity and enhance software supply chain security.

The PowerShell team is also producing SBOMs for modules that they own but ship separately from PowerShell. SBOMs will be added in the next release of the module. For modules, the SBOM is installed in the module's folder under `_manifest/spdx_2.2/manifest.spdx.json`.

For more information about this initiative, see the blog post Generating Software Bills of Materials (SBOMs) with SPDX at Microsoft.

Using Windows Defender Application Control

Article • 05/26/2023

Windows 10 includes two technologies, Windows Defender Application Control (WDAC) and AppLocker that you can use to control applications. They allow you to create a lockdown experience to help secure your PowerShell environment

AppLocker builds on the application control features of Software Restriction Policies. AppLocker contains capabilities and extensions that enable you to create rules to allow or deny apps from running based on unique identities of files and to specify the users or groups that are allowed to run those apps.

> **Note**
>
> When **choosing between WDAC or AppLocker**, we recommend that you implement application control using WDAC rather than AppLocker. Microsoft is continually improving WDAC and Microsoft management platforms are extending their support for WDAC. Although AppLocker may continue to receive security fixes, it won't receive feature enhancements.

WDAC was introduced with Windows 10 and allows organizations to control the drivers and applications are allowed to run on their Windows devices. WDAC is designed as a security feature under the servicing criteria defined by the Microsoft Security Response Center (MSRC).

For more information about AppLocker and WDAC, see Application Controls for Windows and WDAC and AppLocker feature availability.

WDAC policy enforcement

When PowerShell runs under a WDAC policy, it changes its behavior based on the defined security policy. Under a WDAC policy, PowerShell runs trusted scripts and modules allowed by the policy in Full Language mode. All other scripts and script blocks are untrusted and run in Constrained Language mode. PowerShell throws errors when the untrusted scripts attempt to perform actions that aren't allowed in Constrained Language mode. It can be difficult to know why a script failed to run correctly in Constrained Language mode.

WDAC policy auditing

PowerShell 7.4-preview.4 added a new experimental feature, `PSConstrainedAuditLogging`. When you enable this feature, PowerShell supports WDAC policies in **Audit** mode. In audit mode, PowerShell runs the untrusted scripts in Constrained Language mode without errors, but logs messages to the event log instead. The log messages describe what restrictions would apply if the policy was in **Enforce** mode.

Viewing audit events

PowerShell logs audit events to the **PowerShellCore/Analytic** event log. You must enable the Analytic log. To enable the Analytic log in the Windows Event Viewer, right-click on the **PowerShellCore/Analytic** log and select **Enable Log**.

Or, you can run the following command from an elevated PowerShell session.

PowerShell

```
wevtutil.exe sl PowerShellCore/Analytic /enabled:true /quiet
```

You can view the events in the Windows Event Viewer or use the `Get-WinEvent` cmdlet to retrieve the events.

PowerShell

```
Get-WinEvent -LogName PowerShellCore/Analytic -Oldest |
    Where-Object Id -eq 16387 | Format-List
```

Output

```
TimeCreated  : 4/19/2023 10:11:07 AM
ProviderName : PowerShellCore
Id           : 16387
Message      : WDAC Audit.

    Title: Method or Property Invocation
    Message: Method or Property 'WriteLine' on type 'System.Console'
invocation will not
        be allowed in ConstrainedLanguage mode.
        At C:\scripts\Test1.ps1:3 char:1
        + [System.Console]::WriteLine("pwnd!")
        + ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
    FullyQualifiedId: MethodOrPropertyInvocationNotAllowed
```

The event message includes the script position where the restriction would be applied. This information helps you understand where you need to change your script so that it runs under the WDAC policy.

> **ⓘ Important**
>
> Once you have reviewed the audit events, you should disable the Analytic log. Analytic logs grow quickly and consume large amounts of disk space.

Viewing audit events in the PowerShell debugger

If you set the `$DebugPreference` variable to `Break` for an interactive PowerShell session, PowerShell will break into the command-line script debugger at the current location in the script where the audit event occurred. This allows you to debug your code and inspect the current state of the script in real time.

Using Experimental Features in PowerShell

Article • 06/22/2023

The Experimental Features support in PowerShell provides a mechanism for experimental features to coexist with existing stable features in PowerShell or PowerShell modules.

An experimental feature is one where the design isn't finalized. The feature is available for users to test and provide feedback. Once an experimental feature is finalized, the design changes become breaking changes.

> **⊗ Caution**
>
> Experimental features aren't intended to be used in production since the changes are allowed to be breaking. Experimental features aren't officially supported. However, we appreciate any feedback and bug reports. You can file issues in the **GitHub source repository**.

For more information about enabling or disabling these features, see about_Experimental_Features.

Available features

This article describes the experimental features that are available and how to use the feature.

Legend

- The 🚧 icon indicates that the experimental feature is available in the version of PowerShell
- The ✅ icon indicates the version of PowerShell where the experimental feature became mainstream
- The ❌ icon indicates the version of PowerShell where the experimental feature was removed

Name	7.2	7.3	7.4
PSCommandNotFoundSuggestion	🚧	🚧	🚧

Name	7.2	7.3	7.4
PSDesiredStateConfiguration.InvokeDscResource (DSC v2)	🚧	🚧	🚧
PSNativePSPathResolution	🚧	❌	
PSSubsystemPluginModel	🚧	🚧	🚧
PSNativeCommandArgumentPassing	🚧	✅	
PSAnsiRenderingFileInfo	🚧	✅	
PSLoadAssemblyFromNativeCode	🚧	🚧	🚧
PSNativeCommandErrorActionPreference		🚧	🚧
PSCustomTableHeaderLabelDecoration			🚧
PSFeedbackProvider			🚧
PSModuleAutoLoadSkipOfflineFiles			🚧
PSCommandWithArgs			🚧
PSConstrainedAuditLogging			🚧
PSNativeCommandPreserveBytePipe			🚧
PSWindowsNativeCommandArgPassing			🚧

PSAnsiRenderingFileInfo

> ⓘ **Note**
>
> This feature became mainstream in PowerShell 7.3.

This experiment was added in PowerShell 7.2. This feature adds the `$PSStyle.FileInfo` member and enables coloring of specific file types.

- `$PSStyle.FileInfo.Directory` - Built-in member to specify color for directories
- `$PSStyle.FileInfo.SymbolicLink` - Built-in member to specify color for symbolic links
- `$PSStyle.FileInfo.Executable` - Built-in member to specify color for executables.
- `$PSStyle.FileInfo.Extension` - Use this member to define colors for different file extensions. The **Extension** member pre-includes extensions for archive and PowerShell files.

For more information, see about_Automatic_Variables.

> **Note**
>
> This feature is dependent on the **PSAnsiRendering** feature that's now a standard feature.

PSCommandNotFoundSuggestion

Recommends potential commands based on fuzzy matching search after a **CommandNotFoundException**.

PowerShell

```
PS> get
```

Output

```
get: The term 'get' isn't recognized as the name of a cmdlet, function,
script file,
or operable program. Check the spelling of the name, or if a path was
included, verify
that the path is correct and try again.

Suggestion [4,General]: The most similar commands are: set, del, ft, gal,
gbp, gc, gci,
gcm, gdr, gcs.
```

PSCommandWithArgs

This feature enables the `-CommandWithArgs` parameter for `pwsh`. This parameter allows you to execute a PowerShell command with arguments. Unlike `-Command`, this parameter populates the `$args` built-in variable that can be used by the command.

The first string is the command and subsequent strings delimited by whitespace are the arguments.

For example:

PowerShell

```
pwsh -CommandWithArgs '$args | % { "arg: $_" }' arg1 arg2
```

This example produces the following output:

Output

```
arg: arg1
arg: arg2
```

This feature was added in PowerShell 7.4-preview.2.

PSConstrainedAuditLogging

On Windows, when PowerShell runs under a Windows Defender Application Control (WDAC) policy, it changes its behavior based on the defined security policy. Under a WDAC policy, PowerShell runs trusted scripts and modules allowed by the policy in Full Language mode. All other scripts and script blocks are untrusted and run in Constrained Language mode. PowerShell throws errors when the untrusted scripts attempt to perform disallowed actions. It's difficult to know why a script fails to run correctly in Constrained Language mode.

When you enable the `PSConstrainedAuditLogging` experimental feature, PowerShell supports WDAC policies in **Audit** mode. In audit mode, PowerShell runs the untrusted scripts in Constrained Language mode but logs messages to the event log instead of throwing errors. The log messages describe what restrictions would apply if the policy was in **Enforce** mode.

This feature was added in PowerShell 7.4-preview.4.

PSCustomTableHeaderLabelDecoration

When you enable this feature, `$PSStyle` includes formatting differentiation for table header labels that aren't property members. For example, the default output from `Get-Process` includes the following columns: `NPM(K)`, `PM(M)`, `WS(M)`, and `CPU(s)`.

PowerShell

```powershell
Get-Process pwsh
```

Output

```
 NPM(K)    PM(M)      WS(M)     CPU(s)      Id  SI ProcessName
 ------    -----      -----     ------      --  -- -----------
     99    84.57     170.50       5.89   48688   1 pwsh
```

```
     73    87.75     133.08       3.09   49120   1 pwsh
     98    70.31     158.56       4.23   91220   1 pwsh
    125    70.19     171.33       4.84   92124   1 pwsh
```

These column names don't match any properties of the **System.Diagnostics.Process** object returned by the cmdlet. These are values calculated by the PowerShell formatting system.

With this feature enabled these column headers are displayed in italics to distinguish these column names from property names.

PSDesiredStateConfiguration.InvokeDscResource

Enables compilation to MOF on non-Windows systems and enables the use of `Invoke-DSCResource` without an LCM.

In earlier previews of PowerShell 7.2, this feature was enabled by default. Beginning with PowerShell 7.2, the **PSDesiredStateConfiguration** module was removed and this feature is disabled by default. To enable this feature you must install the **PSDesiredStateConfiguration** v2.0.5 module from the PowerShell Gallery and enable the feature using `Enable-ExperimentalFeature`.

DSC v3 doesn't have this experimental feature. DSC v3 only supports `Invoke-DSCResource` and doesn't use or support MOF compilation. For more information, see PowerShell Desired State Configuration v3.

PSFeedbackProvider

When you enable this feature, PowerShell uses a new feedback provider to give you feedback when a command can't be found. The feedback provider is extensible, and can be implemented by third-party modules. The feedback provider can be used by other subsystems, such as the predictor subsystem, to provide predictive IntelliSense results.

This feature includes two built-in feedback providers:

- **GeneralCommandErrorFeedback** serves the same suggestion functionality existing today
- **UnixCommandNotFound**, available on Linux, provides feedback similar to bash.

  The **UnixCommandNotFound** serves as both a feedback provider and a predictor. The suggestion from command-not-found command is used both for providing

the feedback when command can't be found in an interactive run, and for providing predictive IntelliSense results for the next command line.

PSLoadAssemblyFromNativeCode

Exposes an API to allow assembly loading from native code.

PSModuleAutoLoadSkipOfflineFiles

With this feature enabled, if a user's **PSModulePath** contains a folder from a cloud provider, such as OneDrive, PowerShell no longer triggers the download of all files contained within that folder. Any file marked as not downloaded are skipped. Users who use cloud providers to sync their modules between machines should mark the module folder as **Pinned** or the equivalent status for providers other than OneDrive. Marking the module folder as **Pinned** ensures that the files are always kept on disk.

PSNativeCommandArgumentPassing

> ⓘ **Note**
>
> This feature became mainstream in PowerShell 7.3.

When this experimental feature is enabled PowerShell uses the `ArgumentList` property of the `StartProcessInfo` object rather than our current mechanism of reconstructing a string when invoking a native executable.

> ⊗ **Caution**
>
> The new behavior is a **breaking change** from current behavior. This may break scripts and automation that work around the various issues when invoking native applications. Historically, quotes must be escaped and it isn't possible to provide empty arguments to a native application. Use the **stop-parsing token** (`--%`) or the **Start-Process** cmdlet to sidestep native argument passing when needed.

This feature adds a new `$PSNativeCommandArgumentPassing` preference variable that controls this behavior. This variable allows you to select the behavior at runtime. The valid values are `Legacy`, `Standard`, and `Windows`. The default behavior is platform

specific. On Windows platforms, the default setting is `Windows` and non-Windows platforms default to `Standard`.

`Legacy` is the historic behavior. The behavior of `Windows` and `Standard` mode are the same except, in `Windows` mode, invocations of the following files automatically use the `Legacy` style argument passing.

- `cmd.exe`
- `find.exe`
- `cscript.exe`
- `wscript.exe`
- `sqlcmd.exe` - Added in PowerShell 7.3.1
- ending with `.bat`
- ending with `.cmd`
- ending with `.js`
- ending with `.vbs`
- ending with `.wsf`

If the `$PSNativeCommandArgumentPassing` is set to either `Legacy` or `Standard`, the parser doesn't check for these files.

The default behavior is platform specific. On Windows platforms, the default setting is `Windows` and non-Windows platforms is `Standard`.

> **Note**
>
> The following examples use the `TestExe.exe` tool. You can build `TestExe` from the source code. See **TestExe** in the PowerShell source repository.

New behaviors made available by this change:

- Literal or expandable strings with embedded quotes the quotes are preserved:

  PowerShell

  ```
  PS> $a = 'a" "b'
  PS> TestExe -echoargs $a 'c" "d' e" "f
  Arg 0 is <a" "b>
  Arg 1 is <c" "d>
  Arg 2 is <e f>
  ```

- Empty strings as arguments are preserved:

PowerShell

```
PS> TestExe -echoargs '' a b ''
Arg 0 is <>
Arg 1 is <a>
Arg 2 is <b>
Arg 3 is <>
```

For more examples of the new behavior, see about_Parsing.

PowerShell 7.3 also added the ability to trace parameter binding for native commands. For more information, see Trace-Command.

PSNativeCommandErrorActionPreference

Native commands usually return an exit code to the calling application that's zero for success or non-zero for failure. However, native commands currently don't participate in the PowerShell error stream. Redirected **stderr** output isn't interpreted the same as the PowerShell error stream. Many native commands use stderr as an information or verbose stream, thus only the exit code matters. Users working with native commands in their scripts need to check the exit status after each call using similar to the following example:

PowerShell

```
if ($LASTEXITCODE -ne 0) {
    throw "Command failed. See above errors for details"
}
```

However, this example doesn't support all cases where `$?` can be false from a cmdlet or function error, making `$LASTEXITCODE` stale.

This feature implements the `$PSNativeCommandUseErrorActionPreference` preference variable that controls how native commands errors are handled in PowerShell. This allows native command failures to produce error objects that are added to the PowerShell error stream and may terminate execution of the script without extra handling.

To enable this feature, run the following commands:

PowerShell

```
Enable-ExperimentalFeature PSNativeCommandErrorActionPreference
```

You must start a new PowerShell session for this change to be in effect. Beginning in PowerShell 7.4, `$PSNativeCommandUseErrorActionPreference` is set to `$true` by default. With the preference set to `$true` you get the following behavior:

- When `$ErrorActionPreference = 'Stop'`, scripts will break when a native command returns a non-zero exit code.
- When `$ErrorActionPreference = 'Continue'` (the default), you will see PowerShell error messages for native command errors, but scripts won't break.

PSNativeCommandPreserveBytePipe

This feature preserves the byte-stream data when redirecting the **stdout** stream of a native command to a file or when piping byte-stream data to the **stdin** stream of a native command.

For example, using the native command `curl` you can download a binary file and save it to disk using redirection.

PowerShell

```
$uri =
'https://github.com/PowerShell/PowerShell/releases/download/v7.3.4/powershel
l-7.3.4-linux-arm64.tar.gz'

# native command redirected to a file
curl -s -L $uri > powershell.tar.gz
```

You can also pipe the byte-stream data to the **stdin** stream of another native command. The following example downloads a zipped TAR file using `curl`. The downloaded file data is streamed to the `tar` command to extract the contents of the archive.

PowerShell

```
# native command output piped to a native command
curl -s -L $uri | tar -xzvf - -C .
```

You can also pipe the byte-stream output of a PowerShell command to the input of native command. The following examples use `Invoke-WebRequest` to download the same TAR file as the previous example.

PowerShell

```
# byte stream piped to a native command
(Invoke-WebRequest $uri).Content | tar -xzvf - -C .
```

```
# bytes piped to a native command (all at once as byte[])
,(Invoke-WebRequest $uri).Content | tar -xzvf - -C .
```

This feature doesn't support byte-stream data when redirecting **stderr** output to **stdout**. When you combine the **stderr** and **stdout** streams, the combined streams are treated as string data.

This experimental feature was introduced in PowerShell 7.4-preview.4.

PSNativePSPathResolution

> ⓘ **Note**
>
> This experimental feature was removed in PowerShell 7.3 and is no longer supported.

If a PSDrive path that uses the FileSystem provider is passed to a native command, the resolved file path is passed to the native command. This means a command like `code temp:/test.txt` now works as expected.

Also, on Windows, if the path starts with `~`, that's resolved to the full path and passed to the native command. In both cases, the path is normalized to the directory separators for the relevant operating system.

- If the path isn't a PSDrive or `~` (on Windows), then path normalization doesn't occur
- If the path is in single quotes, then it's not resolved and treated as literal

PSSubsystemPluginModel

This feature enables the subsystem plugin model in PowerShell. The feature makes it possible to separate components of `System.Management.Automation.dll` into individual subsystems that reside in their own assembly. This separation reduces the disk footprint of the core PowerShell engine and allows these components to become optional features for a minimal PowerShell installation.

Currently, only the **CommandPredictor** subsystem is supported. This subsystem is used along with the PSReadLine module to provide custom prediction plugins. In future, **Job**, **CommandCompleter**, **Remoting** and other components could be separated into subsystem assemblies outside of `System.Management.Automation.dll`.

The experimental feature includes a new cmdlet, Get-PSSubsystem. This cmdlet is only available when the feature is enabled. This cmdlet returns information about the subsystems that are available on the system.

PSWindowsNativeCommandArgPassing

The feature changes the default values of the `$PSNativeCommandArgumentPassing` variable.

- When you enable this feature on Windows, `$PSNativeCommandArgumentPassing` is set to `Windows`.
- When you enable this feature on non-Windows platforms, `$PSNativeCommandArgumentPassing` is set to `Standard`.
- When you disable this feature on Windows, `$PSNativeCommandArgumentPassing` is set to `Legacy`.
- When you disable this feature on non-Windows platforms, `$PSNativeCommandArgumentPassing` is set to `Standard`.

Also, this feature adds new telemetry metrics to inform us how the feature is being used.

Using aliases

Article • 11/17/2022

An alias is an alternate name or shorthand name for a cmdlet or for a command element, such as a function, script, file, or executable file. You can run the command using the alias instead of the executable name.

Managing command aliases

PowerShell provides cmdlets for managing command aliases.

PowerShell

```
Get-Command -Noun Alias
```

Output

```
CommandType Name         Version Source
----------- ----         ------- ------
Cmdlet      Export-Alias 7.0.0.0 Microsoft.PowerShell.Utility
Cmdlet      Get-Alias    7.0.0.0 Microsoft.PowerShell.Utility
Cmdlet      Import-Alias 7.0.0.0 Microsoft.PowerShell.Utility
Cmdlet      New-Alias    7.0.0.0 Microsoft.PowerShell.Utility
Cmdlet      Remove-Alias 7.0.0.0 Microsoft.PowerShell.Utility
Cmdlet      Set-Alias    7.0.0.0 Microsoft.PowerShell.Utility
```

For more information, see about_Aliases.

Use the Get-Alias cmdlet to list the aliases available in your environment. To list the aliases for a single cmdlet, use the **Definition** parameter and specify the executable name.

PowerShell

```
Get-Alias -Definition Get-ChildItem
```

Output

```
CommandType     Name
-----------     ----
Alias           dir -> Get-ChildItem
Alias           gci -> Get-ChildItem
Alias           ls -> Get-ChildItem
```

To get the definition of a single alias, use the **Name** parameter.

PowerShell

```
Get-Alias -Name gci
```

Output

```
CommandType     Name
-----------     ----
Alias           gci -> Get-ChildItem
```

Compatibility aliases in Windows

PowerShell has several aliases that allow **UNIX** and **cmd.exe** users to use familiar commands in Windows. The following table show common commands, the related PowerShell cmdlet, and the PowerShell alias:

cmd.exe command	UNIX command	PowerShell cmdlet	PowerShell alias
cd, chdir	cd	`Set-Location`	`sl`, `cd`, `chdir`
cls	clear	`Clear-Host`	`cls` `clear`
copy	cp	`Copy-Item`	`cpi`, `cp`, `copy`
del, erase, rd, rmdir	rm	`Remove-Item`	`ri`, `del`, `erase`, `rd`, `rm`, `rmdir`
dir	ls	`Get-ChildItem`	`gci`, `dir`, `ls`
echo	echo	`Write-Output`	`write` `echo`
md	mkdir	`New-Item`	`ni`
move	mv	`Move-Item`	`mi`, `move`, `mi`
popd	popd	`Pop-Location`	`popd`
	pwd	`Get-Location`	`gl`, `pwd`
pushd	pushd	`Push-Location`	`pushd`
ren	mv	`Rename-Item`	`rni`, `ren`
type	cat	`Get-Content`	`gc`, `cat`, `type`

> **Note**
>
> The aliases in this table are Windows-specific. Some aliases aren't available on other platforms. This is to allow the native command to work in a PowerShell session. For example, `ls` isn't defined as a PowerShell alias on macOS or Linux so that the native command is run instead of `Get-ChildItem`.

Creating alternate names for commands with parameters

You can assign an alias to a cmdlet, script, function, or executable file. Unlike some Unix shells, you cannot assign an alias to a command with parameters. For example, you can assign an alias to the `Get-Eventlog` cmdlet, but you cannot assign an alias to the `Get-Eventlog -LogName System` command. You must create a function that contains the command with parameters.

For more information, see about_Aliases.

Parameter aliases and shorthand names

PowerShell also provides ways to create shorthand names for parameters. Parameter aliases are defined using the `Alias` attribute when you declare the parameter. These can't be defined using the `*-Alias` cmdlets.

For more information, see the Alias attribute documentation.

In addition to parameter aliases, PowerShell lets you specify the parameter name using the fewest characters needed to uniquely identify the parameter. For example, the `Get-ChildItem` cmdlet has the **Recurse** and **ReadOnly** parameters. To uniquely identify the **Recurse** parameter you only need to provide `-rec`. If you combine that with the command alias, `Get-ChildItem -Recurse` can be shortened to `dir -rec`.

Don't use aliases in scripts

Aliases are a convenience feature to be used interactively in the shell. You should always use the full command and parameter names in your scripts.

- Aliases can be deleted or redefined in a profile script
- Any aliases you define may not be available to the user of your scripts

- Aliases make your code harder to read and maintain

PowerShell learning resources

Article • 09/20/2022

Additional resources for learning about PowerShell.

Learn modules

Microsoft Learn is a free, online training platform that provides interactive learning for Microsoft products and more. Our goal is to help you become proficient on our technologies and learn more skills with fun, guided, hands-on, interactive content that's specific to your role and goals.

- PowerShell modules

Blogs and community

In addition to the Help available at the command line, the following resources provide more information for users who want to run PowerShell.

- PowerShell Team Blog. The best resource for learning directly from the PowerShell product team.
- PowerShell Community Blog articles are scenario-driven. Written by the community, for the community.
- Have questions about using PowerShell? Connect with hundreds of other people who have similar interests in one of the many community forums listed on the PowerShell Community page.

Microsoft Virtual Academy

The Microsoft Virtual Academy videos have been moved to Channel 9.

- Getting Started with Microsoft PowerShell
- Advanced Tools & Scripting with PowerShell 3.0 Jump Start
- Testing PowerShell with Pester
- Getting Started with PowerShell Desired State Configuration (DSC)
- Advanced PowerShell DSC and Custom Resources
- SharePoint Automation with DSC

Resources for PowerShell Developers

The following resources provide resources to help developers create their own PowerShell modules, functions, cmdlets, providers, and hosting applications.

- PowerShell SDK
- PowerShell SDK API Browser

PowerShell Glossary

Article • 10/14/2022

This article lists common terms used to talk about PowerShell.

B

binary module

A PowerShell module whose root module is a binary (`.dll`) file. A binary module may or may not include a module manifest.

C

CommonParameter

A parameter that's added to all cmdlets, advanced functions, and workflows by the PowerShell engine.

D

dot source

In PowerShell, to start a command by typing a dot and a space before the command. Commands that are dot sourced run in the current scope instead of in a new scope. Any variables, aliases, functions, or drives that command creates are created in the current scope and are available to users when the command is completed.

dynamic module

A module that exists only in memory. The `New-Module` and `Import-PSSession` cmdlets create dynamic modules.

dynamic parameter

A parameter that's added to a PowerShell cmdlet, function, or script under certain conditions. Cmdlets, functions, providers, and scripts can add dynamic parameters.

F

format file

A PowerShell XML file that has the `.format.ps1xml` extension and that defines how PowerShell displays an object based on its .NET Framework type.

G

global session state

The session state that contains the data that's accessible to the user of a PowerShell session.

H

Host

The interface that the PowerShell engine uses to communicate with the user. For example, the host specifies how prompts are handled between PowerShell and the user.

host application

A program that loads the PowerShell engine into its process and uses it to perform operations.

I

input processing method

A method that a cmdlet can use to process the records it receives as input. The input processing methods include the `BeginProcessing` method, the `ProcessRecord` method, the `EndProcessing` method, and the `StopProcessing` method.

M

manifest module

A PowerShell module that has a manifest and whose **RootModule** key is empty.

member-access enumeration

A PowerShell convenience feature to automatically enumerate items in a collection when using the member-access operator (`.`).

module

A self-contained reusable unit that allows you to partition, organize, and abstract your PowerShell code. A module can contain cmdlets, providers, functions, variables, and other types of resources that can be imported as a single unit.

module manifest

A PowerShell data file (`.psd1`) that describes the contents of a module and that controls how a module is processed.

module session state

The session state that contains the public and private data of a PowerShell module. The private data in this session state isn't available to the user of a PowerShell session.

N

non-terminating error

An error that doesn't stop PowerShell from continuing to process the command.

noun

The word that follows the hyphen in a PowerShell cmdlet name. The noun describes the resources upon which the cmdlet acts.

P

parameter set

A group of parameters that can be used in the same command to perform a specific action.

pipe

In PowerShell, to send the results of the preceding command as input to the next command in the pipeline.

pipeline

A series of commands connected by pipeline operators (`|`). Each pipeline operator sends the results of the preceding command as input to the next command.

PowerShell cmdlet

A single command that participates in the pipeline semantics of PowerShell. This includes binary (C#) cmdlets, advanced script functions, CDXML, and Workflows.

PowerShell command

The elements in a pipeline that cause an action to be carried out. PowerShell commands are either typed at the keyboard or invoked programmatically.

PowerShell data file

A text file that has the `.psd1` file extension. PowerShell uses data files for various purposes such as storing module manifest data and storing translated strings for script internationalization.

PowerShell drive

A virtual drive that provides direct access to a data store. It can be defined by a PowerShell provider or created at the command line. Drives created at the command line are session-specific drives and are lost when the session is closed.

provider

A Microsoft .NET Framework-based program that makes the data in a specialized data store available in PowerShell so that you can view and manage it.

PSSession

A type of PowerShell session that's created, managed, and closed by the user.

R

root module

The module specified in the **RootModule** key in a module manifest.

runspace

In PowerShell, the operating environment in which each command in a pipeline is executed.

S

script block

In the PowerShell programming language, a collection of statements or expressions that can be used as a single unit. A script block can accept arguments and return values.

script file

A file that has the `.ps1` extension and contains a script written in the PowerShell language.

script module

A PowerShell module whose root module is a script module (`.psm1`) file. A script module may include a module manifest. The script defines the members that the script module exports.

shell

The command interpreter that's used to pass commands to the operating system.

switch parameter

A parameter that doesn't take an argument. The value of a switch parameter defaults to `$false`. When a switch parameter is used, its value becomes `$true`.

T

terminating error

An error that stops PowerShell from processing the command.

transaction

An atomic unit of work. The work in a transaction must be completed as a whole. If any part of the transaction fails, the entire transaction fails.

type file

A PowerShell XML file that has the `.types.ps1xml` extension and that extends the properties of Microsoft .NET Framework types in PowerShell.

V

verb

The word that precedes the hyphen in a PowerShell cmdlet name. The verb describes the action that the cmdlet performs.

W

Windows PowerShell ISE

The Integrated Scripting Environment (ISE) - A Windows PowerShell host application that enables you to run commands and to write, test, and debug scripts in a friendly, syntax-colored, Unicode-compliant environment.

Windows PowerShell snap-in

A resource that defines a set of cmdlets, providers, and Microsoft .NET Framework types that can be added to the Windows PowerShell environment.

Windows PowerShell Workflow

A workflow is a sequence of programmed, connected steps that perform long-running tasks or require the coordination of multiple steps across multiple devices or managed nodes. Windows PowerShell Workflow lets IT pros and developers author sequences of multi-device management activities, or single tasks within a workflow, as workflows. Windows PowerShell Workflow lets you adapt and run both PowerShell scripts and XAML files as workflows.

Overview of what's new in PowerShell

A collection of release notes and documentation about the new features available in new versions of PowerShell.

What's new in PowerShell 7

WHAT'S NEW

What's new in PowerShell 7.3 (preview)

What's new in PowerShell 7.2 (LTS)

What's new in PowerShell 7.1 (out of support)

What's new in PowerShell 7.0

PowerShell differences on non-Windows platforms

What's new in PowerShell 5.1

WHAT'S NEW

What's new in PowerShell 5.1

Differences between Windows PowerShell 5.1 and PowerShell 7

Migrating from Windows PowerShell 5.1 to PowerShell 7

History & Compatibility

WHAT'S NEW

Release history of modules and cmdlets

Module compatibility

What's new in previous versions of PowerShell

WHAT'S NEW

What's new in PowerShell 6.2

What's new in PowerShell 6.1

What's new in PowerShell 6.0

Breaking changes in PowerShell 6.0

Known issues in PowerShell 6.0

What's New in PowerShell 7.4 (preview)

Article • 06/30/2023

PowerShell 7.4-preview.4 includes the following features, updates, and breaking changes. PowerShell 7.4 is now built on .NET 8.0.0-preview.4.

For a complete list of changes, see the CHANGELOG in the GitHub repository.

Breaking changes

- Nano server docker images aren't available for this release
- Added the **ProgressAction** parameter to the Common Parameters
- Update some PowerShell APIs to throw **ArgumentException** instead of **ArgumentNullException** when the argument is an empty string (#19215) (Thanks @xtqqczze!)
- Remove code related to #requires -pssnapin (#19320)
- `Test-Json` now uses Json.Schema.Net instead of Newtonsoft.Json.Schema. With this change, `Test-Json` no longer supports the older Draft 4 schemas. (#18141) (Thanks @gregsdennis!)
- Output from `Test-Connection` now includes more detailed information about TCP connection tests

Installer updates

The Windows MSI package now provides an option to disable PowerShell telemetry during installation. For more information, see Install the msi package from the command line.

PowerShellGet v3

As of PowerShell 7.4-preview.4, **Microsoft.PowerShell.PSResourceGet** (also known as PowerShellGet v3) is now included in PowerShell 7.4. This module is installed side-by-side with **PowerShellGet** v2.2.5 and **PackageManagement** v1.4.8.1.

For more information, see the documentation for Microsoft.PowerShell.PSResourceGet.

Tab completion improvements

Many thanks to **@MartinGC94** and others for all the work on improving tab completion.

- Fix issue when completing the first command in a script with an empty array expression ([#18355)
- Fix positional argument completion (#17796)
- Prioritize the default parameter set when completing positional arguments (#18755)
- Improve pseudo binding for dynamic parameters (#18030)
- Improve type inference of hashtable keys (#17907)
- Fix type inference error for empty return statements (#18351)
- Improve type inference for Get-Random (#18972)
- Fix type inference for all scope variables (#18758)
- Improve enumeration of inferred types in pipeline (#17799)
- Add completion for values in comparisons when comparing Enums (#17654)
- Add property assignment completion for enums (#19178)
- Fix completion for PSCustomObject variable properties (#18682)
- Fix member completion in attribute argument (#17902)
- Exclude redundant parameter aliases from completion results (#19382)
- Fix class member completion for classes with base types (#19179)
- Add completion for Using keywords (#16514)
- Fix TabExpansion2 variable leak when completing variables (#18763)
- Enable completion of variables across ScriptBlock scopes (#19819)
- Fix completion of the foreach statement variable (#19814)
- Fix variable type inference precedence (#18691)
- Fix member completion for PowerShell Enum class (#19740)
- Fix parsing for array literals in index expressions in method calls (#19224)
- Improve path completion (#19489)
- Fix an indexing out of bound error in CompleteInput for empty script input (#19501)
- Improve variable completion performance (#19595)
- Improve Hashtable key completion for type constrained variable assignments, nested Hashtables and more (#17660)
- Infer external application output as strings (#19193)
- Update parameter completion for enums to exclude values not allowed by `ValidateRange` attributes (#17750) (Thanks @fflaten!).

Web cmdlet improvements

Many thanks to **@CarloToso** and others for all the work on improving web cmdlets.

- Webcmdlets add 308 to redirect codes and small cleanup (#18536)

- Complete the progress bar rendering in Invoke-WebRequest when downloading is complete or cancelled (#18130)
- Web cmdlets get **Retry-After** interval from response headers if the status code is 429 (#18717)
- Web cmdlets set default charset encoding to UTF8 (#18219)
- Preserve WebSession.MaximumRedirection from changes (#19190)
- WebCmdlets parse XML declaration to get encoding value, if present. (#18748)
- Fix using xml -Body in webcmdlets without an encoding (#19281)
- Adjust PUT method behavior to POST one for default content type in WebCmdlets (#19152)
- Take into account ContentType from Headers in WebCmdlets (#19227)
- Allow to preserve the original HTTP method by adding -**PreserveHttpMethodOnRedirect** to Web cmdlets (#18894)
- Webcmdlets display an error on https to http redirect (#18595)
- Add **AllowInsecureRedirect** switch to Web cmdlets (#18546)
- Improve verbose message in web cmdlets when content length is unknown (#19252)
- Build the relative URI for links from the response in `Invoke-WebRequest` (#19092)
- Fix redirection for `-CustomMethod POST` in WebCmdlets (#19111)
- Dispose previous response in Webcmdlets (#19117)
- Improve `Invoke-WebRequest` xml and json errors format (#18837)
- Add ValidateNotNullOrEmpty to **OutFile** and **InFile** parameters of WebCmdlets (#19044)
- HttpKnownHeaderNames update headers list (#18947)
- `Invoke-RestMethod -FollowRelLink` fix links containing commas (#18829)
- Fix bug with managing redirection and KeepAuthorization in Web cmdlets (#18902)
- Add **StatusCode** to **HttpResponseException** (#18842)
- Support HTTP persistent connections in Web Cmdlets (#19249) (Thanks @stevenebutler!)
- Small cleanup `Invoke-RestMethod` (#19490)
- Improve the verbose message of WebCmdlets to show correct HTTP version (#19616)
- Add **FileNameStar** to **MultipartFileContent** in WebCmdlets (#19467)
- Fix HTTP status from 409 to 429 for WebCmdlets to get retry interval from Retry-After header. (#19622) (Thanks @mkht!)
- Change `-TimeoutSec` to `-ConnectionTimeoutSeconds` and add `-OperationTimeoutSeconds` to web cmdlets (#19558) (Thanks @stevenebutler!)

  Other cmdlets

- Support Ctrl+c when connection hangs while reading data in WebCmdlets (#19330) (Thanks @stevenebutler!)

Other cmdlet improvements

- Add output types to Format commands (#18746) (Thanks @MartinGC94!)
- Add output type attributes for `Get-WinEvent` (#17948) (Thanks @MartinGC94!)
- Add **Path** and **LiteralPath** parameters to `Test-Json` cmdlet (#19042) (Thanks @ArmaanMcleod!)
- Add **NoHeader** parameter to `ConvertTo-Csv` and `Export-Csv` cmdlets (#19108) (Thanks @ArmaanMcleod!)
- Add **Confirm** and **WhatIf** parameters to `Stop-Transcript` (#18731) (Thanks @JohnLBevan!)
- Add **FuzzyMinimumDistance** parameter to `Get-Command` (#18261)
- Make **Encoding** parameter able to take `ANSI` encoding in PowerShell (#19298) (Thanks @CarloToso!)
- Add progress to `Copy-Item` (#18735)
- `Update-Help` now reports an error when using implicit culture on non-US systems. (#17780) (Thanks @dkaszews!)
- Do not require activity when creating a completed progress record (#18474) (Thanks @MartinGC94!)
- Disallow negative values for `Get-Content` cmdlet parameters `-Head` and `-Tail` (#19715) (Thanks @CarloToso!)
- Make `Update-Help` throw proper error when current culture is not associated with a language (#19765) (Thanks @josea!)
- Allow combining of `-Skip` and `-SkipLast` parameters in `Select-Object` cmdlet. (#18849) (Thanks @ArmaanMcleod!)
- Add `Get-SecureRandom` cmdlet (#19587)
- `Set-Clipboard -AsOSC52` for remote usage (#18222) (Thanks @dkaszews!)
- Speed up `Resolve-Path` relative path resolution (#19171) (Thanks @MartinGC94!)

Engine improvements

Updates to `$PSStyle`

- Adds **Dim** and **DimOff** properties (#18653)
- Added static methods to the **PSStyle** class that map foreground and background **ConsoleColor** values to ANSI escape sequences (#17938)

- New formatting properties added by experimental features
- Add support of respecting `$PSStyle.OutputRendering` on the remote host (#19601)

Other Engine updates

- Make PowerShell class not affiliate with Runspace when declaring the `NoRunspaceAffinity` attribute (#18138)
- Add the `ValidateNotNullOrWhiteSpace` attribute (#17191) (Thanks @wmentha!)
- Add `sqlcmd` to the list for legacy argument passing (#18559)
- Add the function `cd~` (#18308) (Thanks @GigaScratch!)
- Fix array type parsing in generic types (#19205) (Thanks @MartinGC94!)
- Fix wildcard globbing in root of device paths (#19442) (Thanks @MartinGC94!)
- Add a public API for getting locations of PSModulePath elements (#19422)
- Fix incorrect string to type conversion (#19560) (Thanks @MartinGC94!)
- Fix slow execution when many breakpoints are used (#14953) (Thanks @nohwnd!)
- Remove code related to `#requires -pssnapin` (#19320)

Experimental Features

PowerShell 7.4 introduces the following experimental features:

- PSCustomTableHeaderLabelDecoration - Add formatting differentiation for table header labels that aren't property members.
  - This feature also adds the **CustomTableHeaderLabel** property to `$PSStyle.Formatting` that allows you to change the formatting of the header label.
- PSFeedbackProvider - Replaces the hard-coded suggestion framework with an extensible feedback provider.
  - This feature also adds the **FeedbackProvider** and **FeedbackText** properties to `$PSStyle.Formatting` that allow you to change the formatting of feedback messages.
- PSModuleAutoLoadSkipOfflineFiles - Module discovery now skips over files that are marked by cloud providers as not fully on disk.
- PSCommandWithArgs - Add support for passing arguments to commands as a single string
- PSConstrainedAuditLogging - Add support for logging message about code that would not be allowed in Constrained language mode
- PSNativeCommandPreserveBytePipe - Preserves the byte-stream data when redirecting the **stdout** stream of a native command to a file or when piping byte-

stream data to the stdin stream of a native command.
- PSWindowsNativeCommandArgPassing - Changes the default value of `$PSNativeCommandArgumentPassing` on Windows

PowerShell 7.4 changed the following experimental features:

- PSNativeCommandErrorActionPreference - `$PSNativeCommandUseErrorActionPreference` is set to `$true` when feature is enabled (#18695)
- PSCommandNotFoundSuggestion - This feature now uses an extensible feedback provider rather than hard-coded suggestions (#18726)

For more information about the Experimental Features, see Using Experimental Features.

What's New in PowerShell 7.3

Article • 02/27/2023

PowerShell 7.3 is the next stable release, built on .NET 7.0.

PowerShell 7.3 includes the following features, updates, and breaking changes.

Breaking Changes and Improvements

- In this release, Windows APIs were updated or removed for compliance, which means that PowerShell 7.3 doesn't run on Windows 7. While Windows 7 is no longer supported, previous builds could run on Windows 7.
- PowerShell Direct for Hyper-V is only supported on Windows 10, version 1809 and higher.
- `Test-Connection` is broken due to an intentional breaking change in .NET 7. It's tracked by #17018
- Add `clean` block to script block as a peer to `begin`, `process`, and `end` to allow easy resource cleanup (#15177)
- Change default for `$PSStyle.OutputRendering` to **Host**
- Make `Out-String` and `Out-File` keep string input unchanged (#17455)
- Move the type data definition of System.Security.AccessControl.ObjectSecurity to the Microsoft.PowerShell.Security module (#16355) (Thanks @iSazonov!)
  - Before this change, a user doesn't need to explicitly import the **Microsoft.PowerShell.Security** module to use the code properties defined for an instance of **System.Security.AccessControl.ObjectSecurity**.
  - After this change, a user needs to explicitly import **Microsoft.PowerShell.Security** module in order to use those code properties and code methods.

Tab completion improvements

- PowerShell 7.3 includes PSReadline 2.2.6, which enables Predictive IntelliSense by default. For more information, see about_PSReadLine.
- Fix tab completion within the script block specified for the `ValidateScriptAttribute`. (#14550) (Thanks @MartinGC94!)
- Added tab completion for loop labels after `break`/`continue` (#16438) (Thanks @MartinGC94!)
- Improve Hashtable completion in multiple scenarios (#16498) (Thanks @MartinGC94!)

    - Parameter splatting
    - **Arguments** parameter for `Invoke-CimMethod`
    - **FilterHashtable** parameter for `Get-WinEvent`
    - **Property** parameter for the CIM cmdlets
    - Removes duplicates from member completion scenarios
- Support forward slashes in network share (UNC path) completion (#17111) (Thanks @sba923!)
- Improve member autocompletion (#16504) (Thanks @MartinGC94!)
- Prioritize ValidateSet completions over Enums for parameters (#15257) (Thanks @MartinGC94!)
- Add type inference support for generic methods with type parameters (#16951) (Thanks @MartinGC94!)
- Improve type inference and completions (#16963) (Thanks @MartinGC94!)
    - Allows methods to be shown in completion results for `ForEach-Object -MemberName`
    - Prevents completion on expressions that return void like `([void](""))`
    - Allows non-default Class constructors to show up when class completion is based on the AST
- Improve type inference for `$_` (#17716) (Thanks @MartinGC94!)
- Fix type inference for **ICollection** (#17752) (Thanks @MartinGC94!)
- Prevent braces from being removed when completing variables (#17751) (Thanks @MartinGC94!)
- Add completion for index expressions for dictionaries (#17619) (Thanks @MartinGC94!)
- Fix type completion for attribute tokens (#17484) (Thanks @MartinGC94!)
- Improve dynamic parameter tab completion (#17661) (Thanks @MartinGC94!)
- Avoid binding positional parameters when completing parameter in front of value (#17693) (Thanks @MartinGC94!)

Improved error handling

- Set `$?` correctly for command expression with redirections (#16046)
- Fix a casting error when using `$PSNativeCommandUseErrorActionPreference` (#15993)
- Make the native command error handling optionally honor `ErrorActionPreference` (#15897)
- Specify the executable path as `TargetObject` for non-zero exit code ErrorRecord (#16108) (Thanks @rkeithhill!)

Session and remoting improvements

- Add `-Options` to the PSRP over SSH commands to allow passing OpenSSH options directly (#12802) (Thanks @BrannenGH!)
- Add `-ConfigurationFile` parameter to `pwsh` to allow starting a new process with the session configuration defined in a `.pssc` file (#17447)
- Add support for using `New-PSSessionConfigurationFile` on non-Windows platforms (#17447)

Updated cmdlets

- Add `-HttpVersion` parameter to web cmdlets (#15853) (Thanks @hayhay27!)
- Add support to web cmdlets for open-ended input tags (#16193) (Thanks @farmerau!)
- Fix `ConvertTo-Json -Depth` to allow 100 at maximum (#16197) (Thanks @KevRitchie!) @rkeithhill!)
- Improve variable handling when calling `Invoke-Command` with the `$using:` expression (#16113) (Thanks @dwtaber!)
- Add `-StrictMode` to `Invoke-Command` to allow specifying strict mode when invoking command locally (#16545) (Thanks @Thomas-Yu!)
- Add `clean` block to script block as a peer to `begin`, `process`, and `end` to allow easy resource cleanup (#15177)
- Add `-Amended` switch to `Get-CimClass` cmdlet (#17477) (Thanks @iSazonov)
- Changed `ConvertFrom-Json -AsHashtable` to use ordered hashtable (#17405)
- Removed ANSI escape sequences in strings before sending to `Out-GridView` (#17664)
- Added the **Milliseconds** parameter to `New-TimeSpan` (#17621) (Thanks @NoMoreFood!)
- Show optional parameters when displaying method definitions and overloads (#13799) (Thanks @eugenesmlv!)
- Allow commands to still be executed even if the current working directory no longer exists (#17579)
- Add support for HTTPS with `Set-AuthenticodeSignature -TimeStampServer` (#16134) (Thanks @Ryan-Hutchison-USAF!)
- Render decimal numbers in a table using current culture (#17650)
- Add type accelerator ordered for **OrderedDictionary** (#17804) (Thanks @fflaten!)
- Add `find.exe` to legacy argument binding behavior for Windows (#17715)
- Add `-noprofileloadtime` switch to pwsh (#17535) (Thanks @rkeithhill!)

For a complete list of changes, see the Change Log in the GitHub repository.

Experimental Features

In PowerShell 7.3, following experimental features became mainstream:

- `PSAnsiRenderingFileInfo` - This feature adds the `$PSStyle.FileInfo` member and enables coloring of specific file types.
- `PSCleanBlock` - Adds `clean` block to script block as a peer to `begin`, `process`, and `end` to allow easy resource cleanup.
- `PSAMSIMethodInvocationLogging` - Extends the data sent to AMSI for inspection to include all invocations of .NET method members.
- PSNativeCommandArgumentPassing - PowerShell now uses the **ArgumentList** property of the **StartProcessInfo** object rather than the old mechanism of reconstructing a string when invoking a native executable.

  PowerShell 7.3.1 adds `sqlcmd.exe` to the list of native commands in Windows that use the `Legacy` style of argument passing.
- `PSExec` - Adds the new `Switch-Process` cmdlet (alias `exec`) to provide `exec` compatibility for non-Windows systems.

  PowerShell 7.3.1 changed the `exec` alias to a function that wraps `Switch-Process`. The function allows you to pass parameters to the native command that might have erroneously bound to the **WithCommand** parameter.

PowerShell 7.3 introduces the following experimental features:

- PSNativeCommandErrorActionPreference - Adds the `$PSNativeCommandUseErrorActionPreference` variable to enable errors produced by native commands to be PowerShell errors.

PowerShell 7.3 removed the following experimental features:

- `PSNativePSPathResolution` experimental feature is no longer supported.
- `PSStrictModeAssignment` experimental feature is no longer supported.

For more information about the Experimental Features, see Using Experimental Features.

What's New in PowerShell 7.2

Article • 01/23/2023

PowerShell 7.2 is the next Long Term Servicing (LTS) release is built on .NET 6.0.

PowerShell 7.2 includes the following features, updates, and breaking changes.

- New universal installer packages for most supported Linux distributions
- Microsoft Update support on Windows
- 2 new experimental features
  - Improved native command argument passing support
  - ANSI FileInfo color support
- Improved Tab Completions
- PSReadLine 2.1 with Predictive IntelliSense
- 7 experimental features promoted to mainstream and 1 removed
- Separating DSC from PowerShell 7 to enable future improvements
- Several breaking changes to improve usability

For a complete list of changes, see the Change Log in the GitHub repository.

Installation updates

Check the installation instructions for your preferred operating system:

- Windows
- macOS
- Linux

Additionally, PowerShell 7.2 supports ARM64 versions of Windows and macOS and ARM32 and ARM64 versions of Debian and Ubuntu.

For up-to-date information about supported operating systems and support lifecycle, see the PowerShell Support Lifecycle.

New universal install packages for Linux distributions

Previously, we created separate installer packages for each supported version of CentOS, RHEL, Debian, and Ubuntu. The universal installer package combines eight different packages into one, making installation on Linux simpler. The universal package installs the necessary dependencies for the target distribution and creates the platform-specific changes to make PowerShell work.

Microsoft Update support for Windows

PowerShell 7.2 add support for Microsoft Update. When you enable this feature, you'll get the latest PowerShell 7 updates in your traditional Windows Update (WU) management flow, whether that's with Windows Update for Business, WSUS, SCCM, or the interactive WU dialog in Settings.

The PowerShell 7.2 MSI package includes following command-line options:

- `USE_MU` - This property has two possible values:
  - `1` (default) - Opts into updating through Microsoft Update or WSUS
  - `0` - don't opt into updating through Microsoft Update or WSUS
- `ENABLE_MU`
  - `1` (default) - Opts into using Microsoft Update the Automatic Updates or Windows Update
  - `0` - don't opt into using Microsoft Update the Automatic Updates or Windows Update

Experimental Features

The following experimental features are now mainstream features in this release:

- `Microsoft.PowerShell.Utility.PSImportPSDataFileSkipLimitCheck` - see Import-PowerShellDataFile
- `Microsoft.PowerShell.Utility.PSManageBreakpointsInRunspace`
- `PSAnsiRendering` - see about_ANSI_Terminals
- `PSAnsiProgress` - see about_ANSI_Terminals
- `PSCultureInvariantReplaceOperator`
- `PSNotApplyErrorActionToStderr`
- `PSUnixFileStat`

The following experimental feature was added in this release:

- PSNativeCommandArgumentPassing - When this experimental feature is enabled PowerShell uses the **ArgumentList** property of the **StartProcessInfo** object rather than our current mechanism of reconstructing a string when invoking a native executable. This feature adds a new automatic variable `$PSNativeCommandArgumentPassing` that allows you to select the behavior at runtime.

- PSAnsiRenderingFileInfo - Allow ANSI color customization of file information.

- PSLoadAssemblyFromNativeCode - Exposes an API to allow assembly loading from native code.

For more information about the Experimental Features, see Using Experimental Features.

Improved Tab Completions

PowerShell 7.2 includes several improvements to Tab Completion. These changes include bugfixes and improve usability.

- Fix tab completion for unlocalized about* topics (#15265) (Thanks @MartinGC94)
- Fix splatting being treated as positional parameter in completions (#14623) (Thanks @MartinGC94)
- Add completions for comment-based help keywords (#15337) (Thanks @MartinGC94)
- Add completion for Requires statements (#14596) (Thanks @MartinGC94)
- Added tab completion for View parameter of Format-* cmdlets (#14513) (Thanks @iSazonov)

PSReadLine 2.1 Predictive IntelliSense

PSReadLine 2.1 introduced `CommandPrediction` APIs that establish a framework for providing predictions for command-line completion. The API enables users to discover, edit, and execute full commands based on matching predictions from the user's history.

Predictive IntelliSense is disabled by default. To enable predictions, run the following command:

PowerShell

```
Set-PSReadLineOption -PredictionSource History
```

Separating DSC from PowerShell 7 to enable future improvements

The PSDesiredStateConfiguration module was removed from the PowerShell 7.2 package and is now published to the PowerShell Gallery. This allows the PSDesiredStateConfiguration module to be developed independently of PowerShell and users can mix and match versions of PowerShell and PSDesiredStateConfiguration for

their environment. To install PSDesiredStateConfiguration 2.0.5 from the PowerShell Gallery:

```PowerShell
Install-Module -Name PSDesiredStateConfiguration -Repository PSGallery -
MaximumVersion 2.99
```

> **ⓘ Important**
>
> Be sure to include the parameter MaximumVersion or you could install version 3 (or higher) of PSDesireStateConfiguration that contains significant differences.

Engine updates

- Add `LoadAssemblyFromNativeMemory` function to load assemblies in memory from a native PowerShell host by awakecoding · Pull Request #14652

Breaking Changes and Improvements

- The PSDesiredStateConfiguration was removed from the PowerShell 7.2 package
- Make PowerShell Linux deb and RPM packages universal (#15109)
- Experimental feature `PSNativeCommandArgumentPassing`: Use ArgumentList for native executable invocation (#14692)
- Ensure `-PipelineVariable` is set for all output from script cmdlets (#12766)
- Emit warning if `ConvertTo-Json` exceeds -Depth value (#13692)
- Remove alias D of -Directory switch CL-General #15171
- Improve detection of mutable value types (#12495)
- Restrict `New-Object` in **NoLanguage** mode under lock down (#14140)
- Enforce AppLocker Deny configuration before Execution Policy Bypass configuration (#15035)
- Change `FileSystemInfo.Target` from a **CodeProperty** to an **AliasProperty** that points to `FileSystemInfo.LinkTarget` (#16165)

Migrating from Windows PowerShell 5.1 to PowerShell 7

Article • 03/02/2023

Designed for cloud, on-premises, and hybrid environments, PowerShell 7 is packed with enhancements and new features.

- Installs and runs side-by-side with Windows PowerShell
- Improved compatibility with existing Windows PowerShell modules
- New language features, like ternary operators and `ForEach-Object -Parallel`
- Improved performance
- SSH-based remoting
- Cross-platform interoperability
- Support for Docker containers

PowerShell 7 works side-by-side with Windows PowerShell letting you easily test and compare between editions before deployment. Migration is simple, quick, and safe.

PowerShell 7 is supported on the following Windows operating systems:

- Windows 8.1, 10, and 11
- Windows Server 2012, 2012 R2, 2016, 2019, and 2022

PowerShell 7 also runs on macOS and several Linux distributions. For a list of supported operating systems and information about the support lifecycle, see the PowerShell Support Lifecycle.

Installing PowerShell 7

For flexibility and to support the needs of IT, DevOps engineers, and developers, there are several options available to install PowerShell 7. In most cases, the installation options can be reduced to the following methods:

- Deploy PowerShell using the MSI package
- Deploy PowerShell using the ZIP package

> **Note**
>
> The MSI package can be deployed and updated with management products such as **System Center Configuration Manager (SCCM)**. Download the packages from **GitHub Release page**.

Deploying the MSI package requires Administrator permission. The ZIP package can be deployed by any user. The ZIP package is the easiest way to install PowerShell 7 for testing, before committing to a full installation.

You may also install PowerShell 7 via the Windows Store or `winget`. For more information about both of these methods, see the detailed instructions in Installing PowerShell on Windows.

Using PowerShell 7 side-by-side with Windows PowerShell 5.1

PowerShell 7 is designed to coexist with Windows PowerShell 5.1. The following features ensure that your investment in PowerShell is protected and your migration to PowerShell 7 is simple.

- Separate installation path and executable name
- Separate PSModulePath
- Separate profiles for each version
- Improved module compatibility
- New remoting endpoints
- Group policy support
- Separate Event logs

Separate installation path and executable name

PowerShell 7 installs to a new directory, enabling side-by-side execution with Windows PowerShell 5.1.

Install locations by version:

- Windows PowerShell 5.1: `$env:WINDIR\System32\WindowsPowerShell\v1.0`
- PowerShell 6.x: `$env:ProgramFiles\PowerShell\6`
- PowerShell 7: `$env:ProgramFiles\PowerShell\7`

The new location is added to your PATH allowing you to run both Windows PowerShell 5.1 and PowerShell 7. If you're migrating from PowerShell 6.x to PowerShell 7, PowerShell 6 is removed and the PATH replaced.

In Windows PowerShell, the PowerShell executable is named `powershell.exe`. In version 6 and above, the executable is named `pwsh.exe`. The new name makes it easy to support side-by-side execution of both versions.

Separate PSModulePath

By default, Windows PowerShell and PowerShell 7 store modules in different locations. PowerShell 7 combines those locations in the `$Env:PSModulePath` environment variable. When importing a module by name, PowerShell checks the location specified by `$Env:PSModulePath`. This allows PowerShell 7 to load both Core and Desktop modules.

Install Scope	Windows PowerShell 5.1	PowerShell 7.0
PowerShell modules	`$env:WINDIR\system32\WindowsPowerShell\v1.0\Modules`	`$PSHOME\Modules`
User installed AllUsers scope	`$env:ProgramFiles\WindowsPowerShell\Modules`	`$env:ProgramFiles\PowerShell\Modules`
User installed CurrentUser scope	`$HOME\Documents\WindowsPowerShell\Modules`	`$HOME\Documents\PowerShell\Modules`

The following examples show the default values of `$Env:PSModulePath` for each version.

- For Windows PowerShell 5.1:

  PowerShell

  ```powershell
  $Env:PSModulePath -split (';')
  ```

  Output

  ```
  C:\Users\<user>\Documents\WindowsPowerShell\Modules
  C:\Program Files\WindowsPowerShell\Modules
  C:\WINDOWS\System32\WindowsPowerShell\v1.0\Modules
  ```

- For PowerShell 7:

  PowerShell

  ```powershell
  $Env:PSModulePath -split (';')
  ```

  Output

  ```
  C:\Users\<user>\Documents\PowerShell\Modules
  C:\Program Files\PowerShell\Modules
  C:\Program Files\PowerShell\7\Modules
  C:\Program Files\WindowsPowerShell\Modules
  C:\WINDOWS\System32\WindowsPowerShell\v1.0\Modules
  ```

Notice that PowerShell 7 includes the Windows PowerShell paths and the PowerShell 7 paths to provide autoloading of modules.

> **Note**
>
> Additional paths may exist if you have changed the PSModulePath environment variable or installed custom modules or applications.

For more information, see about_PSModulePath.

For more information about Modules, see about_Modules.

Separate profiles

A PowerShell profile is a script that executes when PowerShell starts. This script customizes your environment by adding commands, aliases, functions, variables, modules, and PowerShell drives. The profile script makes these customizations available in every session without having to manually recreate them.

The path to the location of the profile has changed in PowerShell 7.

- In Windows PowerShell 5.1, the location of the profile is `$HOME\Documents\WindowsPowerShell`.
- In PowerShell 7, the location of the profile is `$HOME\Documents\PowerShell`.

The profile filenames have also changed:

PowerShell

```
PS> $PROFILE | Select-Object *Host* | Format-List

AllUsersAllHosts       : C:\Program Files\PowerShell\7\profile.ps1
AllUsersCurrentHost    : C:\Program
Files\PowerShell\7\Microsoft.PowerShell_profile.ps1
CurrentUserAllHosts    : C:\Users\<user>\Documents\PowerShell\profile.ps1
CurrentUserCurrentHost : C:\Users\
<user>\Documents\PowerShell\Microsoft.PowerShell_profile.ps1
```

For more information about_Profiles.

PowerShell 7 compatibility with Windows PowerShell 5.1 modules

Most of the modules you use in Windows PowerShell 5.1 already work with PowerShell 7, including Azure PowerShell and Active Directory. We're continuing to work with other teams

to add native PowerShell 7 support for more modules including Microsoft Graph, Office 365, and others. For the current list of supported modules, see PowerShell 7 module compatibility.

> ⓘ Note
>
> On Windows, we've also added a **UseWindowsPowerShell** switch to `Import-Module` to ease the transition to PowerShell 7 for those using incompatible modules. For more information on this functionality, see **about_Windows_PowerShell_Compatibility**.

PowerShell Remoting

PowerShell remoting lets you run any PowerShell command on one or more remote computers. You can establish persistent connections, start interactive sessions, and run scripts on remote computers.

WS-Management remoting

Windows PowerShell 5.1 and below use the WS-Management (WSMAN) protocol for connection negotiation and data transport. Windows Remote Management (WinRM) uses the WSMAN protocol. If WinRM has been enabled, PowerShell 7 uses the existing Windows PowerShell 5.1 endpoint named `Microsoft.PowerShell` for remoting connections. To update PowerShell 7 to include its own endpoint, run the `Enable-PSRemoting` cmdlet. For information about connecting to specific endpoints, see WS-Management Remoting in PowerShell

To use Windows PowerShell remoting, the remote computer must be configured for remote management. For more information, including instructions, see About Remote Requirements.

For more information about working with remoting, see About Remote

SSH-based remoting

SSH-based remoting was added in PowerShell 6.x to support other operating systems that can't use Windows native components like **WinRM**. SSH remoting creates a PowerShell host process on the target computer as an SSH subsystem. For details and examples on setting up SSH-based remoting on Windows or Linux, see: PowerShell remoting over SSH.

> ⓘ Note
>
> The PowerShell Gallery (PSGallery) contains a module and cmdlet that automatically configures SSH-based remoting. Install the `Microsoft.PowerShell.RemotingTools` module from the **PSGallery** and run the `Enable-SSH` cmdlet.

The `New-PSSession`, `Enter-PSSession`, and `Invoke-Command` cmdlets have new parameter sets to support SSH connections.

```
PowerShell

[-HostName <string>]  [-UserName <string>]  [-KeyFilePath <string>]
```

To create a remote session, specify the target computer with the **HostName** parameter and provide the user name with **UserName**. When running the cmdlets interactively, you're prompted for a password.

```
PowerShell

Enter-PSSession -HostName <Computer> -UserName <Username>
```

Alternatively, when using the **HostName** parameter, provide the username information followed by the at sign (`@`), followed by the computer name.

```
PowerShell

Enter-PSSession -HostName <Username>@<Computer>
```

You may set up SSH key authentication using a private key file with the **KeyFilePath** parameter. For more information, see OpenSSH Key Management.

Group Policy supported

PowerShell includes Group Policy settings to help you define consistent option values for servers in an enterprise environment. These settings include:

- Console session configuration: Sets a configuration endpoint in which PowerShell is run.
- Turn on Module Logging: Sets the LogPipelineExecutionDetails property of modules.
- Turn on PowerShell Script Block Logging: Enables detailed logging of all PowerShell scripts.
- Turn on Script Execution: Sets the PowerShell execution policy.
- Turn on PowerShell Transcription: enables capturing of input and output of PowerShell commands into text-based transcripts.
- Set the default source path for Update-Help: Sets the source for Updatable Help to a directory, not the Internet.

For more information, see about_Group_Policy_Settings.

PowerShell 7 includes Group Policy templates and an installation script in `$PSHOME`.

Group Policy tools use administrative template files (`.admx`, `.adml`) to populate policy settings in the user interface. This allows administrators to manage registry-based policy settings. The `InstallPSCorePolicyDefinitions.ps1` script installs PowerShell Administrative Templates on the local machine.

PowerShell

```powershell
Get-ChildItem -Path $PSHOME -Filter *Core*Policy*
```

Output

```
    Directory: C:\Program Files\PowerShell\7

Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a---           2/27/2020 12:38 AM          15861
InstallPSCorePolicyDefinitions.ps1
-a---           2/27/2020 12:28 AM           9675
PowerShellCoreExecutionPolicy.adml
-a---           2/27/2020 12:28 AM           6201
PowerShellCoreExecutionPolicy.admx
```

Separate Event Logs

Windows PowerShell and PowerShell 7 log events to separate event logs. Use the following command to get a list of the PowerShell logs.

PowerShell

```powershell
Get-WinEvent -ListLog *PowerShell*
```

For more information, see about_Logging_Windows.

Improved editing experience with Visual Studio Code

Visual Studio Code (VSCode) with the PowerShell Extension is the supported scripting environment for PowerShell 7. The Windows PowerShell Integrated Scripting Environment (ISE) only supports Windows PowerShell.

The updated PowerShell extension includes:

- New ISE compatibility mode
- PSReadLine in the Integrated Console, including syntax highlighting, multi-line editing, and back search

- Stability and performance improvements
- New CodeLens integration
- Improved path autocompletion

To make the transition to Visual Studio Code easier, use the **Enable ISE Mode** function available in the **Command Palette**. This function switches VSCode into an ISE-style layout. The ISE-style layout gives you all the new features and capabilities of PowerShell in a familiar user experience.

To switch to the new ISE layout, press `Ctrl`+`Shift`+`P` to open the **Command Palette**, type `PowerShell` and select **PowerShell: Enable ISE Mode**.

To set the layout to the original layout, open the **Command Palette**, select **PowerShell: Disable ISE Mode (restore to defaults)**.

For details about customizing the VSCode layout to ISE, see How to Replicate the ISE Experience in Visual Studio Code

> **Note**
>
> There are no plans to update the ISE with new features. In the latest versions of Windows 10 or Windows Server 2019 and higher, the ISE is now a user-uninstallable feature. There are no plans to permanently remove the ISE. The PowerShell Team and its partners are focused on improving the scripting experience in the PowerShell extension for Visual Studio Code.

Next Steps

Armed with the knowledge to effectively migrate, install PowerShell 7 now!

Differences between Windows PowerShell 5.1 and PowerShell 7.x

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Windows PowerShell 5.1 is built on top of the .NET Framework v4.5. With the release of PowerShell 6.0, PowerShell became an open source project built on .NET Core 2.0. Moving from the .NET Framework to .NET Core allowed PowerShell to become a cross-platform solution. PowerShell runs on Windows, macOS, and Linux.

There are few differences in the PowerShell language between Windows PowerShell and PowerShell. The most notable differences are in the availability and behavior of PowerShell cmdlets between Windows and non-Windows platforms and the changes that stem from the differences between the .NET Framework and .NET Core.

This article summarizes the significant differences and breaking changes between Windows PowerShell and the current version of PowerShell. This summary does not include new features or cmdlets that have been added. Nor does this article discuss what changed between versions. The goal of this article is to present the current state of PowerShell and how that is different from Windows PowerShell. For a detailed discussion of changes between versions and the addition of new features, see the **What's New** articles for each version.

- What's new in PowerShell 7.4
- What's new in PowerShell 7.3
- What's new in PowerShell 7.2
- What's new in PowerShell 7.1
- What's new in PowerShell 7.0
- What's new in PowerShell 6.x

.NET Framework vs .NET Core

PowerShell on Linux and macOS uses .NET core, which is a subset of the full .NET Framework on Microsoft Windows. This is significant because PowerShell provides direct access to the underlying framework types and methods. As a result, scripts that run on Windows may not run on non-Windows platforms because of the differences in the frameworks. For more information about changes in .NET Core, see Breaking changes for migration from .NET Framework to .NET Core.

Each new release of PowerShell is built on a newer version of .NET. There can be breaking changes in .NET that affect PowerShell.

- PowerShell 7.3 - Built on .NET 7.0
- PowerShell 7.2 (LTS-current) - Built on .NET 6.0 (LTS-current)
- PowerShell 7.1 - Built on .NET 5.0
- PowerShell 7.0 (LTS) - Built on .NET Core 3.1 (LTS)
- PowerShell 6.2 - Built on .NET Core 2.1
- PowerShell 6.1 - Built on .NET Core 2.1
- PowerShell 6.0 - Built on .NET Core 2.0

With the advent of .NET Standard 2.0, PowerShell can load many traditional Windows PowerShell modules without modification. Additionally, PowerShell 7 includes a Windows PowerShell Compatibility feature that allows you to use Windows PowerShell modules that still require the full framework.

For more information see:

- about_Windows_PowerShell_Compatibility
- PowerShell 7 module compatibility

Modules no longer shipped with PowerShell

For various compatibility reasons, the following modules are no longer included in PowerShell.

- ISE
- Microsoft.PowerShell.LocalAccounts
- Microsoft.PowerShell.ODataUtils
- Microsoft.PowerShell.Operation.Validation
- PSScheduledJob
- PSWorkflow
- PSWorkflowUtility

PowerShell Workflow

PowerShell Workflow is a feature in Windows PowerShell that builds on top of Windows Workflow Foundation (WF) that enables the creation of robust runbooks for long-running or parallelized tasks.

Due to the lack of support for Windows Workflow Foundation in .NET Core, we removed PowerShell Workflow from PowerShell.

In the future, we would like to enable native parallelism/concurrency in the PowerShell language without the need for PowerShell Workflow.

If there is a need to use checkpoints to resume a script after the OS restarts, we recommend using Task Scheduler to run a script on OS startup, but the script would need to maintain its own state (like persisting it to a file).

Cmdlets removed from PowerShell

For the modules that are included in PowerShell, the following cmdlets were removed from PowerShell for various compatibility reasons or the use of unsupported APIs.

CimCmdlets

- `Export-BinaryMiLog`

Microsoft.PowerShell.Core

- `Add-PSSnapin`
- `Export-Console`
- `Get-PSSnapin`
- `Remove-PSSnapin`
- `Resume-Job`
- `Suspend-Job`

Microsoft.PowerShell.Diagnostics

- `Export-Counter`
- `Import-Counter`

Microsoft.PowerShell.Management

- `Add-Computer`
- `Checkpoint-Computer`
- `Clear-EventLog`
- `Complete-Transaction`
- `Disable-ComputerRestore`
- `Enable-ComputerRestore`
- `Get-ComputerRestorePoint`
- `Get-ControlPanelItem`
- `Get-EventLog`
- `Get-Transaction`
- `Get-WmiObject`
- `Invoke-WmiMethod`

- `Limit-EventLog`
- `New-EventLog`
- `New-WebServiceProxy`
- `Register-WmiEvent`
- `Remove-Computer`
- `Remove-EventLog`
- `Remove-WmiObject`
- `Reset-ComputerMachinePassword`
- `Restore-Computer`
- `Set-WmiInstance`
- `Show-ControlPanelItem`
- `Show-EventLog`
- `Start-Transaction`
- `Test-ComputerSecureChannel`
- `Undo-Transaction`
- `Use-Transaction`
- `Write-EventLog`

Microsoft.PowerShell.Utility

- `Convert-String`
- `ConvertFrom-String`

PSDesiredStateConfiguration

- `Disable-DscDebug`
- `Enable-DscDebug`
- `Get-DscConfiguration`
- `Get-DscConfigurationStatus`
- `Get-DscLocalConfigurationManager`
- `Publish-DscConfiguration`
- `Remove-DscConfigurationDocument`
- `Restore-DscConfiguration`
- `Set-DscLocalConfigurationManager`
- `Start-DscConfiguration`
- `Stop-DscConfiguration`
- `Test-DscConfiguration`
- `Update-DscConfiguration`

WMI v1 cmdlets

The following WMI v1 cmdlets were removed from PowerShell:

- `Register-WmiEvent`
- `Set-WmiInstance`
- `Invoke-WmiMethod`
- `Get-WmiObject`
- `Remove-WmiObject`

The CimCmdlets module (aka WMI v2) cmdlets perform the same function and provide new functionality and a redesigned syntax.

`New-WebServiceProxy` cmdlet removed

.NET Core does not support the Windows Communication Framework, which provide services for using the SOAP protocol. This cmdlet was removed because it requires SOAP.

`*-Transaction` cmdlets removed

These cmdlets had very limited usage. The decision was made to discontinue support for them.

- `Complete-Transaction`
- `Get-Transaction`
- `Start-Transaction`
- `Undo-Transaction`
- `Use-Transaction`

`*-EventLog` cmdlets

Due to the use of unsupported APIs, the `*-EventLog` cmdlets have been removed from PowerShell. `Get-WinEvent` and `New-WinEvent` are available to get and create events on Windows.

Cmdlets that use the Windows Presentation Framework (WPF)

.NET Core 3.1 added support for WPF, so the release of PowerShell 7.0 restored the following Windows-specific features:

- The `Show-Command` cmdlet
- The `Out-GridView` cmdlet
- The **ShowWindow** parameter of `Get-Help`

PowerShell Desired State Configuration (DSC) changes

`Invoke-DscResource` was restored as an experimental feature in PowerShell 7.0.

Beginning with PowerShell 7.2, the PSDesiredStateConfiguration module has been removed from PowerShell and has been published to the PowerShell Gallery. For more information, see the announcement in the PowerShell Team blog.

PowerShell executable changes

Renamed `powershell.exe` to `pwsh.exe`

The binary name for PowerShell has been changed from `powershell(.exe)` to `pwsh(.exe)`. This change provides a deterministic way for users to run PowerShell on machines and support side-by-side installations of Windows PowerShell and PowerShell.

Additional changes to `pwsh(.exe)` from `powershell.exe`:

- Changed the first positional parameter from `-Command` to `-File`. This change fixes the usage of `#!` (aka as a shebang) in PowerShell scripts that are being executed from non-PowerShell shells on non-Windows platforms. It also means that you can run commands like `pwsh foo.ps1` or `pwsh fooScript` without specifying `-File`. However, this change requires that you explicitly specify `-c` or `-Command` when trying to run commands like `pwsh.exe -Command Get-Command`.
- `pwsh` accepts the `-i` (or `-Interactive`) switch to indicate an interactive shell. This allows PowerShell to be used as a default shell on Unix platforms.
- Removed parameters `-ImportSystemModules` and `-PSConsoleFile` from `pwsh.exe`.
- Changed `pwsh -version` and built-in help for `pwsh.exe` to align with other native tools.
- Invalid argument error messages for `-File` and `-Command` and exit codes consistent with Unix standards
- Added `-WindowStyle` parameter on Windows. Similarly, package-based installations updates on non-Windows platforms are in-place updates.

The shortened name is also consistent with naming of shells on non-Windows platforms.

Support running a PowerShell script with bool parameter

Previously, using `pwsh.exe` to execute a PowerShell script using `-File` provided no way to pass `$true`/`$false` as parameter values. Support for `$true`/`$false` as parsed values to parameters was added. Switch values are also supported.

Improved backwards compatibility with Windows PowerShell

For Windows, a new switch parameter **UseWindowsPowerShell** is added to `Import-Module`. This switch creates a proxy module in PowerShell 7 that uses a local Windows PowerShell process to implicitly run any cmdlets contained in that module. For more information, see Import-Module.

For more information on which Microsoft modules work with PowerShell 7.0, see the Module Compatibility Table.

Microsoft Update support for Windows

PowerShell 7.2 added support for Microsoft Update. When you enable this feature, you'll get the latest PowerShell 7 updates in your traditional Windows Update (WU) management flow, whether that's with Windows Update for Business, WSUS, SCCM, or the interactive WU dialog in Settings.

The PowerShell 7.2 MSI package includes following command-line options:

- `USE_MU` - This property has two possible values:
  - `1` (default) - Opts into updating through Microsoft Update or WSUS
  - `0` - Do not opt into updating through Microsoft Update or WSUS
- `ENABLE_MU`
  - `1` (default) - Opts into using Microsoft Update the Automatic Updates or Windows Update
  - `0` - Do not opt into using Microsoft Update the Automatic Updates or Windows Update

Engine changes

Support PowerShell as a default Unix shell

On Unix, it is a convention for shells to accept `-i` for an interactive shell and many tools expect this behavior (`script` for example, and when setting PowerShell as the default shell) and calls the shell with the `-i` switch. This change is breaking in that `-i` previously could be used as short hand to match `-inputformat`, which now needs to be `-in`.

Custom snap-ins

PowerShell snap-ins are a predecessor to PowerShell modules that do not have widespread adoption in the PowerShell community.

Due to the complexity of supporting snap-ins and their lack of usage in the community, we no longer support custom snap-ins in PowerShell.

Experimental feature flags

PowerShell 6.2 enabled support for Experimental Features. This allows PowerShell developers to deliver new features and get feedback before the design is complete. This way we avoid making breaking changes as the design evolves.

Use `Get-ExperimentalFeature` to get a list of available experimental features. You can enable or disable these features with `Enable-ExperimentalFeature` and `Disable-ExperimentalFeature`.

Load assembly from module base path before trying to load from the GAC

Previously, when a binary module has the module assembly in GAC, we loaded the assembly from GAC before trying to load it from module base path.

Skip null-element check for collections with a value-type element type

For the `Mandatory` parameter and `ValidateNotNull` and `ValidateNotNullOrEmpty` attributes, skip the null-element check if the collection's element type is value type.

Preserve `$?` for ParenExpression, SubExpression and ArrayExpression

This PR alters the way we compile subpipelines `(...)`, subexpressions `$(...)` and array expressions `@()` so that `$?` is not automatically **true**. Instead the value of `$?` depends on the result of the pipeline or statements executed.

Fix `$?` to not be `$false` when native command writes to `stderr`

`$?` is not set to `$false` when native command writes to `stderr`. It is common for native commands to write to `stderr` without intending to indicate a failure. `$?` is set to `$false` only when the native command has a non-zero exit code.

Make `$ErrorActionPreference` not affect `stderr` output of native commands

It is common for native commands to write to `stderr` without intending to indicate a failure. With this change, `stderr` output is still captured in **ErrorRecord** objects, but the runtime no longer applies `$ErrorActionPreference` if the **ErrorRecord** comes from a native command.

Change `$OutputEncoding` to use `UTF-8 NoBOM` encoding rather than ASCII

The previous encoding, ASCII (7-bit), would result in incorrect alteration of the output in some cases. Making `UTF-8 NoBOM` the default preserves Unicode output with an encoding supported by most tools and operating systems.

Unify cmdlets with parameter `-Encoding` to be of type `System.Text.Encoding`

The `-Encoding` value `Byte` has been removed from the filesystem provider cmdlets. A new parameter, `-AsByteStream`, is now used to specify that a byte stream is required as input or that the output is a stream of bytes.

Change `New-ModuleManifest` encoding to `UTF8NoBOM` on non-Windows platforms

Previously, `New-ModuleManifest` creates `psd1` manifests in UTF-16 with BOM, creating a problem for Linux tools. This breaking change changes the encoding of `New-ModuleManifest` to be UTF (no BOM) in non-Windows platforms.

Remove `AllScope` from most default aliases

To speed up scope creation, `AllScope` was removed from most default aliases. `AllScope` was left for a few frequently used aliases where the lookup was faster.

`-Verbose` and `-Debug` no longer overrides `$ErrorActionPreference`

Previously, if `-Verbose` or `-Debug` were specified, it overrode the behavior of `$ErrorActionPreference`. With this change, `-Verbose` and `-Debug` no longer affect the behavior of `$ErrorActionPreference`.

Also, the `-Debug` parameter sets `$DebugPreference` to **Continue** instead of **Inquire**.

Make `$PSCulture` consistently reflect in-session culture changes

In Windows PowerShell, the current culture value is cached, which can allow the value to get out of sync with the culture is change after session-startup. This caching behavior is fixed in PowerShell core.

Allow explicitly specified named parameter to supersede the same one from hashtable splatting

With this change, the named parameters from splatting are moved to the end of the parameter list so that they are bound after all explicitly specified named parameters are bound. Parameter binding for simple functions doesn't throw an error when a specified named parameter cannot be found. Unknown named parameters are bound to the `$args` parameter of the simple function. Moving splatting to the end of the argument list changes the order the parameters appears in `$args`.

For example:

```
PowerShell
```

```
function SimpleTest {
    param(
        $Name,
        $Path
    )
    "Name: $Name; Path: $Path; Args: $args"
}
```

In the previous behavior, **MyPath** is not bound to `-Path` because it's the third argument in the argument list. ## So it ends up being stuffed into '$args' along with `Blah = "World"`

PowerShell

```
PS> $hash = @{ Name = "Hello"; Blah = "World" }
PS> SimpleTest @hash "MyPath"
Name: Hello; Path: ; Args: -Blah: World MyPath
```

With this change, the arguments from `@hash` are moved to the end of the argument list. **MyPath** becomes the first argument in the list, so it is bound to `-Path`.

PowerShell

```
PS> SimpleTest @hash "MyPath"
Name: Hello; Path: MyPath; Args: -Blah: World
```

Language changes

Null-coalescing operator `??`

The null-coalescing operator `??` returns the value of its left-hand operand if it isn't null. Otherwise, it evaluates the right-hand operand and returns its result. The `??` operator doesn't evaluate its right-hand operand if the left-hand operand evaluates to non-null.

PowerShell

```
$x = $null
$x ?? 100
```

Output

```
100
```

In the following example, the right-hand operand won't be evaluated.

PowerShell

```
[string] $todaysDate = '1/10/2020'
$todaysDate ?? (Get-Date).ToShortDateString()
```

Output

```
1/10/2020
```

Null-coalescing assignment operator `??=`

The null-coalescing assignment operator `??=` assigns the value of its right-hand operand to its left-hand operand only if the left-hand operand evaluates to null. The `??=` operator doesn't evaluate its right-hand operand if the left-hand operand evaluates to non-null.

PowerShell

```
$x = $null
$x ??= 100
$x
```

Output

```
100
```

In the following example, the right-hand operand won't be evaluated.

PowerShell

```
[string] $todaysDate = '1/10/2020'
$todaysDate ??= (Get-Date).ToShortDateString()
```

Output

```
1/10/2020
```

Null-conditional operators

> **Note**
>
> This feature was moved from experimental to mainstream in PowerShell 7.1.

A null-conditional operator applies a member access, `?.`, or element access, `?[]`, operation to its operand only if that operand evaluates to non-null; otherwise, it returns null.

Since PowerShell allows `?` to be part of the variable name, formal specification of the variable name is required for using these operators. So it is required to use `{}` around the variable names like `${a}` or when `?` is part of the variable name `${a?}`.

In the following example, the value of **PropName** is returned.

PowerShell

```
$a = @{ PropName = 100 }
${a}?.PropName
```

Output

```
100
```

The following example will return null, without trying to access the member name **PropName**.

PowerShell

```
$a = $null
${a}?.PropName
```

Similarly, the value of the element will be returned.

PowerShell

```
$a = 1..10
${a}?[0]
```

Output

```
1
```

And when the operand is null, the element isn't accessed and null is returned.

PowerShell

```
$a = $null
${a}?[0]
```

> **Note**
>
> The variable name syntax of `${<name>}` should not be confused with the `$()` subexpression operator. For more information, see Variable name section of **about_Variables**.

Added `&` operator for job control

Putting `&` at the end of a pipeline causes the pipeline to be run as a PowerShell job. When a pipeline is backgrounded, a job object is returned. Once the pipeline is running as a job, all of the standard `*-Job` cmdlets can be used to manage the job. Variables (ignoring process-specific variables) used in the pipeline are automatically copied to the job so `Copy-Item $foo $bar &` just works. The job is also run in the current directory instead of the user's home directory.

New methods/properties on `PSCustomObject`

We've added new methods and properties to `PSCustomObject`. `PSCustomObject` now includes a `Count`/`Length` property like other objects.

PowerShell

```
$PSCustomObject = [pscustomobject]@{foo = 1}

$PSCustomObject.Length
```

Output

```
1
```

PowerShell

```
$PSCustomObject.Count
```

Output

```
1
```

This work also includes `ForEach` and `Where` methods that allow you to operate and filter on `PSCustomObject` items:

PowerShell

```
$PSCustomObject.ForEach({$_.foo + 1})
```

Output

```
2
```

PowerShell

```
$PSCustomObject.Where({$_.foo -gt 0})
```

Output

```
foo
---
  1
```

Conversions from PSMethod to Delegate

You can convert a `PSMethod` into a delegate. This allows you to do things like passing `PSMethod` `[M]::DoubleStrLen` as a delegate value into `[M]::AggregateString`:

PowerShell

```
class M {
    static [int] DoubleStrLen([string] $value) { return 2 * $value.Length }

    static [long] AggregateString([string[]] $values, [func[string, int]]
$selector) {
        [long] $res = 0
        foreach($s in $values){
            $res += $selector.Invoke($s)
        }
        return $res
    }
}

[M]::AggregateString((gci).Name, [M]::DoubleStrLen)
```

String comparison behavior changed in PowerShell 7.1

PowerShell 7.1 is built on .NET 5.0, which introduced the following breaking change:

- Behavior changes when comparing strings on .NET 5+

As of .NET 5.0, culture invariant string comparisons ignore non-printing control characters.

For example, the following two strings are considered to be identical:

PowerShell

```powershell
# Escape sequence "`a" is Ctrl-G or [char]7
'Food' -eq "Foo`ad"
```

Output

```
True
```

New cmdlets

New Get-Uptime cmdlet

The Get-Uptime cmdlet returns the time elapsed since the last boot of the operating system. The cmdlet was introduced in PowerShell 6.0.

New Remove-Alias cmdlet

The Remove-Alias cmdlet removes an alias from the current PowerShell session. The cmdlet was introduced in PowerShell 6.0.

New cmdlet Remove-Service

The Remove-Service cmdlet removes a Windows service in the registry and in the service database. The `Remove-Service` cmdlet was introduced in PowerShell 6.0.

New Markdown cmdlets

Markdown is a standard for creating readable plaintext documents with basic formatting that can be rendered into HTML.

The following cmdlets were added in PowerShell 6.1:

- ConvertFrom-Markdown - Convert the contents of a string or a file to a **MarkdownInfo** object.
- Get-MarkdownOption - Returns the current colors and styles used for rendering Markdown content in the console.
- Set-MarkdownOption - Sets the colors and styles used for rendering Markdown content in the console.
- Show-Markdown - Displays Markdown content in the console or as HTML

New Test-Json cmdlet

The Test-Json cmdlet tests whether a string is a valid JavaScript Object Notation (JSON) document and can optionally verify that JSON document against a provided schema.

This cmdlet was introduced in PowerShell 6.1

New cmdlets to support Experimental Features

The following cmdlets were added in PowerShell 6.2 to support Experimental Features.

- Disable-ExperimentalFeature
- Enable-ExperimentalFeature
- Get-ExperimentalFeature

New Join-String cmdlet

The Join-String cmdlet combines objects from the pipeline into a single string. This cmdlet was added in PowerShell 6.2.

New view ConciseView and cmdlet Get-Error

PowerShell 7.0 enhances the display of error messages to improve the readability of interactive and script errors with a new default view, **ConciseView**. The views are user-selectable through the preference variable `$ErrorView`.

With **ConciseView**, if an error is not from a script or parser error, then it's a single line error message:

PowerShell

```
Get-Childitem -Path c:\NotReal
```

Output

```
Get-ChildItem: Cannot find path 'C:\NotReal' because it does not exist
```

If the error occurs during script execution or is a parsing error, PowerShell returns a multiline error message that contains the error, a pointer, and an error message showing where the error is in that line. If the terminal doesn't support ANSI color escape sequences (VT100), then colors are not displayed.

The default view in PowerShell 7 is **ConciseView**. The previous default view was **NormalView** and you can select this by setting the preference variable `$ErrorView`.

PowerShell

```
$ErrorView = 'NormalView' # Sets the error view to NormalView
$ErrorView = 'ConciseView' # Sets the error view to ConciseView
```

> **Note**
>
> A new property **ErrorAccentColor** is added to `$Host.PrivateData` to support changing the accent color of the error message.

The new `Get-Error` cmdlet provides a complete detailed view of the fully qualified error when desired. By default the cmdlet displays the full details, including inner exceptions, of the last error that occurred.

The `Get-Error` cmdlet supports input from the pipeline using the built-in variable `$Error`. `Get-Error` displays all piped errors.

PowerShell

```
$Error | Get-Error
```

The `Get-Error` cmdlet supports the **Newest** parameter, allowing you to specify how many errors from the current session you wish displayed.

PowerShell

```
Get-Error -Newest 3 # Displays the lst three errors that occurred in the
session
```

For more information, see Get-Error.

Cmdlet changes

Parallel execution added to ForEach-Object

Beginning in PowerShell 7.0, the `ForEach-Object` cmdlet, which iterates items in a collection, now has built-in parallelism with the new **Parallel** parameter.

By default, parallel script blocks use the current working directory of the caller that started the parallel tasks.

This example retrieves 50,000 log entries from 5 system logs on a local Windows machine:

PowerShell

```
$logNames = 'Security','Application','System','Windows
PowerShell','Microsoft-Windows-Store/Operational'

$logEntries = $logNames | ForEach-Object -Parallel {
    Get-WinEvent -LogName $_ -MaxEvents 10000
} -ThrottleLimit 5

$logEntries.Count

50000
```

The **Parallel** parameter specifies the script block that is run in parallel for each input log name.

The new **ThrottleLimit** parameter limits the number of script blocks running in parallel at a given time. The default is 5.

Use the `$_` variable to represent the current input object in the script block. Use the `$using:` scope to pass variable references to the running script block.

For more information, see ForEach-Object.

Check `system32` for compatible built-in modules on Windows

In the Windows 10 1809 update and Windows Server 2019, we updated a number of built-in PowerShell modules to mark them as compatible with PowerShell.

When PowerShell starts up, it automatically includes `$windir\System32` as part of the `PSModulePath` environment variable. However, it only exposes modules to `Get-Module` and `Import-Module` if its `CompatiblePSEdition` is marked as compatible with `Core`.

You can override this behavior to show all modules using the `-SkipEditionCheck` switch parameter. We've also added a `PSEdition` property to the table output.

`-lp` alias for all `-LiteralPath` parameters

We created a standard parameter alias `-lp` for all the built-in PowerShell cmdlets that have a `-LiteralPath` parameter.

Fix `Get-Item -LiteralPath a*b` if `a*b` doesn't actually exist to return error

Previously, `-LiteralPath` given a wildcard would treat it the same as `-Path` and if the wildcard found no files, it would silently exit. Correct behavior should be that `-LiteralPath` is literal so if the file doesn't exist, it should error. Change is to treat wildcards used with `-Literal` as literal.

Set working directory to current directory in `Start-Job`

The `Start-Job` cmdlet now uses the current directory as the working directory for the new job.

Remove `-Protocol` from `*-Computer` cmdlets

Due to issues with RPC remoting in CoreFX (particularly on non-Windows platforms) and ensuring a consistent remoting experience in PowerShell, the `-Protocol` parameter was removed from the `\*-Computer` cmdlets. DCOM is no longer supported for remoting. The following cmdlets only support WSMAN remoting:

- `Rename-Computer`
- `Restart-Computer`
- `Stop-Computer`

Remove `-ComputerName` from `*-Service` cmdlets

In order to encourage the consistent use of PSRP, the `-ComputerName` parameter was removed from `*-Service` cmdlets.

Fix `Get-Content -Delimiter` to not include the delimiter in the returned lines

Previously, the output while using `Get-Content -Delimiter` was inconsistent and inconvenient as it required further processing of the data to remove the delimiter. This change removes the delimiter in returned lines.

Changes to `Format-Hex`

The `-Raw` parameter is now a "no-op" (in that it does nothing). Going forward all output is displayed with a true representation of numbers that includes all of the bytes for its type. This is what the `-Raw` parameter was doing prior to this change.

Typo fix in Get-ComputerInfo property name

`BiosSerialNumber` was misspelled as `BiosSeralNumber` and has been changed to the correct spelling.

Add `Get-StringHash` and `Get-FileHash` cmdlets

This change is that some hash algorithms are not supported by CoreFX, therefore they are no longer available:

- `MACTripleDES`
- `RIPEMD160`

Add validation on `Get-*` cmdlets where passing $null returns all objects instead of error

Passing `$null` to any of the following now throws an error:

- `Get-Credential -UserName`
- `Get-Event -SourceIdentifier`
- `Get-EventSubscriber -SourceIdentifier`
- `Get-Help -Name`
- `Get-PSBreakpoint -Script`

- `Get-PSProvider -PSProvider`
- `Get-PSSessionConfiguration -Name`
- `Get-Runspace -Name`
- `Get-RunspaceDebug -RunspaceName`
- `Get-Service -Name`
- `Get-TraceSource -Name`
- `Get-Variable -Name`

Add support for the W3C Extended Log File Format in `Import-Csv`

Previously, the `Import-Csv` cmdlet cannot be used to directly import the log files in W3C extended log format and additional action would be required. With this change, W3C extended log format is supported.

`Import-Csv` applies `PSTypeNames` upon import when type information is present in the CSV

Previously, objects exported using `Export-CSV` with `TypeInformation` imported with `ConvertFrom-Csv` were not retaining the type information. This change adds the type information to `PSTypeNames` member if available from the CSV file.

`-NoTypeInformation` is the default on `Export-Csv`

Previously, the `Export-CSV` cmdlet would output a comment as the first line containing the type name of the object. The change excludes the type information by default because it's not understood by most CSV tools. This change was made to address customer feedback.

Use `-IncludeTypeInformation` to retain the previous behavior.

Allow `*` to be used in registry path for `Remove-Item`

Previously, `-LiteralPath` given a wildcard would treat it the same as `-Path` and if the wildcard found no files, it would silently exit. Correct behavior should be that `-LiteralPath` is literal so if the file doesn't exist, it should error. Change is to treat wildcards used with `-Literal` as literal.

Group-Object now sorts the groups

As part of the performance improvement, `Group-Object` now returns a sorted listing of the groups. Although you should not rely on the order, you could be broken by this change if you wanted the first group. We decided that this performance improvement was worth the change since the impact of being dependent on previous behavior is low.

Standard deviation in `Measure-Object`

The output from `Measure-Object` now includes a `StandardDeviation` property.

PowerShell

```powershell
Get-Process | Measure-Object -Property CPU -AllStats
```

Output

```
Count             : 308
Average           : 31.3720576298701
Sum               : 9662.59375
Maximum           : 4416.046875
Minimum           :
StandardDeviation : 264.389544720926
Property          : CPU
```

`Get-PfxCertificate -Password`

`Get-PfxCertificate` now has the `Password` parameter, which takes a `SecureString`. This allows you to use it non-interactively:

PowerShell

```powershell
$certFile = '\\server\share\pwd-protected.pfx'
$certPass = Read-Host -AsSecureString -Prompt 'Enter the password for
certificate: '

$certThumbPrint = (Get-PfxCertificate -FilePath $certFile -Password
$certPass ).ThumbPrint
```

Removal of the `more` function

In the past, PowerShell shipped a function on Windows called `more` that wrapped `more.com`. That function has now been removed.

Also, the `help` function changed to use `more.com` on Windows, or the system's default pager specified by `$env:PAGER` on non-Windows platforms.

`cd DriveName:` now returns users to the current working directory in that drive

Previously, using `Set-Location` or `cd` to return to a PSDrive sent users to the default location for that drive. Users are now sent to the last known current working directory for that session.

`cd -` returns to previous directory

PowerShell

```
C:\Windows\System32> cd C:\
C:\> cd -
C:\Windows\System32>
```

Or on Linux:

ShellSession

```
PS /etc> cd /usr/bin
PS /usr/bin> cd -
PS /etc>
```

Also, `cd` and `cd --` change to `$HOME`.

`Update-Help` as non-admin

By popular demand, `Update-Help` no longer needs to be run as an administrator. `Update-Help` now defaults to saving help to a user-scoped folder.

`Where-Object -Not`

With the addition of `-Not` parameter to `Where-Object`, can filter an object at the pipeline for the non-existence of a property, or a null/empty property value.

For example, this command returns all services that don't have any dependent services defined:

```
```

PowerShell

```
Get-Service | Where-Object -Not DependentServices
```

Changes to Web Cmdlets

The underlying .NET API of the Web Cmdlets has been changed to `System.Net.Http.HttpClient`. This change provides many benefits. However, this change along with a lack of interoperability with Internet Explorer have resulted in several breaking changes within `Invoke-WebRequest` and `Invoke-RestMethod`.

- `Invoke-WebRequest` now supports basic HTML Parsing only. `Invoke-WebRequest` always returns a `BasicHtmlWebResponseObject` object. The `ParsedHtml` and `Forms` properties have been removed.
- `BasicHtmlWebResponseObject.Headers` values are now `String[]` instead of `String`.
- `BasicHtmlWebResponseObject.BaseResponse` is now a `System.Net.Http.HttpResponseMessage` object.
- The `Response` property on Web Cmdlet exceptions is now a `System.Net.Http.HttpResponseMessage` object.
- Strict RFC header parsing is now default for the `-Headers` and `-UserAgent` parameter. This can be bypassed with `-SkipHeaderValidation`.
- `file://` and `ftp://` URI schemes are no longer supported.
- `System.Net.ServicePointManager` settings are no longer honored.
- There is currently no certificate based authentication available on macOS.
- Use of `-Credential` over an `http://` URI will result in an error. Use an `https://` URI or supply the `-AllowUnencryptedAuthentication` parameter to suppress the error.
- `-MaximumRedirection` now produces a terminating error when redirection attempts exceed the provided limit instead of returning the results of the last redirection.
- In PowerShell 6.2, a change was made to default to UTF-8 encoding for JSON responses. When a charset is not supplied for a JSON response, the default encoding should be UTF-8 per RFC 8259.
- Default encoding set to UTF-8 for `application-json` responses
- Added `-SkipHeaderValidation` parameter to allow `Content-Type` headers that aren't standards-compliant
- Added `-Form` parameter to support simplified `multipart/form-data` support
- Compliant, case-insensitive handling of relation keys
- Added `-Resume` parameter for web cmdlets

Invoke-RestMethod returns useful info when no data is returned

When an API returns just `null`, `Invoke-RestMethod` was serializing this as the string `"null"` instead of `$null`. This change fixes the logic in `Invoke-RestMethod` to properly serialize a valid single value JSON `null` literal as `$null`.

Web Cmdlets warn when `-Credential` is sent over unencrypted connections

When using HTTP, content including passwords are sent as clear-text. This change is to not allow this by default and return an error if credentials are being passed insecurely. Users can bypass this by using the `-AllowUnencryptedAuthentication` switch.

Make `-OutFile` parameter in web cmdlets to work like `-LiteralPath`

Beginning in PowerShell 7.1, the **OutFile** parameter of the web cmdlets works like **LiteralPath** and does not process wildcards.

API changes

Remove `AddTypeCommandBase` class

The `AddTypeCommandBase` class was removed from `Add-Type` to improve performance. This class is only used by the `Add-Type` cmdlet and should not impact users.

Removed `VisualBasic` as a supported language in Add-Type

In the past, you could compile Visual Basic code using the `Add-Type` cmdlet. Visual Basic was rarely used with `Add-Type`. We removed this feature to reduce the size of PowerShell.

Removed `RunspaceConfiguration` support

Previously, when creating a PowerShell runspace programmatically using the API, you could use the legacy RunspaceConfiguration or the newer InitialSessionState classes.

This change removed support for `RunspaceConfiguration` and only supports `InitialSessionState`.

`CommandInvocationIntrinsics.InvokeScript` bind arguments to `$input` instead of `$args`

An incorrect position of a parameter resulted in the args passed as input instead of as args.

Remove `ClrVersion` and `BuildVersion` properties from `$PSVersionTable`

The `ClrVersion` property of `$PSVersionTable` is not useful with CoreCLR. End users should not be using that value to determine compatibility.

The `BuildVersion` property was tied to the Windows build version, which is not available on non-Windows platforms. Use the `GitCommitId` property to retrieve the exact build version of PowerShell.

Implement Unicode escape parsing

`` `u#### `` or `` `u{####} `` is converted to the corresponding Unicode character. To output a literal `` `u ``, escape the backtick: `` ``u ``.

Parameter binding problem with `ValueFromRemainingArguments` in PS functions

`ValueFromRemainingArguments` now returns the values as an array instead of a single value which itself is an array.

Cleaned up uses of `CommandTypes.Workflow` and `WorkflowInfoCleaned`

Clean up code related to the uses of `CommandTypes.Workflow` and `WorkflowInfo` in **System.Management.Automation**.

These minor breaking changes mainly affect help provider code.

- Change the public constructors of `WorkflowInfo` to internal. We don't support workflow anymore, so it makes sense to not allow people to create `Workflow` instances.
- Remove the type **System.Management.Automation.DebugSource** since it's only used for workflow debugging.
- Remove the overload of `SetParent` from the abstract class **Debugger** that is only used for workflow debugging.
- Remove the same overload of `SetParent` from the derived class **RemotingJobDebugger**.

Do not wrap return result in `PSObject` when converting a `ScriptBlock` to a delegate

When a `ScriptBlock` is converted to a delegate type to be used in C# context, wrapping the result in a `PSObject` brings unneeded troubles:

- When the value is converted to the delegate return type, the `PSObject` essentially gets unwrapped. So the `PSObject` is unneeded.
- When the delegate return type is `object`, it gets wrapped in a `PSObject` making it hard to work with in C# code.

After this change, the returned object is the underlying object.

Remoting Support

PowerShell Remoting (PSRP) using WinRM on Unix platforms requires NTLM/Negotiate or Basic Auth over HTTPS. PSRP on macOS only supports Basic Auth over HTTPS. Kerberos-based authentication is not supported for non-Windows platforms.

PowerShell also supports PowerShell Remoting (PSRP) over SSH on all platforms (Windows, macOS, and Linux). For more information, see SSH remoting in PowerShell.

PowerShell Direct for Containers tries to use `pwsh` first

PowerShell Direct is a feature of PowerShell and Hyper-V that allows you to connect to a Hyper-V VM or Container without network connectivity or other remote management services.

In the past, PowerShell Direct connected using the built-in Windows PowerShell instance on the Container. Now, PowerShell Direct first attempts to connect using any available

`pwsh.exe` on the `PATH` environment variable. If `pwsh.exe` isn't available, PowerShell Direct falls back to use `powershell.exe`.

`Enable-PSRemoting` now creates separate remoting endpoints for preview versions

`Enable-PSRemoting` now creates two remoting session configurations:

- One for the major version of PowerShell. For example, `PowerShell.6`. This endpoint that can be relied upon across minor version updates as the "system-wide" PowerShell 6 session configuration
- One version-specific session configuration, for example: `PowerShell.6.1.0`

This behavior is useful if you want to have multiple PowerShell 6 versions installed and accessible on the same machine.

Additionally, preview versions of PowerShell now get their own remoting session configurations after running the `Enable-PSRemoting` cmdlet:

PowerShell

```
C:\WINDOWS\system32> Enable-PSRemoting
```

Your output may be different if you haven't set up WinRM before.

Output

```
WinRM is already set up to receive requests on this computer.
WinRM is already set up for remote management on this computer.
```

Then you can see separate PowerShell session configurations for the preview and stable builds of PowerShell 6, and for each specific version.

PowerShell

```
Get-PSSessionConfiguration
```

Output

```
Name          : PowerShell.6.2-preview.1
PSVersion     : 6.2
StartupScript :
RunAsUser     :
Permission    : NT AUTHORITY\INTERACTIVE AccessAllowed,
```

```
BUILTIN\Administrators AccessAllowed, BUILTIN\Remote Management Users
AccessAllowed

Name          : PowerShell.6-preview
PSVersion     : 6.2
StartupScript :
RunAsUser     :
Permission    : NT AUTHORITY\INTERACTIVE AccessAllowed,
BUILTIN\Administrators AccessAllowed, BUILTIN\Remote Management Users
AccessAllowed

Name          : powershell.6
PSVersion     : 6.1
StartupScript :
RunAsUser     :
Permission    : NT AUTHORITY\INTERACTIVE AccessAllowed,
BUILTIN\Administrators AccessAllowed, BUILTIN\Remote Management Users
AccessAllowed

Name          : powershell.6.1.0
PSVersion     : 6.1
StartupScript :
RunAsUser     :
Permission    : NT AUTHORITY\INTERACTIVE AccessAllowed,
BUILTIN\Administrators AccessAllowed, BUILTIN\Remote Management Users
AccessAllowed
```

`user@host:port` syntax supported for SSH

SSH clients typically support a connection string in the format `user@host:port`. With the addition of SSH as a protocol for PowerShell Remoting, we've added support for this format of connection string:

```
Enter-PSSession -HostName fooUser@ssh.contoso.com:2222
```

Telemetry can only be disabled with an environment variable

PowerShell sends basic telemetry data to Microsoft when it is launched. The data includes the OS name, OS version, and PowerShell version. This data allows us to better understand the environments where PowerShell is used and enables us to prioritize new features and fixes.

To opt-out of this telemetry, set the environment variable `POWERSHELL_TELEMETRY_OPTOUT` to `true`, `yes`, or `1`. We no longer support deletion of the file `DELETE_ME_TO_DISABLE_CONSOLEHOST_TELEMETRY` to disable telemetry.

PowerShell differences on non-Windows platforms

Article • 11/17/2022

PowerShell strives to provide feature parity across all supported platforms. But, due to differences in .NET Core and platform-specific differences, some features behave differently or aren't available. Additional changes have been made to improve interoperability of PowerShell on non-Windows platforms.

.NET Framework vs .NET Core

PowerShell on Linux and macOS uses .NET Core, which is a subset of the full .NET Framework on Microsoft Windows. As a result, scripts that run on Windows may not run on non-Windows platforms because of the differences in the frameworks.

For more information about changes in .NET Core, see Breaking changes for migration from .NET Framework to .NET Core.

General Unix interoperability changes

- Added support for native command globbing on Unix platforms. This means you can use wildcards with native commands like `ls *.txt`.
- The `more` functionality respects the Linux `$PAGER` and defaults to `less`.
- Trailing backslash is automatically escaped when dealing with native command arguments.
- Fixed ConsoleHost to honor `NoEcho` on Unix platforms.
- don't add `PATHEXT` environment variable on Unix
- A `powershell` man-page is included in the package

Execution policy

The `-ExecutionPolicy` parameter is ignored when running PowerShell on non-Windows platforms. `Get-ExecutionPolicy` returns **Unrestricted** on Linux and macOS. `Set-ExecutionPolicy` does nothing on Linux and macOS.

Case-sensitivity in PowerShell

Historically, PowerShell has been uniformly case-insensitive, with few exceptions. On UNIX-like operating systems, the file system is predominantly case-sensitive and PowerShell adheres to the standard of the file system.

- When specifying a file in PowerShell, the correct case must be used.
- If a script tries to load a module and the module name isn't cased correctly, then the module load fails. This may cause a problem with existing scripts if the name by which the module is referenced doesn't match the proper case of the actual filename.
- While names in the filesystem are case-sensitive, tab-completion of filenames isn't case-sensitive. Tab-completion cycles through the list of names using case-insensitive matching.
- `Get-Help` supports case-insensitive pattern matching on Unix platforms.
- `Import-Module` is case insensitive when it's using a filename to determine the module's name.

Filesystem support for Linux and macOS

- Paths given to cmdlets are now slash-agnostic (both / and \ work as directory separator)
- XDG Base Directory Specification is now respected and used by default:
  - The Linux/macOS profile path is located at `~/.config/powershell/profile.ps1`
  - The history save path is located at `~/.local/share/powershell/PSReadline/ConsoleHost_history.txt`
  - The user module path is located at `~/.local/share/powershell/Modules`
- Support for file and folder names containing the colon character on Unix.
- Support for script names or full paths that have commas.
- Detect when `-LiteralPath` is used to suppress wildcard expansion for navigation cmdlets.
- Updated `Get-ChildItem` to work more like the *nix `ls -R` and the Windows `DIR /S` native commands. `Get-ChildItem` now returns the symbolic links encountered during a recursive search and doesn't search the directories that those links target.

.PS1 File Extensions

PowerShell scripts must end in `.ps1` for the interpreter to understand how to load and run them in the current process. Running scripts in the current process is the expected usual behavior for PowerShell. The `#!` magic number may be added to a script that doesn't have a `.ps1` extension, but this causes the script to be run in a new PowerShell

instance preventing the script from working properly when interchanging objects. This may be the desirable behavior when executing a PowerShell script from `bash` or another shell.

Convenience aliases removed

On Windows, PowerShell provides a set of aliases that map to Linux command names for user convenience. On Linux and macOS, the "convenience aliases" for the basic commands `ls`, `cp`, `mv`, `rm`, `cat`, `man`, `mount`, `ps` have been removed to allow the native executable to run without specifying a path.

Logging

On macOS, PowerShell uses the native `os_log` APIs to log to Apple's unified logging system. On Linux, PowerShell uses Syslog, a ubiquitous logging solution.

Job Control

There is no Unix-style job-control support in PowerShell on Linux or macOS. The `fg` and `bg` commands aren't available. You can use PowerShell jobs that do work across all platforms.

Putting `&` at the end of a pipeline causes the pipeline to be run as a PowerShell job. When a pipeline is backgrounded, a job object is returned. Once the pipeline is running as a job, all `*-Job` cmdlets can be used to manage the job. Variables (ignoring process-specific variables) used in the pipeline are automatically copied to the job so `Copy-Item $foo $bar &` just works. The job is also run in the current directory instead of the user's home directory.

Remoting Support

PowerShell Remoting (PSRP) using WinRM on Unix platforms requires NTLM/Negotiate or Basic Auth over HTTPS. PSRP on macOS only supports Basic Auth over HTTPS. Kerberos-based authentication isn't supported.

PowerShell supports PowerShell Remoting (PSRP) over SSH on all platforms (Windows, macOS, and Linux). For more information, see SSH remoting in PowerShell.

Just-Enough-Administration (JEA) Support

The ability to create constrained administration (JEA) remoting endpoints isn't available in PowerShell on Linux or macOS.

`sudo`, `exec`, and PowerShell

Because PowerShell runs most commands in memory (like Python or Ruby), you can't use sudo directly with PowerShell built-ins. You can run `pwsh` from sudo. If it's necessary to run a PowerShell cmdlet from within PowerShell with sudo, for example, `sudo Set-Date 8/18/2016`, then you would do `sudo pwsh Set-Date 8/18/2016`.

Missing Cmdlets

A large number of the commands (cmdlets) normally available in PowerShell aren't available on Linux or macOS. In many cases, these commands make no sense on these platforms (e.g. Windows-specific features like the registry). Other commands like the service control commands are present, but not functional. Future releases may correct these problems by fixing the broken cmdlets and adding new ones over time.

For a comprehensive list of modules and cmdlets and the platforms they support, see Release history of modules and cmdlets.

Modules no longer shipped with PowerShell

For various compatibility reasons, the following modules are no longer included in PowerShell.

- ISE
- Microsoft.PowerShell.LocalAccounts
- Microsoft.PowerShell.ODataUtils
- Microsoft.PowerShell.Operation.Validation
- PSScheduledJob
- PSWorkflow
- PSWorkflowUtility

The following Windows-specific modules aren't included in PowerShell for Linux or macOS.

- CimCmdlets
- Microsoft.PowerShell.Diagnostics

- Microsoft.WSMan.Management
- PSDiagnostics

Cmdlets not available on non-Windows platforms

For non-Windows platforms, PowerShell includes the following modules:

- Microsoft.PowerShell.Archive
- Microsoft.PowerShell.Core
- Microsoft.PowerShell.Host
- Microsoft.PowerShell.Management
- Microsoft.PowerShell.Security
- Microsoft.PowerShell.Utility
- PackageManagement
- PowerShellGet
- PSDesiredStateConfiguration
- PSReadLine
- ThreadJob

However, some cmdlets have been removed from PowerShell, and others aren't available or may work differently on non-Windows platforms. For a comprehensive list of cmdlets removed from PowerShell, see Cmdlets removed from PowerShell.

Microsoft.PowerShell.Core

The **ShowWindow** parameter of `Get-Help` isn't available for non-Windows platforms.

Microsoft.PowerShell.Security cmdlets

The following cmdlets aren't available on Linux or macOS:

- `Get-Acl`
- `Set-Acl`
- `Get-AuthenticodeSignature`
- `Set-AuthenticodeSignature`
- `New-FileCatalog`
- `Test-FileCatalog`

These cmdlets are only available beginning in PowerShell 7.1.

- `Get-CmsMessage`
- `Protect-CmsMessage`
- `Unprotect-CmsMessage`

Microsoft.PowerShell.Management cmdlets

The following cmdlets aren't available on Linux and macOS:

- `Clear-RecycleBin`
- `Get-HotFix`

The following cmdlets are available with limitations:

`Get-Clipboard` - available on Linux but not supported on macOS `Set-Clipboard` - available in PowerShell 7.0+ `Restart-Computer` - available for Linux and macOS in PowerShell 7.1+ `Stop-Computer` - available for Linux and macOS in PowerShell 7.1+

Microsoft.PowerShell.Utility cmdlets

The following cmdlets aren't available on Linux and macOS:

- `Convert-String`
- `ConvertFrom-String`
- `Out-GridView`
- `Out-Printer`
- `Show-Command`

Aliases not available on Linux or macOS

The following table lists the aliases available for Windows that aren't available on non-Windows platforms. These aliases aren't available because the target cmdlet isn't available or the alias conflicts with a native command on those platforms.

Alias	Cmdlet
`ac`	`Add-Content`
`cat`	`Get-Content`
`clear`	`Clear-Host`
`cnsn`	`Connect-PSSession`

Alias	Cmdlet
`compare`	`Compare-Object`
`cp`	`Copy-Item`
`cpp`	`Copy-ItemProperty`
`diff`	`Compare-Object`
`dnsn`	`Disconnect-PSSession`
`gsv`	`Get-Service`
`kill`	`Stop-Process`
`ls`	`Get-ChildItem`
`man`	`help`
`mount`	`New-PSDrive`
`mv`	`Move-Item`
`ogv`	`Out-GridView`
`ps`	`Get-Process`
`rm`	`Remove-Item`
`rmdir`	`Remove-Item`
`sasv`	`Start-Service`
`shcm`	`Show-Command`
`sleep`	`Start-Sleep`
`sort`	`Sort-Object`
`spsv`	`Stop-Service`
`start`	`Start-Process`
`tee`	`Tee-Object`
`write`	`Write-Output`

PowerShell Desired State Configuration (DSC)

Many cmdlets were removed from the PSDesiredStateConfiguration module beginning in PowerShell 6.0. Support for DSC on non-Windows platforms is limited and mostly experimental. The `Invoke-DscResource` cmdlet was restored as an experimental feature in PowerShell 7.0.

DSC isn't supported on macOS.

For more information about using DSC on Linux, see Get started with DSC for Linux.

Beginning with PowerShell 7.2, the **PSDesiredStateConfiguration** module has been removed from PowerShell and is published to the PowerShell Gallery. For more information, see the announcement in the PowerShell Team blog.

Release history of modules and cmdlets

Article • 02/28/2023

This article lists the modules and cmdlets that are included in various versions of PowerShell. This is a summary of information found in the release notes. More detailed information can be found in the release notes:

- What's new in PowerShell 7.4 (preview)
- What's new in PowerShell 7.3
- What's new in PowerShell 7.2
- What's new in PowerShell 7.1
- What's new in PowerShell 7.0

This is a work in progress. Please help us keep this information fresh.

Module release history

ModuleName / PSVersion	5.1	7.2	7.3	7.4 (preview)	Note
CimCmdlets	✅	✅	✅	✅	Windows only
ISE (introduced in 2.0)	✅				Windows only
Microsoft.PowerShell.Archive	✅	✅	✅	✅	
Microsoft.PowerShell.Core	✅	✅	✅	✅	
Microsoft.PowerShell.Diagnostics	✅	✅	✅	✅	Windows only
Microsoft.PowerShell.Host	✅	✅	✅	✅	
Microsoft.PowerShell.LocalAccounts	✅				Windows only (64-bit only)
Microsoft.PowerShell.Management	✅	✅	✅	✅	
Microsoft.PowerShell.ODataUtils	✅				Windows only
Microsoft.PowerShell.Operation.Validation	✅				Windows only
Microsoft.PowerShell.Security	✅	✅	✅	✅	
Microsoft.PowerShell.Utility	✅	✅	✅	✅	
Microsoft.WsMan.Management	✅	✅	✅	✅	Windows only

ModuleName / PSVersion	5.1	7.2	7.3	7.4 (preview)	Note
PackageManagement	✅	✅	✅	✅	
PowershellGet 1.1	✅				Must upgrade to v2.x
PowershellGet 2.x		✅	✅	✅	New versions available from the Gallery
PowershellGet 3.x					Available from the Gallery
PSDesiredStateConfiguration 1.1	✅				Removed in 7.2 - available from the Gallery
PSDesiredStateConfiguration 2.x		❌			Removed in 7.2 - available from the Gallery
PSDesiredStateConfiguration 3.x					Preview available from the Gallery
PSDiagnostics	✅	✅	✅	✅	Windows only
PSReadLine	v1.x	v2.1	v2.1	v2.1	New versions available from the Gallery
PSScheduledJob	✅				Windows only
PSWorkflow	✅				Windows only
PSWorkflowUtility	✅				Windows only
ThreadJob		✅	✅	✅	Can be installed in PowerShell 5.1

Cmdlet release history

CimCmdlets

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Export-BinaryMiLog	✅				Windows only

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Get-CimAssociatedInstance	✅	✅	✅	✅	Windows only
Get-CimClass	✅	✅	✅	✅	Windows only
Get-CimInstance	✅	✅	✅	✅	Windows only
Get-CimSession	✅	✅	✅	✅	Windows only
Import-BinaryMiLog	✅				Windows only
Invoke-CimMethod	✅	✅	✅	✅	Windows only
New-CimInstance	✅	✅	✅	✅	Windows only
New-CimSession	✅	✅	✅	✅	Windows only
New-CimSessionOption	✅	✅	✅	✅	Windows only
Register-CimIndicationEvent	✅	✅	✅	✅	Windows only
Remove-CimInstance	✅	✅	✅	✅	Windows only
Remove-CimSession	✅	✅	✅	✅	Windows only
Set-CimInstance	✅	✅	✅	✅	Windows only

ISE (introduced in 2.0)

This modules is only available in Windows PowerShell.

Cmdlet name	5.1	Note
Get-IseSnippet	✅	
Import-IseSnippet	✅	
New-IseSnippet	✅	

Microsoft.PowerShell.Archive

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Compress-Archive	✅	✅	✅	✅	
Expand-Archive	✅	✅	✅	✅	

Microsoft.PowerShell.Core

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Add-History	✅	✅	✅	✅	
Add-PSSnapin	✅				Windows only
Clear-History	✅	✅	✅	✅	
Clear-Host	✅	✅	✅	✅	
Connect-PSSession	✅	✅	✅	✅	Windows only
Debug-Job	✅	✅	✅	✅	
Disable-ExperimentalFeature		✅	✅	✅	Added in 6.2
Disable-PSRemoting	✅	✅	✅	✅	Windows only
Disable-PSSessionConfiguration	✅	✅	✅	✅	Windows only
Disconnect-PSSession	✅	✅	✅	✅	Windows only
Enable-ExperimentalFeature		✅	✅	✅	Added in 6.2
Enable-PSRemoting	✅	✅	✅	✅	Windows only
Enable-PSSessionConfiguration	✅	✅	✅	✅	Windows only
Enter-PSHostProcess	✅	✅	✅	✅	Added Linux support in 6.2
Enter-PSSession	✅	✅	✅	✅	
Exit-PSHostProcess	✅	✅	✅	✅	Added Linux support in 6.2
Exit-PSSession	✅	✅	✅	✅	
Export-Console	✅				Windows only
Export-ModuleMember	✅	✅	✅	✅	
ForEach-Object	✅	✅	✅	✅	
Get-Command	✅	✅	✅	✅	
Get-ExperimentalFeature		✅	✅	✅	Added in 6.2
Get-Help	✅	✅	✅	✅	

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Get-History	✅	✅	✅	✅	
Get-Job	✅	✅	✅	✅	
Get-Module	✅	✅	✅	✅	
Get-PSHostProcessInfo	✅	✅	✅	✅	Added Linux support in 6.2
Get-PSSession	✅	✅	✅	✅	
Get-PSSessionCapability	✅	✅	✅	✅	
Get-PSSessionConfiguration	✅	✅	✅	✅	
Get-PSSnapin	✅				Windows only
Get-Verb	✅				Moved to Microsoft.PowerShell.Utility 6.0+
Import-Module	✅	✅	✅	✅	
Invoke-Command	✅	✅	✅	✅	
Invoke-History	✅	✅	✅	✅	
New-Module	✅	✅	✅	✅	
New-ModuleManifest	✅	✅	✅	✅	
New-PSRoleCapabilityFile	✅	✅	✅	✅	
New-PSSession	✅	✅	✅	✅	
New-PSSessionConfigurationFile	✅	✅	✅	✅	Added Linux support in 7.3
New-PSSessionOption	✅	✅	✅	✅	
New-PSTransportOption	✅	✅	✅	✅	
Out-Default	✅	✅	✅	✅	
Out-Host	✅	✅	✅	✅	
Out-Null	✅	✅	✅	✅	
Receive-Job	✅	✅	✅	✅	
Receive-PSSession	✅	✅	✅	✅	Windows only

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Register-ArgumentCompleter	✅	✅	✅	✅	
Register-PSSessionConfiguration	✅	✅	✅	✅	Windows only
Remove-Job	✅	✅	✅	✅	
Remove-Module	✅	✅	✅	✅	
Remove-PSSession	✅	✅	✅	✅	
Remove-PSSnapin	✅				Windows only
Resume-Job	✅				
Save-Help	✅	✅	✅	✅	
Set-PSDebug	✅	✅	✅	✅	
Set-PSSessionConfiguration	✅	✅	✅	✅	Windows only
Set-StrictMode	✅	✅	✅	✅	
Start-Job	✅	✅	✅	✅	
Stop-Job	✅	✅	✅	✅	
Switch-Process			✅	✅	Linux and macOS only
Suspend-Job	✅				Windows only
Test-ModuleManifest	✅	✅	✅	✅	
Test-PSSessionConfigurationFile	✅	✅	✅	✅	Windows only
Unregister-PSSessionConfiguration	✅	✅	✅	✅	Windows only
Update-Help	✅	✅	✅	✅	
Wait-Job	✅	✅	✅	✅	
Where-Object	✅	✅	✅	✅	

Microsoft.PowerShell.Diagnostics

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Export-Counter	✅				Windows only
Get-Counter	✅	✅	✅	✅	Windows only
Get-WinEvent	✅	✅	✅	✅	Windows only
Import-Counter	✅				Windows only
New-WinEvent	✅	✅	✅	✅	Windows only

Microsoft.PowerShell.Host

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Start-Transcript	✅	✅	✅	✅	
Stop-Transcript	✅	✅	✅	✅	

Microsoft.PowerShell.LocalAccounts (64-bit only)

This modules is only available in Windows PowerShell.

Cmdlet name	5.1	Note
Add-LocalGroupMember	✅	
Disable-LocalUser	✅	
Enable-LocalUser	✅	
Get-LocalGroup	✅	
Get-LocalGroupMember	✅	
Get-LocalUser	✅	
New-LocalGroup	✅	
New-LocalUser	✅	
Remove-LocalGroup	✅	
Remove-LocalGroupMember	✅	
Remove-LocalUser	✅	
Rename-LocalGroup	✅	

Cmdlet name	5.1	Note
Rename-LocalUser	✅	
Set-LocalGroup	✅	
Set-LocalUser	✅	

Microsoft.PowerShell.Management

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Add-Computer	✅				Windows only
Add-Content	✅	✅	✅	✅	
Checkpoint-Computer	✅				Windows only
Clear-Content	✅	✅	✅	✅	
Clear-EventLog	✅				Windows only
Clear-Item	✅	✅	✅	✅	
Clear-ItemProperty	✅	✅	✅	✅	
Clear-RecycleBin	✅	✅	✅	✅	Windows only
Complete-Transaction	✅				Windows only
Convert-Path	✅	✅	✅	✅	
Copy-Item	✅	✅	✅	✅	
Copy-ItemProperty	✅	✅	✅	✅	
Debug-Process	✅	✅	✅	✅	
Disable-ComputerRestore	✅				Windows only
Enable-ComputerRestore	✅				Windows only
Get-ChildItem	✅	✅	✅	✅	
Get-Clipboard	✅	✅	✅	✅	NotsupportedonmacOS
Get-ComputerInfo	✅	✅	✅	✅	Windows only
Get-ComputerRestorePoint	✅				Windows only

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Get-Content	✅	✅	✅	✅	
Get-ControlPanelItem	✅				Windows only
Get-EventLog	✅				Windows only
Get-HotFix	✅	✅	✅	✅	Windows only
Get-Item	✅	✅	✅	✅	
Get-ItemProperty	✅	✅	✅	✅	
Get-ItemPropertyValue	✅	✅	✅	✅	
Get-Location	✅	✅	✅	✅	
Get-Process	✅	✅	✅	✅	
Get-PSDrive	✅	✅	✅	✅	
Get-PSProvider	✅	✅	✅	✅	
Get-Service	✅	✅	✅	✅	Windows only
Get-TimeZone	✅	✅	✅	✅	Windows only
Get-Transaction	✅				Windows only
Get-WmiObject	✅				Windows only
Invoke-Item	✅	✅	✅	✅	
Invoke-WmiMethod	✅				Windows only
Join-Path	✅	✅	✅	✅	
Limit-EventLog	✅				Windows only
Move-Item	✅	✅	✅	✅	
Move-ItemProperty	✅	✅	✅	✅	
New-EventLog	✅				Windows only
New-Item	✅	✅	✅	✅	
New-ItemProperty	✅	✅	✅	✅	
New-PSDrive	✅	✅	✅	✅	
New-Service	✅	✅	✅	✅	Windows only

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
New-WebServiceProxy	✅				Windows only
Pop-Location	✅	✅	✅	✅	
Push-Location	✅	✅	✅	✅	
Register-WmiEvent	✅				Windows only
Remove-Computer	✅				Windows only
Remove-EventLog	✅				Windows only
Remove-Item	✅	✅	✅	✅	
Remove-ItemProperty	✅	✅	✅	✅	
Remove-PSDrive	✅	✅	✅	✅	
Remove-Service		✅	✅	✅	Windows only
Remove-WmiObject	✅				Windows only
Rename-Computer	✅	✅	✅	✅	Windows only
Rename-Item	✅	✅	✅	✅	
Rename-ItemProperty	✅	✅	✅	✅	
Reset-ComputerMachinePassword	✅				Windows only
Resolve-Path	✅	✅	✅	✅	
Restart-Computer	✅	✅	✅	✅	Added Linux/macOS support in 7.1
Restart-Service	✅	✅	✅	✅	Windows only
Restore-Computer	✅				Windows only
Resume-Service	✅	✅	✅	✅	Windows only
Set-Clipboard	✅	✅	✅	✅	
Set-Content	✅	✅	✅	✅	
Set-Item	✅	✅	✅	✅	
Set-ItemProperty	✅	✅	✅	✅	

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Set-Location	✅	✅	✅	✅	
Set-Service	✅	✅	✅	✅	Windows only
Set-TimeZone	✅	✅	✅	✅	Windows only
Set-WmiInstance	✅				Windows only
Show-ControlPanelItem	✅				Windows only
Show-EventLog	✅				Windows only
Split-Path	✅	✅	✅	✅	
Start-Process	✅	✅	✅	✅	
Start-Service	✅	✅	✅	✅	Windows only
Start-Transaction	✅				Windows only
Stop-Computer	✅	✅	✅	✅	Added Linux/macOS support in 7.1
Stop-Process	✅	✅	✅	✅	
Stop-Service	✅	✅	✅	✅	Windows only
Suspend-Service	✅	✅	✅	✅	Windows only
Test-ComputerSecureChannel	✅				Windows only
Test-Connection	✅	✅	✅	✅	
Test-Path	✅	✅	✅	✅	
Undo-Transaction	✅				Windows only
Use-Transaction	✅				Windows only
Wait-Process	✅	✅	✅	✅	
Write-EventLog	✅				Windows only

Microsoft.PowerShell.ODataUtils

This modules is only available in Windows PowerShell.

Cmdlet name	5.1	Note

Cmdlet name	5.1	Note
Export-ODataEndpointProxy	✅	

Microsoft.PowerShell.Operation.Validation

This modules is only available in Windows PowerShell.

Cmdlet name	5.1	Note
Get-OperationValidation	✅	
Invoke-OperationValidation	✅	

Microsoft.PowerShell.Security

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
ConvertFrom-SecureString	✅	✅	✅	✅	
ConvertTo-SecureString	✅	✅	✅	✅	
Get-Acl	✅	✅	✅	✅	Windows only
Get-AuthenticodeSignature	✅	✅	✅	✅	Windows only
Get-CmsMessage	✅	✅	✅	✅	Support for Linux/macOS added in 7.1
Get-Credential	✅	✅	✅	✅	
Get-ExecutionPolicy	✅	✅	✅	✅	Returns **Unrestricted** on Linux/macOS
Get-PfxCertificate	✅	✅	✅	✅	
New-FileCatalog	✅	✅	✅	✅	Windows only
Protect-CmsMessage	✅	✅	✅	✅	Support for Linux/macOS added in 7.1
Set-Acl	✅	✅	✅	✅	Windows only
Set-AuthenticodeSignature	✅	✅	✅	✅	Windows only

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Set-ExecutionPolicy	✅	✅	✅	✅	Does nothing on Linux/macOS
Test-FileCatalog	✅	✅	✅	✅	Windows only
Unprotect-CmsMessage	✅	✅	✅	✅	Support for Linux/macOS added in 7.1

Microsoft.PowerShell.Utility

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Add-Member	✅	✅	✅	✅	
Add-Type	✅	✅	✅	✅	
Clear-Variable	✅	✅	✅	✅	
Compare-Object	✅	✅	✅	✅	
ConvertFrom-Csv	✅	✅	✅	✅	
ConvertFrom-Json	✅	✅	✅	✅	
ConvertFrom-Markdown		✅	✅	✅	Added in 6.1
ConvertFrom-SddlString	✅	✅	✅	✅	Windows only
ConvertFrom-String	✅				
ConvertFrom-StringData	✅	✅	✅	✅	
Convert-String	✅				
ConvertTo-Csv	✅	✅	✅	✅	
ConvertTo-Html	✅	✅	✅	✅	
ConvertTo-Json	✅	✅	✅	✅	
ConvertTo-Xml	✅	✅	✅	✅	
Debug-Runspace	✅	✅	✅	✅	
Disable-PSBreakpoint	✅	✅	✅	✅	

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Disable-RunspaceDebug	✅	✅	✅	✅	
Enable-PSBreakpoint	✅	✅	✅	✅	
Enable-RunspaceDebug	✅	✅	✅	✅	
Export-Alias	✅	✅	✅	✅	
Export-Clixml	✅	✅	✅	✅	
Export-Csv	✅	✅	✅	✅	
Export-FormatData	✅	✅	✅	✅	
Export-PSSession	✅	✅	✅	✅	
Format-Custom	✅	✅	✅	✅	
Format-Hex	✅	✅	✅	✅	
Format-List	✅	✅	✅	✅	
Format-Table	✅	✅	✅	✅	
Format-Wide	✅	✅	✅	✅	
Get-Alias	✅	✅	✅	✅	
Get-Culture	✅	✅	✅	✅	
Get-Date	✅	✅	✅	✅	
Get-Error		✅	✅	✅	
Get-Event	✅	✅	✅	✅	No event sources available on Linux/macOS
Get-EventSubscriber	✅	✅	✅	✅	
Get-FileHash	✅	✅	✅	✅	
Get-FormatData	✅	✅	✅	✅	
Get-Host	✅	✅	✅	✅	
Get-MarkdownOption		✅	✅	✅	Added in 6.1
Get-Member	✅	✅	✅	✅	

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Get-PSBreakpoint	✅	✅	✅	✅	
Get-PSCallStack	✅	✅	✅	✅	
Get-Random	✅	✅	✅	✅	
Get-Runspace	✅	✅	✅	✅	
Get-RunspaceDebug	✅	✅	✅	✅	
Get-SecureRandom				✅	Added in 7.4
Get-TraceSource	✅	✅	✅	✅	
Get-TypeData	✅	✅	✅	✅	
Get-UICulture	✅	✅	✅	✅	
Get-Unique	✅	✅	✅	✅	
Get-Uptime		✅	✅	✅	
Get-Variable	✅	✅	✅	✅	
Get-Verb		✅	✅	✅	Moved from Microsoft.PowerShell.Core
Group-Object	✅	✅	✅	✅	
Import-Alias	✅	✅	✅	✅	
Import-Clixml	✅	✅	✅	✅	
Import-Csv	✅	✅	✅	✅	
Import-LocalizedData	✅	✅	✅	✅	
Import-PowerShellDataFile	✅	✅	✅	✅	
Import-PSSession	✅	✅	✅	✅	
Invoke-Expression	✅	✅	✅	✅	
Invoke-RestMethod	✅	✅	✅	✅	
Invoke-WebRequest	✅	✅	✅	✅	
Join-String		✅	✅	✅	

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Measure-Command	✅	✅	✅	✅	
Measure-Object	✅	✅	✅	✅	
New-Alias	✅	✅	✅	✅	
New-Event	✅	✅	✅	✅	No event sources available on Linux/macOS
New-Guid	✅	✅	✅	✅	
New-Object	✅	✅	✅	✅	
New-TemporaryFile	✅	✅	✅	✅	
New-TimeSpan	✅	✅	✅	✅	
New-Variable	✅	✅	✅	✅	
Out-File	✅	✅	✅	✅	
Out-GridView	✅	✅	✅	✅	Windows only
Out-Printer	✅	✅	✅	✅	Windows only
Out-String	✅	✅	✅	✅	
Read-Host	✅	✅	✅	✅	
Register-EngineEvent	✅	✅	✅	✅	No event sources available on Linux/macOS
Register-ObjectEvent	✅	✅	✅	✅	
Remove-Alias		✅	✅	✅	
Remove-Event	✅	✅	✅	✅	No event sources available on Linux/macOS
Remove-PSBreakpoint	✅	✅	✅	✅	
Remove-TypeData	✅	✅	✅	✅	
Remove-Variable	✅	✅	✅	✅	
Select-Object	✅	✅	✅	✅	
Select-String	✅	✅	✅	✅	
Select-Xml	✅	✅	✅	✅	

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Send-MailMessage	✅	✅	✅	✅	
Set-Alias	✅	✅	✅	✅	
Set-Date	✅	✅	✅	✅	
Set-MarkdownOption		✅	✅	✅	Added in 6.1
Set-PSBreakpoint	✅	✅	✅	✅	
Set-TraceSource	✅	✅	✅	✅	
Set-Variable	✅	✅	✅	✅	
Show-Command	✅	✅	✅	✅	Windows only
Show-Markdown		✅	✅	✅	Added in 6.1
Sort-Object	✅	✅	✅	✅	
Start-Sleep	✅	✅	✅	✅	
Tee-Object	✅	✅	✅	✅	
Test-Json		✅	✅	✅	
Trace-Command	✅	✅	✅	✅	
Unblock-File	✅	✅	✅	✅	Added support for macOS in 7.0
Unregister-Event	✅	✅	✅	✅	No event sources available on Linux/macOS
Update-FormatData	✅	✅	✅	✅	
Update-List	✅	✅	✅	✅	
Update-TypeData	✅	✅	✅	✅	
Wait-Debugger	✅	✅	✅	✅	
Wait-Event	✅	✅	✅	✅	
Write-Debug	✅	✅	✅	✅	
Write-Error	✅	✅	✅	✅	
Write-Host	✅	✅	✅	✅	
Write-Information	✅	✅	✅	✅	

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Write-Output	✅	✅	✅	✅	
Write-Progress	✅	✅	✅	✅	
Write-Verbose	✅	✅	✅	✅	
Write-Warning	✅	✅	✅	✅	

Microsoft.WsMan.Management

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Connect-WSMan	✅	✅	✅	✅	Windows only
Disable-WSManCredSSP	✅	✅	✅	✅	Windows only
Disconnect-WSMan	✅	✅	✅	✅	Windows only
Enable-WSManCredSSP	✅	✅	✅	✅	Windows only
Get-WSManCredSSP	✅	✅	✅	✅	Windows only
Get-WSManInstance	✅	✅	✅	✅	Windows only
Invoke-WSManAction	✅	✅	✅	✅	Windows only
New-WSManInstance	✅	✅	✅	✅	Windows only
New-WSManSessionOption	✅	✅	✅	✅	Windows only
Remove-WSManInstance	✅	✅	✅	✅	Windows only
Set-WSManInstance	✅	✅	✅	✅	Windows only
Set-WSManQuickConfig	✅	✅	✅	✅	Windows only
Test-WSMan	✅	✅	✅	✅	Windows only

PackageManagement

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Find-Package	✅	✅	✅	✅	
Find-PackageProvider	✅	✅	✅	✅	

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Get-Package	✅	✅	✅	✅	
Get-PackageProvider	✅	✅	✅	✅	
Get-PackageSource	✅	✅	✅	✅	
Import-PackageProvider	✅	✅	✅	✅	
Install-Package	✅	✅	✅	✅	
Install-PackageProvider	✅	✅	✅	✅	
Register-PackageSource	✅	✅	✅	✅	
Save-Package	✅	✅	✅	✅	
Set-PackageSource	✅	✅	✅	✅	
Uninstall-Package	✅	✅	✅	✅	
Unregister-PackageSource	✅	✅	✅	✅	

PowershellGet 2.x

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Find-Command	✅	✅	✅	✅	
Find-DscResource	✅	✅	✅	✅	
Find-Module	✅	✅	✅	✅	
Find-RoleCapability	✅	✅	✅	✅	
Find-Script	✅	✅	✅	✅	
Get-CredsFromCredentialProvider		✅	✅	✅	
Get-InstalledModule	✅	✅	✅	✅	
Get-InstalledScript	✅	✅	✅	✅	
Get-PSRepository	✅	✅	✅	✅	
Install-Module	✅	✅	✅	✅	
Install-Script	✅	✅	✅	✅	
New-ScriptFileInfo	✅	✅	✅	✅	

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Publish-Module	✅	✅	✅	✅	
Publish-Script	✅	✅	✅	✅	
Register-PSRepository	✅	✅	✅	✅	
Save-Module	✅	✅	✅	✅	
Save-Script	✅	✅	✅	✅	
Set-PSRepository	✅	✅	✅	✅	
Test-ScriptFileInfo	✅	✅	✅	✅	
Uninstall-Module	✅	✅	✅	✅	
Uninstall-Script	✅	✅	✅	✅	
Unregister-PSRepository	✅	✅	✅	✅	
Update-Module	✅	✅	✅	✅	
Update-ModuleManifest	✅	✅	✅	✅	
Update-Script	✅	✅	✅	✅	
Update-ScriptFileInfo	✅	✅	✅	✅	

PowershellGet 3.x - Preview

This modules is only available from the PowerShell Gallery.

Name	Note
Find-PSResource	
Get-InstalledPSResource	
Get-PSResourceRepository	
Install-PSResource	
Publish-PSResource	
Register-PSResourceRepository	
Save-PSResource	
Set-PSResourceRepository	

Name	Note
Uninstall-PSResource	
Unregister-PSResourceRepository	
Update-PSResource	

PSDesiredStateConfiguration v1.1

This modules is only available from in Windows PowerShell.

Cmdlet name	5.1	Note
Configuration	✅	
Disable-DscDebug	✅	
Enable-DscDebug	✅	
Get-DscConfiguration	✅	
Get-DscConfigurationStatus	✅	
Get-DscLocalConfigurationManager	✅	
Get-DscResource	✅	
Invoke-DscResource	✅	
New-DSCCheckSum	✅	
Publish-DscConfiguration	✅	
Remove-DscConfigurationDocument	✅	
Restore-DscConfiguration	✅	
Set-DscLocalConfigurationManager	✅	
Start-DscConfiguration	✅	
Stop-DscConfiguration	✅	
Test-DscConfiguration	✅	
Update-DscConfiguration	✅	

PSDesiredStateConfiguration v2.0.5

This modules is only available from the PowerShell Gallery.

Cmdlet name	2.0.5	Note
Configuration	✅	
Get-DscResource	✅	
Invoke-DscResource	✅	Experimental
New-DSCCheckSum	✅	

PSDesiredStateConfiguration v3.x - Preview

This modules is only available from the PowerShell Gallery.

Cmdlet name	3.0 (preview)	Note
Configuration	✅	
ConvertTo-DscJsonSchema	✅	
Get-DscResource	✅	
Invoke-DscResource	✅	Experimental
New-DscChecksum	✅	

PSDiagnostics

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Disable-PSTrace	✅	✅	✅	✅	Windows only
Disable-PSWSManCombinedTrace	✅	✅	✅	✅	Windows only
Disable-WSManTrace	✅	✅	✅	✅	Windows only
Enable-PSTrace	✅	✅	✅	✅	Windows only
Enable-PSWSManCombinedTrace	✅	✅	✅	✅	Windows only
Enable-WSManTrace	✅	✅	✅	✅	Windows only
Get-LogProperties	✅	✅	✅	✅	Windows only
Set-LogProperties	✅	✅	✅	✅	Windows only
Start-Trace	✅	✅	✅	✅	Windows only

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Stop-Trace	✅	✅	✅	✅	Windows only

PSReadLine

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Get-PSReadLineKeyHandler	✅	✅	✅	✅	
Get-PSReadLineOption	✅	✅	✅	✅	
PSConsoleHostReadLine	✅	✅	✅	✅	
Remove-PSReadLineKeyHandler	✅	✅	✅	✅	
Set-PSReadLineKeyHandler	✅	✅	✅	✅	
Set-PSReadLineOption	✅	✅	✅	✅	

PSScheduledJob

This modules is only available in Windows PowerShell.

Cmdlet name	5.1	Note
Add-JobTrigger	✅	
Disable-JobTrigger	✅	
Disable-ScheduledJob	✅	
Enable-JobTrigger	✅	
Enable-ScheduledJob	✅	
Get-JobTrigger	✅	
Get-ScheduledJob	✅	
Get-ScheduledJobOption	✅	
New-JobTrigger	✅	
New-ScheduledJobOption	✅	
Register-ScheduledJob	✅	
Remove-JobTrigger	✅	

Cmdlet name	5.1	Note
Set-JobTrigger	✅	
Set-ScheduledJob	✅	
Set-ScheduledJobOption	✅	
Unregister-ScheduledJob	✅	

PSWorkflow & PSWorkflowUtility

This modules is only available in Windows PowerShell.

Cmdlet name	5.1	Note
New-PSWorkflowExecutionOption	✅	
New-PSWorkflowSession	✅	
Invoke-AsWorkflow	✅	

ThreadJob

Cmdlet name	5.1	7.2	7.3	7.4 (preview)	Note
Start-ThreadJob		✅	✅	✅	Can be installed in PowerShell 5.1

PowerShell 7 module compatibility

Article • 06/28/2023

This article contains a partial list of PowerShell modules published by Microsoft.

The PowerShell team is working with the various feature teams that create PowerShell modules to help them produce modules that work in PowerShell 7. These modules are not owned by the PowerShell team.

The following modules are known to support PowerShell 7.

Azure PowerShell

The Az PowerShell module is a set of cmdlets for managing Azure resources directly from PowerShell. PowerShell 7.0.6 LTS or higher is the recommended version of PowerShell for use with the Azure Az PowerShell module on all platforms.

For more information, see Introducing the Azure Az PowerShell module.

MSGraph PowerShell SDK

The Microsoft Graph SDKs are designed to simplify building high-quality, efficient, and resilient applications that access Microsoft Graph. PowerShell 7 and later is the recommended PowerShell version for use with the Microsoft Graph PowerShell SDK.

For more information, see Install the Microsoft Graph PowerShell SDK.

Windows management modules

The Windows management modules provide management and support for various Windows features and services. Most of these modules have been updated to work natively with PowerShell 7, or tested for compatibility with PowerShell 7.

These modules are installed in different ways depending on the Edition of Windows, and how the module is packaged for that Edition.

For more information about installation and compatibility, see PowerShell 7 module compatibility in the Windows documentation.

Exchange Online Management 2.0

The Exchange Online PowerShell V2 module (EXO V2) connects to all Exchange-related PowerShell environments in Microsoft 365: Exchange Online PowerShell, Security & Compliance PowerShell, and standalone Exchange Online Protection (EOP) PowerShell.

EXO v2.0.4 or later is supported in PowerShell 7.0.3 or later.

For more information, see About the Exchange Online PowerShell V2 module.

PowerShell modules for SQL Server

There are two SQL Server PowerShell modules:

- **SqlServer**: This module includes new cmdlets to support the latest SQL features, including updated versions of the cmdlets in SQLPS.
- **SQLPS**: The SQLPS is the module used by SQL Agent to run agent jobs in agent job steps using the PowerShell subsystem.

The SqlServer modules require PowerShell version 5.0 or greater.

For more information, see Install the SQL Server PowerShell module.

Finding the status of other modules

You can find a complete list of modules using the PowerShell Module Browser. Using the Module Browser, you can find documentation for other PowerShell modules to determine their PowerShell version requirements.

Installing Windows PowerShell

Article • 10/25/2022

Windows PowerShell comes installed by default in every Windows, starting with Windows 7 SP1 and Windows Server 2008 R2 SP1.

If you are interested in PowerShell 7 and later, you need to install PowerShell instead of Windows PowerShell. For more information, see Installing PowerShell on Windows.

Finding PowerShell in Windows 11, 10, 8.1, 8.0, and 7

Sometimes locating PowerShell console or the Integrated Scripting Environment (ISE) in Windows can be difficult, as its location moves from one version of Windows to the next.

The following tables should help you find PowerShell in your Windows version. All versions listed here are the original version, as released, with no updates.

For Console

- For Windows 10 and 11 - Click Windows icon (lower left corner for Windows 10, lower center for Windows 11), start typing PowerShell.
- For Windows 8.1 - On the start screen, start typing PowerShell. If on desktop, click left lower corner Windows icon, start typing PowerShell.

For ISE

- For Windows 10 and 11 - Click Windows icon (lower left corner for Windows 10, lower center for Windows 11), start typing ISE.
- For Windows 8.1 - On the start screen, type **PowerShell ISE**. If on desktop, click left lower corner Windows icon, type **PowerShell ISE**.

Finding PowerShell in Windows Server versions

Starting with Windows Server 2008 R2, Windows operating system can be installed without the graphical user interface (GUI). Editions of Windows Server without GUI are named **Core** editions, and editions with the GUI are named **Desktop**.

Windows Server Core editions

In all Core editions, when you log to the server you get a Windows command prompt window.

Type `powershell` and press `ENTER` to start PowerShell inside the command prompt session. Type `exit` to close the PowerShell session and return to command prompt.

Windows Server Desktop editions

In all desktop editions, click the left lower corner Windows icon, start typing PowerShell. You get both console and ISE options.

The only exception to the above rule is the ISE in Windows Server 2008 R2 SP1. In this case, click the left lower corner Windows icon, type PowerShell ISE.

How to check the version of PowerShell

To find which version of PowerShell you have installed, start a PowerShell console (or the ISE) and type `$PSVersionTable` and press `ENTER`. Look for the `PSVersion` value.

Upgrading existing Windows PowerShell

The installation package for PowerShell comes inside a WMF installer. The version of the WMF installer matches the version of PowerShell. There's no stand alone installer for Windows PowerShell.

If you need to update your existing version of PowerShell, in Windows, use the following table to locate the installer for the version of PowerShell you want to update to.

Windows	**PS 3.0**	**PS 4.0**	**PS 5.0**	**PS 5.1**
Windows 11 Windows Server 2022	-	-	-	installed
Windows 10 (see Note1) Windows Server 2016	-	-	-	installed
Windows 8.1 Windows Server 2012 R2	-	installed	not supported	WMF 5.1
Windows 8 Windows Server 2012	installed	not supported	not supported	WMF 5.1

Windows	PS 3.0	PS 4.0	PS 5.0	PS 5.1
Windows 7 SP1 Windows Server 2008 R2 SP1	not supported	not supported	not supported	WMF 5.1

> **Note**
>
> On the initial release of Windows 10, with automatic updates enabled, PowerShell gets updated from version 5.0 to 5.1. If the original version of Windows 10 is not updated through Windows Updates, the version of PowerShell is 5.0.

Need Azure PowerShell

If you're looking for **Azure PowerShell**, you could start with Overview of Azure PowerShell.

See Also

- Windows PowerShell System Requirements
- Starting Windows PowerShell

Installing the Windows PowerShell 2.0 Engine

Article • 10/25/2022

This topic explains how to install the Windows PowerShell 2.0 Engine.

Windows PowerShell 3.0 is designed to be backwards compatible with Windows PowerShell 2.0. Cmdlets, providers, snap-ins, modules, and scripts written for Windows PowerShell 2.0 run unchanged in Windows PowerShell 3.0 and Windows PowerShell 4.0. However, due to a change in the runtime activation policy in Microsoft .NET Framework 4, Windows PowerShell host programs that were written for Windows PowerShell 2.0 and compiled with Common Language Runtime (CLR) 2.0 cannot run without modification in later releases of Windows PowerShell, which is compiled with CLR 4.0.

To maintain backward compatibility with commands and host programs that are affected by these changes, the Windows PowerShell 2.0, Windows PowerShell 3.0, and Windows PowerShell 4.0 engines are designed to run side-by-side. Also, the Windows PowerShell 2.0 Engine is included in Windows Server 2012 R2, Windows 8.1, Windows 8, Windows Server 2012, and Windows Management Framework 3.0. The Windows PowerShell 2.0 Engine is intended to be used only when an existing script or host program cannot run because it is incompatible with Windows PowerShell 3.0, Windows PowerShell 4.0, or Microsoft .NET Framework 4. Such cases are expected to be rare.

The Windows PowerShell 2.0 Engine is an optional feature of Windows Server 2012 R2, Windows 8.1, Windows 8 and Windows Server 2012. On earlier versions of Windows, when you install Windows Management Framework 3.0, the Windows PowerShell 3.0 installation completely replaces the Windows PowerShell 2.0 installation in the Windows PowerShell installation directory. However, the Windows PowerShell 2.0 Engine is retained.

For information about starting the Windows PowerShell 2.0 Engine, see Starting the Windows PowerShell 2.0 Engine.

On Windows 8.1 and Windows 8

On Windows 8.1 and Windows 8, the Windows PowerShell 2.0 Engine feature is turned on by default. However, to use it, you need to turn on the option for Microsoft .NET Framework 3.5, which it requires. This section also explains how to turn the Windows PowerShell 2.0 Engine feature on and off.

To turn on .NET Framework 3.5

1. On the **Start** screen, type **Windows Features**.
2. On the **Apps** bar, click **Settings**, and then click **Turn Windows features on or off**.
3. In the **Windows Features** box, click **.NET Framework 3.5 (includes .NET 2.0 and 3.0** to select it.

   When you select **.NET Framework 3.5 (includes .NET 2.0 and 3.0**, the box fills to indicate that only part of the feature is selected. However, this is sufficient for the Windows PowerShell 2.0 Engine.

To turn the Windows PowerShell 2.0 Engine on and off

1. On the **Start** screen, type **Windows Features**.
2. On the **Apps** bar, click **Settings**, and then click **Turn Windows features on or off**.
3. In the **Windows Features** box, expand the **Windows PowerShell 2.0** node, and click the **Windows PowerShell 2.0 Engine** box to select or clear it.

On Windows Server 2012 R2 and Windows Server 2012

Use the following procedures to add the Windows PowerShell 2.0 Engine and Microsoft .NET Framework 3.5 features. The Windows PowerShell 2.0 Engine requires Microsoft .NET Framework 2.0.50727 at a minimum. This requirement is fulfilled by Microsoft .NET Framework 3.5.

To add the .NET Framework 3.5 feature

1. In **Server Manager**, from the **Manage** menu, select **Add Roles and Features**.

   Or in **Server Manager**, click **All Servers**, right-click a server name, and then select **Add Roles and Features**.

2. On the **Installation Type** page, select **Role-based or feature-based installation**.

3. On the **Features** page, expand the **.NET 3.5 Framework Features** node and select **.NET Framework 3.5 (includes .NET 2.0 and 3.0)**.

   The other options under that node are not required for the Windows PowerShell 2.0 Engine.

To add the Windows PowerShell 2.0 Engine feature

- In **Server Manager**, from the **Manage** menu, select **Add Roles and Features**.

  Or **Server Manager**, click **All Servers**, right-click a server name, and then select **Add Roles and Features**.

- On the **Installation Type** page, select **Role-based or feature-based installation**.

- On the **Features** page, expand the **Windows PowerShell (Installed)** node and select **Windows PowerShell 2.0 Engine**.

For information about starting the Windows PowerShell 2.0 Engine, see Starting the Windows PowerShell 2.0 Engine.

See Also

- Windows PowerShell System Requirements
- Installing Windows PowerShell
- Starting Windows PowerShell)
- Starting the Windows PowerShell 2.0 Engine

Windows PowerShell System Requirements

Article • 10/25/2022

This article lists the system requirements for Windows PowerShell 3.0, Windows PowerShell 4.0, Windows PowerShell 5.0, and Windows PowerShell 5.1. And, special features, such as Windows PowerShell Integrated Scripting Environment (ISE), Common Information Model (CIM) commands, and workflows.

Windows 8.1 and Windows Server 2012 R2 include all required programs. This article is designed for users of earlier releases of Windows.

Operating system requirements

Windows PowerShell 5.1

Windows PowerShell 5.1 runs on the following versions of Windows. To run Windows PowerShell 5.1, install Windows Management Framework 5.1. For more information, see Install and Configure WMF 5.1.

Windows version	System requirement
Windows Server 2022	Installed by default
Windows Server 2019	Installed by default
Windows Server 2016	Installed by default
Windows Server 2012 R2	Install Windows Management Framework 5.1
Windows Server 2012	Install Windows Management Framework 5.1
Windows Server 2008 R2 with Service Pack 1	Install Windows Management Framework 5.1
Windows 11	Installed by default
Windows 10 version 1607 and up	Installed by default
Windows 10 version 1507, 1511	Install Windows Management Framework 5.1
Windows 8.1	Install Windows Management Framework 5.1
Windows 7 with Service Pack 1	Install Windows Management Framework 5.1

Windows PowerShell 5.0

Windows Management Framework 5.1 supersedes Windows Management Framework 5.0. For more information, see Install and Configure WMF 5.1.

Windows version	System requirement
Windows Server 2022	Higher version installed by default
Windows Server 2019	Higher version installed by default
Windows Server 2016	Higher version installed by default
Windows Server 2012 R2	Install Windows Management Framework 5.1
Windows Server 2012	Install Windows Management Framework 5.1
Windows Server 2008 R2 with Service Pack 1	Install Windows Management Framework 5.1
Windows 11	Higher version installed by default
Windows 10 version 1607 and up	Higher version installed by default
Windows 10 version 1507, 1511	Installed by default
Windows 8.1	Install Windows Management Framework 5.1
Windows 7 with Service Pack 1	Install Windows Management Framework 5.1

Windows PowerShell 4.0

Windows PowerShell 4.0 runs on the following versions of Windows.

Windows version	System requirement
Windows 8.1	Installed by default
Windows Server 2012 R2	Installed by default

Windows PowerShell 3.0

Windows PowerShell 3.0 runs on the following versions of Windows.

Windows version	System requirement
Windows 8	Installed by default
Windows Server 2012	Installed by default

Microsoft .NET Framework requirements

Windows PowerShell 5.1 requires the full installation of Microsoft .NET Framework 4.5 or higher.

Windows Management Framework 4.0

Windows PowerShell 5.0 requires Windows Management Framework 4.0 to be preinstalled on Windows Server 2008 R2 SP1 and Windows 7 SP1.

WS-Management 3.0

Windows PowerShell 3.0 and Windows PowerShell 4.0 require WS-Management 3.0, which supports the WinRM service and WSMan protocol. This program is included in Windows 8.1, Windows Server 2012 R2, Windows 8, Windows Server 2012, Windows Management Framework 4.0, and Windows Management Framework 3.0.

Windows Management Instrumentation 3.0

Windows PowerShell 3.0 and Windows PowerShell 4.0 require Windows Management Instrumentation 3.0 (WMI). This program is included in Windows 8.1, Windows Server 2012 R2, Windows 8, Windows Server 2012, Windows Management Framework 4.0, and Windows Management Framework 3.0. If this program isn't installed on the computer, features that require WMI, such as CIM commands, don't run.

Common Language Runtime 4.0

Windows PowerShell 3.0, Windows PowerShell 4.0, and Windows PowerShell 5.0 are compiled against Common Language Runtime (CLR) 4.0.

Graphical user interface requirements

Windows PowerShell is a console-based application that doesn't require a graphical user interface. It's well suited to computers that don't have screens or monitors, or a user interface, such as the Server Core installation options of Windows Server 2012 R2 or Windows Server 2012.

Some items require a graphical user interface. For details, see the help article for each item.

- Windows PowerShell Integrated Scripting Environment (ISE). For more information, see Introducing the Windows PowerShell ISE.
- Cmdlets
  - Out-GridView
  - Show-Command
  - Show-ControlPanelItem
  - Show-EventLog
- Parameters
  - **ShowWindow** parameter of the Get-Help cmdlet.
  - **ShowSecurityDescriptorUI** parameter of the Register-PSSessionConfiguration and Set-PSSessionConfiguration cmdlets.

Windows PowerShell engine requirements

Windows PowerShell 4.0 is designed to be backwards compatible with Windows PowerShell 3.0 and Windows PowerShell 2.0. Cmdlets, providers, snap-ins, modules, and scripts written for Windows PowerShell 2.0 and Windows PowerShell 3.0 run unchanged in Windows PowerShell 4.0.

However, due to a change in the runtime activation policy in Microsoft .NET Framework 4, Windows PowerShell host programs that were written for Windows PowerShell 2.0 and compiled with Common Language Runtime (CLR) 2.0 can't run without modification in Windows PowerShell 3.0, which is compiled with CLR 4.0.

The Windows PowerShell 2.0 engine's minimum requirement is Microsoft .NET Framework 2.0.50727. This requirement is fulfilled by Microsoft .NET Framework 3.5 Service Pack 1. This requirement isn't fulfilled by Microsoft .NET Framework 4 and later releases of Microsoft .NET Framework.

For information about adding or installing the Windows PowerShell 2.0 engine, and adding or installing the required versions of the Microsoft .NET Framework, see Installing the Windows PowerShell 2.0 Engine. For information about starting the Windows PowerShell 2.0 engine, see Starting the Windows PowerShell 2.0 Engine.

Windows Preinstallation Environment

Windows PowerShell 2.0, Windows PowerShell 3.0, and Windows PowerShell 4.0 run in the Windows Preinstallation Environment (Windows PE). However, the following cmdlets aren't supported.

- Background Intelligent Transfer Service (BITS) cmdlets. For more information, see BitsTransfer.
- Get-EventLog
- Get-WinEvent
- Save-Help
- Update-Help

The **WinRM** service isn't present on Windows PE.

For information on installing Windows PowerShell 5.1 on Windows PE, see Adding Windows PowerShell support to Windows PE.

See also

- Installing Windows PowerShell
- Starting Windows PowerShell
- Windows Management Framework

Optimizing your shell experience

Article • 12/01/2022

PowerShell is a command-line shell and a scripting language used for automation.

Wikipedia includes the following description of a shell:

> A shell manages the user-system interaction by prompting users for input, interpreting their input, and then handling output from the underlying operating system (much like a read-eval-print loop or REPL).

Similar to other shells like `bash` or `cmd.exe`, PowerShell allows you to run any command available on your system, not just PowerShell commands.

PowerShell commands are known as *cmdlets* (pronounced command-lets). Cmdlets are PowerShell commands, not stand-alone executables. PowerShell commands can't be run in other shells without running PowerShell first.

Features of the PowerShell command-line interface

PowerShell is a modern command shell that includes the best features of other popular shells. Unlike most shells that only accept and return text, PowerShell accepts and returns .NET objects. The shell has several features that you can use to optimize your interactive user experience.

- Robust command-line history
- Tab completion and command prediction
- Supports command and parameter aliases
- Pipeline for chaining commands
- In-console help system, similar to Unix `man` pages

What's New in Windows PowerShell 5.0

Article • 12/16/2022

Windows PowerShell 5.0 includes significant new features that extend its use, improve its usability, and allow you to control and manage Windows-based environments more easily and comprehensively.

Windows PowerShell 5.0 is backward-compatible. Cmdlets, providers, modules, snap-ins, scripts, functions, and profiles that were designed for Windows PowerShell 4.0, Windows PowerShell 3.0, and Windows PowerShell 2.0 generally work in Windows PowerShell 5.0 without changes.

Installing Windows PowerShell

Windows PowerShell 5.0 is installed by default on Windows Server 2016 Technical Preview and Windows 10.

To install Windows PowerShell 5.0 on Windows Server 2012 R2, Windows 8.1 Enterprise, or Windows 8.1 Pro, download and install Windows Management Framework 5.0. Be sure to read the download details, and meet all system requirements, before you install Windows Management Framework 5.0.

In this topic

- Windows PowerShell 4.0 DSC updates in KB 3000850
- New features in Windows PowerShell 5.0
- New features in Windows PowerShell 4.0
- New features in Windows PowerShell 3.0

Windows PowerShell 4.0 updates in November 2014 update rollup (KB 3000850)

Many updates and improvements to Windows PowerShell Desired State Configuration (DSC) in Windows PowerShell 4.0 are available in the November 2014 update rollup for Windows RT 8.1, Windows 8.1, and Windows Server 2012 R2 (KB3000850). You can determine if KB3000850 is installed on your system by running `Get-Hotfix -Id KB3000850` in Windows PowerShell.

- Updates to existing cmdlets in the PSDesiredStateConfiguration module

    - Get-DscResource is faster (especially in ISE).
    - Start-DscConfiguration has a new parameter, -UseExisting, which reapplies the last applied configuration.
    - Start-DscConfiguration -Force has been fixed.
    - Get-DscLocalConfigurationManager displays more useful information about the engine state.
    - Test-DscConfiguration now returns the computer name along with True or False.
    - New-DscChecksum now supports UNC paths.

- New cmdlets in the PSDesiredStateConfiguration module
    - Update-DscConfiguration: Performs an on-demand pull server check.
    - Stop-DscConfiguration: Stops a configuration that is already running.
    - Remove-DscConfigurationDocument: Lets you remove configuration documents in various stages (pending, previous, or current).

- Language enhancements
    - DependsOn now supports composite resources.
    - DependsOn now supports numbers in resource instance names.
    - Node expressions that evaluate to empty no longer throw errors.
    - An error that occurs if a node expression evaluates to empty has been fixed.
    - Configurations calling configurations now work in the Windows PowerShell console.

- Pull mode enhancements
    - Pull mode now supports all ZIP files.
    - **AllowModuleOverwrite** now works correctly.

- Resiliency improvements
    - New **DebugMode** lets you reload resource modules.
    - If a configuration failure occurs, the pending.mof file is not deleted.
    - The Local Configuration Manager (LCM) is now more resilient when metaconfiguration settings have become corrupted.

- Diagnostic improvements
    - A warning is displayed when the LCM sets the timer to different settings than you have specified.
    - Error log files now contain the call stack for Windows PowerShell resources.

- Flexibility improvements
    - The LocalConfigurationManager resource has a new property, **ActionAfterReboot**.
        - ContinueConfiguration (default value): Automatically resumes a configuration after a target node restarts.

    - StopConfiguration: Do not automatically resume a configuration after a node restarts.
  - A consistency run can now occur more often than a PULL operation, or vice-versa.
  - Versioning support: DSC can now recognize a document that was generated on a newer client (included with WMF 5.0).

- Error prevention improvements
  - Module version is now enforced before a configuration is applied.
  - **DebugPreference** is now set correctly for Get-, Set-, or Test-TargetResource calls.

- Credential handling improvements
  - A certificate is now used, if both **Certificate** and **PSDscAllowPlainTextPassword** are specified.
  - Credentials are decrypted, even for Get-TargetResource.
  - Metaconfiguration credentials are encrypted and decrypted.
  - PSCredentials are now decrypted when they are in an embedded object.

- Built-in resource improvements
  - The Package resource
    - No longer installs the wrong package (either from local or web sources).
    - Now supports HTTPS.
  - There is now support for HTTPS in the Package resource.
  - Archive resource now supports credentials.

New features in Windows PowerShell 5.0

- New features in Windows PowerShell
- New features in Windows PowerShell Desired State Configuration
- New features in Windows PowerShell ISE
- New features in Windows PowerShell Web Services
- Notable bug fixes in Windows PowerShell 5.0

New features in Windows PowerShell

- Starting in Windows PowerShell 5.0, you can develop using classes, formal syntax, and semantics that are similar to other object-oriented programming languages. **Class**, **Enum**, and other keywords have been added to the Windows PowerShell language to support the new feature. For more information about working with classes, see about_Classes.

- Windows PowerShell 5.0 introduces a new, structured information stream that you can use to transmit structured data between a script and its callers (or hosting environment). You can now use Write-Host to emit output to the information stream. Information streams also work for PowerShell.Streams, jobs, scheduled jobs, and workflows. The following features support the information stream.
  - A new Write-Information cmdlet that lets you specify how Windows PowerShell handles information stream data for a command. Write-Host is a wrapper for Write-Information. Write-Information is also a supported workflow activity.
  - Two new common parameters, InformationVariable and InformationAction, let you determine how information streams from a command are displayed. Valid values for InformationAction are SilentlyContinue, Stop, Continue, Inquire, Ignore, or Suspend, with SilentlyContinue being the default. InformationVariable specifies a string as the name of a variable to which you want the Write-Host data from a command saved.
  - A new preference variable, InformationPreference, specifies your default preference for information stream data in a Windows PowerShell session. The default value is SilentlyContinue.
  - Two new workflow common parameters, PSInformation and InformationAction, have been added.
  - When you use the Format-Table command, table columns are now automatically formatted by evaluating the first 300ms of data that passes through the stream.

- In collaboration with Microsoft Research, a new cmdlet, ConvertFrom-String, has been added. ConvertFrom-String lets you extract and parse structured objects from the content of text strings. For more information, see ConvertFrom-String.

- A new Convert-String cmdlet automatically formats text based on an example that you provide in an -Example parameter.

- A new module, Microsoft.PowerShell.Archive, includes cmdlets that let you compress files and folders into archive (also known as ZIP) files, extract files from existing ZIP files, and update ZIP files with newer versions of files compressed within them.

- A new module, PackageManagement, lets you discover and install software packages on the Internet. The PackageManagement (formerly known as OneGet) module is a manager or multiplexer of existing package managers (also called package providers) to unify Windows package management with a single Windows PowerShell interface.

- A new module, PowerShellGet, lets you find, install, publish, and update modules and DSC resources on the PowerShell Gallery, or on an internal module repository that you can set up by running the Register-PSRepository cmdlet.

- A new language keyword, **Hidden**, has been added to specify that a member (a property or a method) is not shown by default in Get-Member results (unless you add the -Force parameter). Properties or methods that have been marked hidden also do not show up in IntelliSense results, unless you are in a context where the member should be visible; for example, the automatic variable $This should show hidden members when in the class method.

- New-Item, Remove-Item, and Get-ChildItem have been enhanced to support creating and managing symbolic links. The **-ItemType** parameter for New-Item accepts a new value, **SymbolicLink**. Now you can create symbolic links in a single line by running the New-Item cmdlet.

- Get-ChildItem also has a new -Depth parameter, which you use with the -Recurse parameter to limit the recursion. For example, Get-ChildItem -Recurse -Depth 2 returns results from the current folder, all of the child folders within the current folder, and all of the folders within the child folders.

- Copy-Item now lets you copy files or folders from one Windows PowerShell session to another, meaning that you can copy files to sessions that are connected to remote computers, (including computers that are running Nano Server, and thus have no other interface). To copy files, specify PSSession IDs as the value of the new -FromSession and -ToSession parameters, and add -Path and -Destination to specify origin path and destination, respectively. For example, Copy-Item -Path c:\myFile.txt -ToSession $s -Destination d:\destinationFolder.

- Windows PowerShell transcription has been improved to apply to all hosting applications (such as Windows PowerShell ISE) in addition to the console host (**powershell.exe**). Transcription options (including enabling a system-wide transcript) can be configured by enabling the **Turn on PowerShell Transcription** Group Policy setting, found in Administrative Templates/Windows Components/Windows PowerShell.

- A new detailed script tracing feature lets you enable detailed tracking and analysis of Windows PowerShell scripting use on a system. After you enable detailed script tracing, Windows PowerShell logs all script blocks to the Event Tracing for Windows (ETW) event log, **Microsoft-Windows-PowerShell/Operational**.

- Starting in Windows PowerShell 5.0, new Cryptographic Message Syntax cmdlets support encryption and decryption of content using the IETF standard format for

cryptographically protecting messages as documented by RFC5652. The Get-CmsMessage, Protect-CmsMessage, and Unprotect-CmsMessage cmdlets have been added to the Microsoft.PowerShell.Security module.

- New cmdlets in the Microsoft.PowerShell.Utility module, Get-Runspace, Debug-Runspace, Get-RunspaceDebug, Enable-RunspaceDebug, and Disable-RunspaceDebug, let you set debug options on a runspace, and start and stop debugging on a runspace. For debugging arbitrary runspaces (that is, runspaces that are not the default runspace for a Windows PowerShell console or Windows PowerShell ISE session) Windows PowerShell lets you set breakpoints in a script, and have added breakpoints stop the script from running until you can attach a debugger to debug the runspace script. Nested debugging support for arbitrary runspaces has been added to the Windows PowerShell script debugger for runspaces.

- A new Format-Hex cmdlet has been added to the Microsoft.PowerShell.Utility module. Format-Hex lets you view text or binary data in hexadecimal format.

- Get-Clipboard and Set-Clipboard cmdlets have been added to the Microsoft.PowerShell.Utility module; they ease the transfer of content to and from a Windows PowerShell session. The Clipboard cmdlets support images, audio files, file lists, and text.

- A new cmdlet, Clear-RecycleBin, has been added to the Microsoft.PowerShell.Management module; this cmdlet empties the Recycle Bin for a fixed drive, which includes external drives. By default, you are prompted to confirm a Clear-RecycleBin command, because the ConfirmImpact property of the cmdlet is set to ConfirmImpact.High.

- A new cmdlet, New-TemporaryFile, lets you create a temporary file as part of scripting. By default, the new temporary file is created in `C:\Users\<user name>\AppData\Local\Temp`.

- The Out-File, Add-Content, and Set-Content cmdlets now have a new -NoNewline parameter, which omits a new line after the output.

- The New-Guid cmdlet leverages the .NET Framework Guid class to generate a GUID, useful when you are writing scripts or DSC resources.

- Because file version information can be misleading, particularly after a file is patched, new FileVersionRaw and ProductVersionRaw script properties are available for FileInfo objects. For example, you can run the following command to display the values of these properties for powershell.exe, where $pid contains the

process ID for a running session of Windows PowerShell: `Get-Process -Id $pid -FileVersionInfo | Format-List *version* -Force`

- New cmdlets Enter-PSHostProcess and Exit-PSHostProcess let you debug Windows PowerShell scripts in processes separate from the current process that is running in the Windows PowerShell console. Run Enter-PSHostProcess to enter, or attach to, a specific process ID, and then run Get-Runspace to return the active runspaces within the process. Run Exit-PSHostProcess to detach from the process when you are finished debugging the script within the process.

- A new Wait-Debugger cmdlet has been added to the Microsoft.PowerShell.Utility module. You can run Wait-Debugger to stop a script in the debugger before running the next statement in the script.

- The Windows PowerShell Workflow debugger now supports command or tab completion, and you can debug nested workflow functions. You can now press **Ctrl+Break** to enter the debugger in a running script, in both local and remote sessions, and in a workflow script.

- A Debug-Job cmdlet has been added to the Microsoft.PowerShell.Core module to debug running job scripts for Windows PowerShell Workflow, background, and jobs running in remote sessions.

- A new state, AtBreakpoint, has been added for Windows PowerShell jobs. The AtBreakpoint state applies when a job is running a script that includes set breakpoints, and the script has hit a breakpoint. When a job is stopped at a debug breakpoint, you must debug the job by running the Debug-Job cmdlet.

- Windows PowerShell 5.0 implements support for multiple versions of a single Windows PowerShell module in the same folder in $PSModulePath. A RequiredVersion property has been added to the ModuleSpecification class to help you get the desired version of a module; this property is mutually exclusive with the ModuleVersion property. RequiredVersion is now supported as part of the value of the FullyQualifiedName parameter of the Get-Module, Import-Module, and Remove-Module cmdlets.

- You can now perform module version validation by running the Test-ModuleManifest cmdlet.

- Results of the Get-Command cmdlet now display a Version column; a new Version property has been added to the CommandInfo class. Get-Command shows commands from multiple versions of the same module. The Version property is also part of derived classes of CmdletInfo: CmdletInfo and ApplicationInfo.

- Get-Command has a new parameter, -ShowCommandInfo, that returns ShowCommand information as PSObjects. This is especially useful functionality for when Show-Command is run in Windows PowerShell ISE using Windows PowerShell remoting. The -ShowCommandInfo parameter replaces the existing Get-SerializedCommand function in the Microsoft.PowerShell.Utility module, but the Get-SerializedCommand script is still available to support downlevel scripting.

- A new Get-ItemPropertyValue cmdlet lets you get the value of a property without using dot notation. For example, in older releases of Windows PowerShell, you can run the following command to get the value of the Application Base property of the PowerShellEngine registry key: **(Get-ItemProperty -Path HKLM:\SOFTWARE\Microsoft\PowerShell\3\PowerShellEngine -Name ApplicationBase).ApplicationBase**. Starting in Windows PowerShell 5.0, you can run **Get-ItemPropertyValue -Path HKLM:\SOFTWARE\Microsoft\PowerShell\3\PowerShellEngine -Name ApplicationBase**.

- The Windows PowerShell console now uses syntax coloring, just as in Windows PowerShell ISE.

- A new NetworkSwitch module contains cmdlets that enable you to apply switch, virtual LAN (VLAN), and basic Layer 2 network switch port configuration to Windows Server 2012 R2 logo-certified network switches.

- The FullyQualifiedName parameter has been added to Import-Module and Remove-Module cmdlets, to support storing multiple versions of a single module.

- Save-Help, Update-Help, Import-PSSession, Export-PSSession, and Get-Command have a new parameter, FullyQualifiedModule, of type ModuleSpecification. Add this parameter to specify a module by its fully qualified name.

- The value of **$PSVersionTable.PSVersion** has been updated to 5.0.

- WMF 5.0 (PowerShell 5.0) includes the **Pester** module. Pester is a unit testing framework for PowerShell. It provides a few simple-to-use keywords that let you create tests for your scripts.

New features in Windows PowerShell Desired State Configuration

- Windows PowerShell language enhancements let you define Windows PowerShell Desired State Configuration (DSC) resources using classes. Import-DscResource is now a true dynamic keyword; Windows PowerShell parses the specified module's

root module, searching for classes that contain the DscResource attribute. You can now use classes to define DSC resources, in which neither a MOF file nor a DSCResource subfolder in the module folder is required. A Windows PowerShell module file can contain multiple DSC resource classes.

- A new parameter, ThrottleLimit, has been added to the following cmdlets in the PSDesiredStateConfiguration module. Add the ThrottleLimit parameter to specify the number of target computers or devices on which you want the command to work at the same time.
  - Get-DscConfiguration
  - Get-DscConfigurationStatus
  - Get-DscLocalConfigurationManager
  - Restore-DscConfiguration
  - Test-DscConfiguration
  - Compare-DscConfiguration
  - Publish-DscConfiguration
  - Set-DscLocalConfigurationManager
  - Start-DscConfiguration
  - Update-DscConfiguration
- With centralized DSC error reporting, rich error information is not only logged in the event log, but it can be sent to a central location for later analysis. You can use this central location to store DSC configuration errors that have occurred for any server in their environment. After the report server is defined in the meta-configuration, all errors are sent to the report server, and then stored in a database. You can set up this functionality regardless of whether or not a target node is configured to pull configurations from a pull server.
- Improvements to Windows PowerShell ISE ease DSC resource authoring. You can now do the following.
  - List all DSC resources within a **configuration** or **node** block by entering **Ctrl+Space** on a blank line within the block.
  - Automatic completion on resource properties of the **enumeration** type.
  - Automatic completion on the **DependsOn** property of DSC resources, based on other resource instances in the configuration.
  - Improved tab completion of resource property values.
- A user can now run a resource under a specified set of credentials by adding the **PSDscRunAsCredential** attribute to a Node block. For example, PSDscRunAsCredential = Get-Credential Contoso\DscUser. This functionality is useful for creating configurations that run Windows Installer and executable installers, access the per-user registry hive, or perform other tasks outside the current user context.
- 32-bit (x86-based) support has been added for the **Configuration** keyword.

- Windows PowerShell now includes support for custom help for DSC configurations, defined by adding [CmdletBinding()] to the generated configuration function.
- A new **DscLocalConfigurationManager** attribute designates a configuration block as a meta-configuration, which is used to configure the DSC Local Configuration Manager. This attribute restricts a configuration to containing only items which configure the DSC Local Configuration Manager. During processing, this configuration generates a *.meta.mof file that is then sent to the appropriate target nodes by running the Set-DscLocalConfigurationManager cmdlet.
- Partial configurations are now allowed in Windows PowerShell 5.0. You can deliver configuration documents to a node in fragments. For a node to receive multiple fragments of a configuration document, the node's Local Configuration Manager must be first set to specify the expected fragments
- Cross-computer synchronization is new in DSC in Windows PowerShell 5.0. using the built-in WaitFor* resources (**WaitForAll**, **WaitForAny**, and **WaitForSome**), you can now specify dependencies across computers during configuration runs, without external orchestrations. These resources provide node-to-node synchronization using CIM connections over the WS-Man protocol. A configuration can wait for another computer's specific resource state to change.
- Just Enough Administration (JEA), a new delegation security feature, leverages DSC and Windows PowerShell constrained runspaces to help secure enterprises from data loss or compromise by employees, whether intentional or unintentional. For more information about JEA, including where you can download the xJEA DSC resource, see Just Enough Administration.
- The following new cmdlets have been added to the PSDesiredStateConfiguration module.
  - A new Get-DscConfigurationStatus cmdlet gets high-level information about configuration status from a target node. You can obtain the status of the last, or of all configurations.
  - A new Compare-DscConfiguration cmdlet compares a specified configuration with the actual state of one or more target nodes.
  - A new Publish-DscConfiguration cmdlet copies a configuration MOF file to a target node, but does not apply the configuration. The configuration is applied during the next consistency pass, or when you run the Update-DscConfiguration cmdlet.
  - A new Test-DscConfiguration cmdlet lets you verify that a resulting configuration matches the desired configuration, returning either True if the configuration matches the desired configuration, or False if the actual configuration does not match the desired configuration.
  - A new Update-DscConfiguration cmdlet forces a configuration to be processed. If the Local Configuration Manager is in pull mode, the cmdlet gets the

configuration from the pull server before applying it.

New features in Windows PowerShell ISE

- You can now edit remote Windows PowerShell scripts and files in a local copy of Windows PowerShell ISE, by running Enter-PSSession to start a remote session on the computer that's storing the files you want to edit, and then running **PSEdit <path and file name on the remote computer>**. This feature eases editing Windows PowerShell files that are stored on the Server Core installation option of Windows Server, where Windows PowerShell ISE cannot run.
- The Start-Transcript cmdlet is now supported in Windows PowerShell ISE.
- You can now debug remote scripts in Windows PowerShell ISE.
- A new menu command, **Break All** (Ctrl+B), breaks into the debugger for both local and remotely-running scripts.

New features in Windows PowerShell Web Services (Management OData IIS Extension)

- Starting in Windows PowerShell 5.0, you can generate a set of Windows PowerShell cmdlets based on the functionality exposed by a given OData endpoint, by running the Export-ODataEndpointProxy cmdlet, found in the new Microsoft.PowerShell.OdataUtils module.

Notable bug fixes in Windows PowerShell 5.0

- Windows PowerShell 5.0 includes a new COM implementation, which offers significant performance improvements when you are working with COM objects.
- Significant performance improvements have been made to the first tab completion in a Windows PowerShell session, shortening tab completion time by nearly 500 ms.

New features in Windows PowerShell 4.0

Windows PowerShell 4.0 is backward-compatible. Cmdlets, providers, modules, snap-ins, scripts, functions, and profiles that were designed for Windows PowerShell 3.0 and Windows PowerShell 2.0 work in Windows PowerShell 4.0 without changes.

Windows PowerShell 4.0 is installed by default on Windows 8.1 and Windows Server 2012 R2. To install Windows PowerShell 4.0 on Windows 7 with SP1, or Windows Server 2008 R2, download and install Windows Management Framework 4.0. Be sure to read

the download details, and meet all system requirements, before you install Windows Management Framework 4.0.

- New features in Windows PowerShell
- New features in Windows PowerShell Integrated Scripting Environment (ISE)
- New features in Windows PowerShell Workflow
- New features in Windows PowerShell Web Services
- New features in Windows PowerShell Web Access
- Notable bug fixes in Windows PowerShell 4.0

Windows PowerShell 4.0 includes the following new features.

New features in Windows PowerShell

- **Windows PowerShell Desired State Configuration** (DSC) is a new management system in Windows PowerShell 4.0 that enables the deployment and management of configuration data for software services and the environment in which these services run. For more information about DSC, see Get Started with Windows PowerShell Desired State Configuration.
- **Save-Help** now lets you save help for modules that are installed on remote computers. You can use Save-Help to download module Help from an Internet-connected client (on which not all of the modules for which you want help are necessarily installed), and then copy the saved Help to a remote shared folder or a remote computer that does not have Internet access.
- The Windows PowerShell debugger has been enhanced to allow debugging of Windows PowerShell workflows, as well as scripts that are running on remote computers. Windows PowerShell workflows can now be debugged at the script level from either the Windows PowerShell command line or Windows PowerShell ISE. Windows PowerShell scripts, including script workflows, can now be debugged over remote sessions. Remote debugging sessions are preserved over Windows PowerShell remote sessions that are disconnected and then later reconnected.
- A **RunNow** parameter for **Register-ScheduledJob** and **Set-ScheduledJob** eliminates the need to set an immediate start date and time for jobs using the **Trigger** parameter.
- **Invoke-RestMethod** and **Invoke-WebRequest** now let you set all headers using the Headers parameter. Although this parameter has always existed, it was one of several parameters for the web cmdlets that resulted in exceptions or errors.
- **Get-Module** has a new parameter, **FullyQualifiedName**, of the type **ModuleSpecification[]**. The **FullyQualifiedName** parameter of Get-Module now lets you specify a module using the module's name, version, and optionally, its GUID.

- The default execution policy setting on Windows Server 2012 R2 is **RemoteSigned**. On Windows 8.1, there is no change in default setting.
- Starting in Windows PowerShell 4.0, method invocation using dynamic method names is supported. You can use a variable to store a method name, and then dynamically invoke the method by calling the variable.
- Asynchronous workflow jobs are no longer deleted when the time-out period that is specified by the **PSElapsedTimeoutSec** workflow common parameter has elapsed.
- A new parameter, **RepeatIndefinitely**, has been added to the **New-JobTrigger** and **Set-JobTrigger** cmdlets. This eliminates the necessity of specifying a **TimeSpan.MaxValue** value for the **RepetitionDuration** parameter to run a scheduled job repeatedly for an indefinite period.
- A **Passthru** parameter has been added to the **Enable-JobTrigger** and **Disable-JobTrigger** cmdlets. The Passthru parameter displays any objects that are created or modified by your command.
- The parameter names for specifying a workgroup in the **Add-Computer** and **Remove-Computer** cmdlets are now consistent. Both cmdlets now use the parameter **WorkgroupName**.
- A new common parameter, **PipelineVariable**, has been added. PipelineVariable lets you save the results of a piped command (or part of a piped command) as a variable that can be passed through the remainder of the pipeline.
- Collection filtering using a method syntax is now supported. This means that you can now filter a collection of objects using simplified syntax, similar to that for Where() or Where-Object, formatted as a method call. The following is an example: (Get-Process).where({$_.Name -match 'powershell'})
- The **Get-Process** cmdlet has a new switch parameter, **IncludeUserName**.
- A new cmdlet, **Get-FileHash**, that returns a file hash in one of several formats for a specified file, has been added.
- In Windows PowerShell 4.0, if a module uses the **DefaultCommandPrefix** key in its manifest, or if the user imports a module with the **Prefix** parameter, the **ExportedCommands** property of the module shows the commands in the module with the prefix. When you run the commands using the module-qualified syntax, ModuleName\CommandName, the command names must include the prefix.
- The value of **$PSVersionTable.PSVersion** has been updated to 4.0.
- **Where()** operator behavior has changed. `Collection.Where('property -match name')` accepting a string expression in the format `"Property -CompareOperator Value"` is no longer supported. However, the **Where()** operator accepts string expressions in the format of a scriptblock; this is still supported.

New features in Windows PowerShell Integrated Scripting Environment (ISE)

- Windows PowerShell ISE supports both Windows PowerShell Workflow debugging and remote script debugging.
- IntelliSense support has been added for Windows PowerShell Desired State Configuration providers and configurations.

New features in Windows PowerShell Workflow

- Support has been added for a new **PipelineVariable** common parameter in the context of iterative pipelines, such as those used by System Center Orchestrator; that is, pipelines that run commands simply left-to-right, as opposed to interspersed running using streaming.
- Parameter binding has been significantly enhanced to work outside of tab completion scenarios, such as with commands that do not exist in the current runspace.
- Support for custom container activities has been added to Windows PowerShell Workflow. If an activity parameter is of the types **Activity**, **Activity[]** (or is a generic collection of activities) and the user has supplied a script block as an argument, then Windows PowerShell Workflow converts the script block to XAML, as with normal Windows PowerShell script-to-workflow compilation.
- After a crash, Windows PowerShell Workflow automatically reconnects to managed nodes.
- You can now throttle **Foreach -Parallel** activity statements using the **ThrottleLimit** property.
- The **ErrorAction** common parameter has a new valid value, **Suspend**, that is exclusively for workflows.
- A workflow endpoint now automatically closes if there are no active sessions, no in-progress jobs, and no pending jobs. This feature conserves resources on the computer that is acting as the workflow server, when the automatic closure conditions have been met.

New features in Windows PowerShell Web Services

- When an error occurs in Windows PowerShell Web Services (PSWS, also called Management OData IIS Extension), while a cmdlet is running, more detailed error messages are returned to the caller. In addition, error codes follow Windows Azure REST API error code guidelines.

- An endpoint can now define the API version, as well as enforce the usage of a specific API version. Whenever version mismatches occur between client and server, errors are displayed to both the client and the server.
- Management of the dispatch schema has been simplified by automatically generating values for any missing fields in the schema. Generation occurs, as a helpful starting point, even if the dispatch schema does not exist.
- Type handling in PSWS has been improved to support types that use a different constructor than the default constructor, by behaving similarly to the **PSTypeConverter** in Windows PowerShell. This lets you use complex types with PSWS.
- PSWS now allows expanding an associated instance while running a query. For larger binary contents (such as images, audio, or video), the transfer cost is significant, and it is better to transfer binary data without encoding. PSWS uses named resource streams for transferring without encoding. The named resource stream is a property of an entity of the **Edm.Stream** type. Each named resource stream has a separate URI for GET or UPDATE operations.
- OData actions now provide a mechanism for invoking non-CRUD (Create, Read, Update, and Delete) methods on a resource. You can invoke an action by sending an HTTP POST request to the URI that is defined for the action. The parameters for the action are defined in the body of the POST request.
- To be consistent with Windows Azure guidelines, all URLs should be simplified. A change included in **Key As Segment** allows single keys to be represented as segments. Note that references that use multiple key values require comma-separated values in parenthetical notation, as before.
- Before this release of PSWS, the only way to perform Create, Update, or Delete operations was to invoke Post, Put, or Delete on a top-level resource. New in this release of PSWS, Contained Resource operations let users achieve the same results while reaching the same resource less directly, approaching as if these resources were contained.

New features in Windows PowerShell Web Access

- You can disconnect from and reconnect to existing sessions in the web-based Windows PowerShell Web Access console. A **Save** button in the web-based console lets you disconnect from a session without deleting it and reconnect to the session another time.
- Default parameters can be displayed on the sign-in page. To display default parameters, configure values for all of the settings displayed in the **Optional Connection Settings** area of the sign-in page in a file named **web.config**. You can

use the **web.config** file to configure all optional connection settings except for a second or alternate set of credentials.
- In Windows Server 2012 R2, you can remotely manage authorization rules for Windows PowerShell Web Access. The **Add-PswaAuthorizationRule** and **Test-PswaAuthorizationRule** cmdlets now include a Credential parameter that enables administrators to manage authorization rules from a remote computer or in a Windows PowerShell Web Access session.
- You can now have multiple Windows PowerShell Web Access sessions in a single browser session by using a new browser tab for each session. You no longer need to open a new browser session to connect to a new session in the web-based Windows PowerShell console.

Notable bug fixes in Windows PowerShell 4.0

- **Get-Counter** can now return counters that contain an apostrophe character in French editions of Windows.
- You can now view the **GetType** method on deserialized objects.
- **#Requires** statements now let users require Administrator access rights, if needed.
- The **Import-Csv** cmdlet now ignores blank lines.
- A problem where Windows PowerShell ISE uses too much memory when you are running an **Invoke-WebRequest** command has been fixed.
- **Get-Module** now displays module versions in a **Version** column.
- Remove-Item -Recurse now removes items from subfolders as expected.
- A **UserName** property has been added to **Get-Process** output objects.
- The **Invoke-RestMethod** cmdlet now returns all available results.
- **Add-Member** now takes effect on hashtables, even if the hashtables have not yet been accessed.
- **Select-Object -Expand** no longer fails or generates an exception if the value of the property is null or empty.
- **Get-Process** can now be used in a pipeline with other commands that get the **ComputerName** property from objects.
- **ConvertTo-Json** and **ConvertFrom-Json** can now accept terms within double quotes, and its error messages are now localizable.
- **Get-Job** now returns any completed scheduled jobs, even in new sessions.
- Issues with mounting and unmounting VHDs using the **FileSystem** provider in Windows PowerShell 4.0 have been fixed. Windows PowerShell is now able to detect new drives when they are mounted in the same session.
- You no longer need to explicitly load **ScheduledJob** or **Workflow** modules to work with their job types.

- Performance improvements have been made to the process of importing workflows that define nested workflows; this process is now faster.

New features in Windows PowerShell 3.0

Windows PowerShell 3.0 includes the following new features.

- Windows PowerShell Workflow
- Windows PowerShell Web Access
- New Windows PowerShell ISE Features
- Support for Microsoft .NET Framework 4.0
- Support for Windows Preinstallation Environment
- Disconnected Sessions
- Robust Session Connectivity
- Updatable Help System
- Enhanced Online Help
- CIM integration
- Session Configuration Files
- Scheduled Jobs and Task Scheduler Integration
- Windows PowerShell Language Enhancements
- New Core Cmdlets
- Improvements to Existing Core Cmdlets and Providers
- Remote module import and discovery
- Enhanced Tab Completion
- Module Auto-Loading
- Module Experience Improvements
- Simplified Command Discovery
- Improved Logging, Diagnostics, and Group Policy Support
- Formatting and Output Improvements
- Enhanced Console Host Experience
- New Cmdlet and Hosting APIs
- Performance Improvements
- RunAs and Shared Host Support
- Special Character Handling Improvements

Windows PowerShell Workflow

Windows PowerShell Workflow brings the power of Windows Workflow Foundation to Windows PowerShell. You can write workflows in XAML or in the Windows PowerShell

language and run them just as you would run a cmdlet. The `Get-Command` cmdlet gets workflow commands and the `Get-Help` cmdlet gets help for workflows.

Workflows are sequences of multicomputer management activities that are long-running, repeatable, frequent, parallelizable, interruptible, suspendable, and restartable. Workflows can be resumed from an intentional or accidental interruption, such as a network outage, a Windows restart, or a power failure.

Workflows are also portable; they can be exported as or imported from XAML files. You can write custom session configurations that allow workflow or activities in a workflow to be run by delegated or subordinate users.

The following are the benefits of Windows PowerShell Workflow

- Automation of sequenced, long-running tasks.
- **Remote monitoring of long-running tasks**. Status and progress of activities are visible at any time.
- **Multicomputer management.** Simultaneously run tasks as workflows on hundreds of managed nodes. Windows PowerShell Workflow includes a built-in library of common management parameters, such as **PSComputerName**, which enable multi-computer management scenarios.
- **Single task execution of complex processes.** You can combine related scripts that implement an entire end-to-end scenario into a single workflow.
- **Persistence.**: a workflow is saved (or check-pointed) at specific points defined by its author so you can resume the workflow from the last persisted task (or checkpoint), instead of restarting the workflow from the beginning.
- **Robustness.** Automated failure recovery. Workflows survive planned and unplanned restarts. You can suspend workflow execution and then resume the workflow from the last persistence point. Workflow authors can designate specific activities to be re-run in case of failure on one or more managed nodes.
- **Ability to disconnect, reconnect, and run in disconnected sessions.** Users can connect and disconnect from the workflow server, but the workflow runs continuously. You can log off of the client computer or restart the client computer and monitor the workflow execution from another computer without interrupting the workflow.
- **Scheduling.** Workflow tasks can be scheduled like any Windows PowerShell cmdlet or script.
- **Workflow and Connection Throttling.** Workflow execution and connections to nodes can be throttled, thus enabling scalability and high-availability scenarios.

Windows PowerShell Web Access

Windows PowerShell Web Access is a Windows Server 2012 feature that lets users run Windows PowerShell commands and scripts in a web-based console. Devices that use the web-based console do not require Windows PowerShell, remote management software, or browser plug-in installations. All that is required is a properly-configured Windows PowerShell Web Access gateway and a client device browser that supports JavaScript and accepts cookies.

For more information, see Deploy Windows PowerShell Web Access.

New Windows PowerShell ISE Features

For Windows PowerShell 3.0, Windows PowerShell Integrated Scripting Environment (ISE) has many new features, including IntelliSense, Show-Command window, a unified Console Pane, snippets, brace-matching, expand-collapse sections, auto-save, recent items list, rich copy, block copy, and full support for writing Windows PowerShell script workflows. For more information, see about_Windows_PowerShell_ISE.

Support for Microsoft .NET Framework 4

Windows PowerShell is built against the Common Language Runtime 4.0. Cmdlet, script, and workflow authors can use the new Microsoft .NET Framework 4 classes in Windows PowerShell, with features that include Application Compatibility and Deployment, Managed Extensibility Framework, Parallel Computing, Networking, Windows Communication Foundation and Windows Workflow Foundation.

Support for Windows Preinstallation Environment

Windows PowerShell 3.0 is an optional component of Windows Preinstallation Environment (Windows PE) 4.0 for Windows 8. Windows PE is a minimal operating system that starts a computer that has no operating system and prepares it for Windows installation. Windows PE can be used to partition and format hard drives, copy disk images to a computer, and initiate Windows Setup from a network share. Windows PowerShell 3.0 can be used on Windows PE to manage deployment, diagnostics, and recovery scenarios.

Disconnected Sessions

Beginning in Windows PowerShell 3.0, persistent user-managed sessions ("PSSessions") that you create using the New-PSSession cmdlet are saved on the remote computer. They are no longer dependent on the session in which they were created.

You can now disconnect from a session without disrupting the commands that are running in the session. You can close the session and shut down your computer. Later, you can reconnect to the session from a different session on the same or on a different computer.

The **ComputerName** parameter of the `Get-PSSession` cmdlet now gets all of the user's sessions that connect to the computer, even if they were started in a different session on a different computer. You can connect to the sessions, get the results of commands, start new commands, and then disconnect from the session.

New cmdlets have been added to support the Disconnected Sessions feature, including `Disconnect-PSSession`, `Connect-PSSession`, and `Receive-PSSession`, and new parameters have been added to cmdlets that manage PSSessions, such as the **InDisconnectedSession** parameter of the `Invoke-Command` cmdlet.

The Disconnected Sessions feature is supported only when the computers at both the originating ("client") and terminating ("server") ends of the connection are running Windows PowerShell 3.0.

Robust Session Connectivity

Windows PowerShell 3.0 detects unexpected losses of connectivity between the client and server and attempts to reestablish connectivity and resume execution automatically. If the client-server connection cannot be reestablished in the allotted time, the user is notified and the session is disconnected. During the attempt to reconnect, Windows PowerShell provides continuous feedback to the user.

If the disconnected session was started using the InvokeCommand, Windows PowerShell creates a job for the disconnected session to make it easier to reconnect and resume execution.

These features provide a more reliable and recoverable remoting experience and allow users to perform long-running tasks that require robust sessions, such as workflows.

Updatable Help System

You can now download updated help files for the cmdlets in your modules. The `Update-Help` cmdlet identifies the newest help files, downloads them from the Internet, unpacks them, validates them, and installs them in the correct language-specific directory for the module.

To use the updated help files, just type `Get-Help`. You do not need to restart Windows or Windows PowerShell. To update help for modules in the $pshome directory, start Windows PowerShell with the "Run as administrator" option.

To support users who don't have Internet access and users behind firewalls, the new `Save-Help` cmdlet downloads help files to a file system directory, such as a file share. Users can then use the `Update-Help` cmdlet to get updated help files from the file share.

You can use the `Update-Help` cmdlet to update help files for all or particular modules in all supported UI cultures. You can even put an `Update-Help` command in your Windows PowerShell profile. By default, Windows PowerShell downloads the help files for a module no more than once each day.

Windows 8 and Windows Server 2012 modules do not include help files. To download the latest help files, type `Update-Help`. For more information, type `Get-Help` (without parameters) or see about_Updatable_Help.

When the help files for a cmdlet are not installed on the computer, the `Get-Help` cmdlet now displays auto-generated help. The auto-generated help includes the command syntax and instructions for using the `Update-Help` cmdlet to download help files.

Any module author can support Updatable Help for their module. You can include help files in the module and use Updatable Help to update them or omit the help files and use Updatable Help to install them. For more information about supporting Updatable Help, see Supporting Updatable Help.

Enhanced Online Help

Windows PowerShell online help is a valuable resource for all users, but it is especially important to users who do not or cannot install updated help files.

To get online help for any Windows PowerShell cmdlet, type:

```
Get-Help <cmdlet-name> -Online
```

Windows PowerShell opens the online version of the help topic in your default Internet browser.

The **Get-Help -Online** feature in Windows PowerShell 3.0 is now even more powerful because it works even when help files for the cmdlet are not installed on the computer.

The **Get-Help -Online** feature gets the URI for online help topic from the HelpUri property of cmdlets and advanced functions.

```
PS C:\>(Get-Command Get-ScheduledJob).HelpUri
https://go.microsoft.com/fwlink/?LinkID=223923
```

Beginning in Windows PowerShell 3.0, authors of C# cmdlets can populate the **HelpUri** property by creating a **HelpUri** attribute on the cmdlet class. Authors of advanced functions can define a **HelpUri** property on the **CmdletBinding** attribute. The value of the **HelpUri** property must begin with "http" or "https".

You can also include a **HelpUri** value in the first related link of an XML-based cmdlet help file or the .Link directive of comment-based help in a function.

For more information about supporting online help, see Supporting Online Help.

CIM integration

Windows PowerShell 3.0 includes support for the Common Information Model (CIM), which provides common definitions of management information for systems, networks, applications, and services, allowing them the exchange of management information between heterogeneous systems. Support for CIM in Windows PowerShell 3.0, including the ability to author Windows PowerShell cmdlets based on new or existing CIM classes, commands based on cmdlet definition XML files, support for CIM .NET Framework. API, CIM management cmdlets and WMI 2.0 providers.

Session Configuration Files

Beginning in Windows PowerShell 3.0, you can design a custom session configuration using a file. The new session configuration file lets you determine the environment of sessions that use the session configuration, including which modules, scripts, and format files are loaded into sessions, which cmdlets and language elements users can use, which modules and scripts they can run, and which variables they can see.

You can design a session in which users can only run the cmdlets from one particular module, or a session in which users have full language, access to all modules, and access to scripts that perform advanced tasks.

In previous versions of Windows PowerShell, control at this level was available only to those who could write a C# program or a complex start-up script. Now, any member of

the Administrators group on the computer can customize a session configuration using a configuration file.

To create a session configuration file, use the `New-PSSessionConfigurationFile` cmdlet. To apply the session configuration file to a session configuration, use the `Register-PSSessionConfiguration` or `Set-PSSessionConfiguration cmdlets.

For more information, see about_Session_Configuration_Files and `New-PSSessionConfigurationFile`.

Scheduled Jobs and Task Scheduler Integration

You can now schedule Windows PowerShell background jobs and manage them in Windows PowerShell and in Task Scheduler.

Windows PowerShell scheduled jobs are a useful hybrid of Windows PowerShell background jobs and Task Scheduler tasks.

Like Windows PowerShell background jobs, scheduled jobs run asynchronously in the background. Instances of scheduled jobs that have completed can be managed using the job cmdlets, such as `Start-Job` and `Get-Job`.

Like Task Scheduler tasks, you can run scheduled jobs on a one-time or recurrent schedule, or in response to an action or event. You can view and manage scheduled jobs in Task Scheduler, enable and disable them as needed, run them or use them as templates, and set conditions under which the jobs start.

In addition, scheduled jobs come with a customized set of cmdlets for managing them. The cmdlets let you create, edit, manage, disable, and re-enable scheduled jobs, create scheduled job triggers and set scheduled job options.

For more information about scheduled jobs, see about_Scheduled_Jobs.

Windows PowerShell Language Enhancements

Windows PowerShell 3.0 includes many features that are designed to make its language simpler, easier to use, and to avoid common errors. The improvements include property enumeration, count and length properties on scalar objects, new redirection operators, the $Using scope modifier, PSItem automatic variable, flexible script formatting, attributes of variables, simplified attribute arguments, numeric command names, the Stop-Parsing operator, improved array splatting, new bit operators, ordered dictionaries, PSCustomObject casting, and improved comment-based help.

New Core Cmdlets

New cmdlets were added to the Windows PowerShell installation, including cmdlets to manage scheduled jobs, disconnected sessions, CIM integration and the Updatable Help System.

- CimCmdlets
  - Get-CimAssociatedInstance
  - Get-CimClass
  - Get-CimInstance
  - Get-CimSession
  - Invoke-CimMethod
  - New-CimInstance
  - New-CimSession
  - New-CimSessionOption
  - Register-CimIndicationEvent
  - Remove-CimInstance
  - Remove-CimSession
  - Set-CimInstance
- Microsoft.PowerShell.Core
  - Connect-PSSession
  - Disconnect-PSSession
  - New-PSSessionConfigurationFile
  - New-PSTransportOption
  - Receive-PSSession
  - Resume-Job
  - Save-Help
  - Suspend-Job
  - Test-PSSessionConfigurationFile
  - Update-Help
- Microsoft.PowerShell.Diagnostics
  - New-WinEvent
- Microsoft.PowerShell.Management
  - Get-ControlPanelItem
  - Rename-Computer
  - Show-ControlPanelItem
- Microsoft.PowerShell.Utility
  - ConvertFrom-Json
  - ConvertTo-Json
  - Get-TypeData
  - Invoke-RestMethod

    - Invoke-WebRequest
    - Remove-TypeData
    - Show-Command
    - Unblock-File
- PSScheduledJob
    - Add-JobTrigger
    - Disable-JobTrigger
    - Disable-ScheduledJob
    - Enable-JobTrigger
    - Enable-ScheduledJob
    - Get-JobTrigger
    - Get-ScheduledJob
    - Get-ScheduledJobOption
    - New-JobTrigger
    - New-ScheduledJobOption
    - Register-ScheduledJob
    - Set-JobTrigger
    - Set-ScheduledJob
    - Set-ScheduledJobOption
    - Unregister-ScheduledJob
- PSWorkflow
    - New-PSWorkflowExecutionOption
    - New-PSWorkflowSession
- PSWorkflowUtility
    - Invoke-AsWorkflow
- ISE
    - Get-IseSnippet
    - Import-IseSnippet
    - New-IseSnippet

Improvements to Existing Core Cmdlets and Providers

Windows PowerShell 3.0 includes new features for existing cmdlets including the simplified syntax, and new parameters for the following cmdlets: Computer cmdlets, CSV cmdlets, Get-ChildItem, Get-Command, Get-Content, Get-History, Measure-Object, Security cmdlets, Select-Object, Select-String, Split-Path, Start-Process, Tee-Object, Test-Connection, Add-Member, and WMI cmdlets.

The Windows PowerShell providers were also improved significantly, including Certificate provider support for managing Secure Socket Layer (SSL) certificates for web

hosting, support for credential, persistent network drives, and alternate data streams in file system drives.

Remote module import and discovery

Windows PowerShell 3.0 extends module discovery, importing, and implicit remoting capabilities on remote computers. The Module cmdlets get modules on remote computers and import the modules to the remote or local computer using Windows PowerShell remoting. New CIM session support allows you to use CIM and WMI to manage non-Windows computers by importing commands to the local computer that run implicitly on the remote computer.

For more information, see the help topics for the `Get-Module` and `Import-Module` cmdlets.

Enhanced Tab Completion

Tab completion in the Windows PowerShell console now completes the names of cmdlets, parameters, parameter values, enumerations, .NET Frameworks types, COM objects, hidden directories, and more. The tab completion feature is completely rewritten based on a new parser and abstract syntax tree to support more scenarios, including in-memory parsing trees and midline tab completion.

Module Auto-Loading

The `Get-Command` cmdlet now gets all cmdlets and functions from all modules that are installed on the computer, even if the module is not imported into the current session.

When you get the cmdlet that you need, you can use it immediately without importing any modules. Windows PowerShell modules are now imported automatically when you use any cmdlet in the module. You no longer need to search for the module and import it to use its cmdlets.

Automatic importing of modules is triggered using the cmdlet in a command, running `Get-Command` for a cmdlet without wildcards, or running `Get-Help` for a cmdlet without wildcards.

You can enable, disable, and configure automatic importing of modules using the **$PSModuleAutoLoadingPreference** preference variable.

For more information, see about_Modules, about_Preference_Variables, and the help topics for the `Get-Command` and `Import-Module` cmdlets.

Module Experience Improvements

Windows PowerShell 3.0 brings advanced feature support to modules, including the following new features.

1. Module logging for individual modules (LogPipelineExecutionDetails) and the new "Turn on Module Logging" Group Policy setting
2. Extended module objects that expose the values from the module manifest
3. New **ExportedCommands** property of modules, including nested modules, that combines commands of all types
4. Improved discovery of available (un-imported) modules, including allowing the **Path** and **ListAvailable** parameters in the same command
5. New **DefaultCommandPrefix** key in module manifests that avoids name conflicts without changing module code.
6. Improved module requirements, including fully-qualified required modules with version and GUID and automatic importing of required modules
7. Quieter, streamlined operation of the `New-ModuleManifest` cmdlet.
8. New **Module** parameter for #Requires
9. Improved `Import-Module` cmdlet with both **MinimumVersion** and **RequiredVersion** parameters.

Simplified Command Discovery

You no longer need to import all modules to discover the commands available to your session. In Windows PowerShell 3.0, the `Get-Command` cmdlet gets all commands from all installed modules. And, if you use a command, the module that exports the command is automatically imported into your session.

The new `Show-Command` cmdlet is designed especially for beginners. You can search for commands in a window. You can view all commands or filter by module, import a module by clicking a button, use text boxes and drop-down lists to construct a valid command, and then copy or run the command without ever leaving the window.

Improved Logging, Diagnostics, and Group Policy Support

Windows PowerShell 3.0 improves the logging and tracing support for commands and modules with support for Event Tracing in Windows (ETW) logs, an editable **LogPipelineExecutionDetails** property of modules, and the "Turn on Module Logging" Group Policy setting. You can now get parameter values from log details by displaying the log properties.

Formatting and Output Improvements

New formatting and output improvements improve the efficiency of all Windows PowerShell users. The improvements include output redirection for all streams, an enhanced Update-Type cmdlet that adds types dynamically without Format.ps1xml files, word wrap in output, default formatting properties of custom objects, the **PSCustomObject** type, improved formatting for WMI objects and heterogeneous objects, and support for discovering method overloads.

Enhanced Console Host Experience

The Windows PowerShell console host program has new features in Windows PowerShell 3.0 including single threaded apartment by default. The new "Run with PowerShell" option in File Explorer lets you run scripts in a unrestricted session just by right-clicking. New console host launch logic starts Windows PowerShell faster and new fonts allow you to personalize the familiar console window experience.

New Cmdlet and Hosting APIs

The new Cmdlet API and Hosting API include public advanced syntax tree (AST) APIs, and APIs for pipeline paging, nested pipelines, runspace pools tab completion, Windows RT, the Obsolete cmdlet attribute, and Verb and Noun properties of the FunctionInfo object.

Performance Improvements

Significant performance improvements in Windows PowerShell come from the new language parser, which is built on Dynamic Runtime Language (DLR) in .NET Framework 4., along with runtime script compilation, engine reliability improvements, and changes to the algorithm of the `Get-ChildItem` that improve its performance, especially when searching network shares.

RunAs and Shared Host Support

Windows PowerShell 3.0 includes support for RunAs and Shared Host features.

The *RunAs* feature, designed for Windows PowerShell Workflow, lets users of a session configuration create sessions that run with the permission of a shared user account. This enables less privileged users to run particular commands and scripts with administrator permissions, and reduces the need for adding less senior users to the Administrators group.

The **SharedHost** feature allows multiple users on multiple computers to connect to a workflow session concurrently and monitor the progress of a workflow. Users can start a workflow on one computer and then connect to the workflow session on another computer without disconnecting the session from the original computer. Users must have the same permissions and be using the same session configuration. For more information, see "Running a Windows PowerShell Workflow" in Getting Started with Windows PowerShell Workflow.

Special Character Handling Improvements

To improve the ability of Windows PowerShell 3.0 to interpret and correctly handle special characters, the **LiteralPath** parameter, which handles special characters in paths, is valid on almost all cmdlets that have a **Path** parameter, including the new `Update-Help` and `Save-Help` cmdlets. The parser also includes special logic to improve handling of the backtick character (`` ` ``) and square brackets in file names and paths.

See Also

- about_Windows_PowerShell_5.0
- Windows PowerShell

What's New in the Windows PowerShell 5.0 ISE

Article • 10/06/2021

This article explains the new and updated features that have been introduced in version 5.0 of the Windows PowerShell Integrated Scripting Environment (ISE).

> **Note**
>
> The PowerShell ISE is no longer in active feature development. As a shipping component of Windows, it continues to be officially supported for security and high-priority servicing fixes. We currently have no plans to remove the ISE from Windows.
>
> There is no support for the ISE in PowerShell v6 and beyond. Users looking for replacement for the ISE should use **Visual Studio Code** with the **PowerShell Extension**.

Feature description

The Windows PowerShell ISE is a host application that enables you to write, run, and test scripts and modules in a graphical and intuitive environment. Key features such as syntax-coloring, tab completion, visual debugging, Unicode compliance, and context-sensitive Help provide a rich scripting experience.

For more information, see Introducing the Windows PowerShell ISE.

The following table lists the new and changed features for this release of Windows PowerShell ISE in Windows PowerShell.

IntelliSense

> Added in ISE 3.0

IntelliSense is an automatic-completion assistance feature that is part of Windows PowerShell ISE. IntelliSense displays clickable menus of potentially matching cmdlets, parameters, parameter values, files, or folders as you type.

What value does this change add?

With the addition of IntelliSense, it's easier to discover cmdlets and syntax when you use Windows PowerShell ISE to create scripts. You can also use Windows PowerShell ISE to learn Windows PowerShell while you create new scripts.

What works differently?

When you type cmdlets in the Windows PowerShell ISE, a scrollable and clickable menu displays, allowing you to browse and select the appropriate commands.

Snippets

> Added in ISE 3.0

Snippets are short sections of Windows PowerShell code that you can insert into the scripts you create in Windows PowerShell ISE. Windows PowerShell ISE comes with a default set of snippets. You can add snippets by using the `New-Snippet` cmdlet while working in Windows PowerShell ISE.

What value does this change add?

By using snippets, you can quickly assemble and create scripts to automate your environment.

What works differently?

To use snippets in Windows PowerShell 3.0 or later, on the **Edit** menu, click **Start Snippets**, or press `Ctrl`+`J`.

Add-on tools

> Added in PowerShell 3.0

Windows PowerShell ISE now supports add-on tools using the object model. These add-ons are Windows Presentation Foundation (WPF) controls that are displayed as a vertical or horizontal pane in the console. Multiple add-on tools in a pane are displayed as a tabbed control. You can also add or remove add-on tools that are produced by non-Microsoft parties. For more information, see The Purpose of the Windows PowerShell ISE Scripting Object Model.

What value does this change add?

Add-ons allow you to extend and customize Windows PowerShell ISE with tools that add functionality and enhance your scripting experience.

What works differently?

Windows PowerShell ISE 3.0 and later come with the **Commands** add-on. The **Commands** add-on allows you to browse cmdlets, and access help about the cmdlets side-by-side with the **Script** and **Console** Panes.

Additional add-ons can be found by using the **Open Add-on Tools Website** command on the **Add-ons** menu.

Restart manager and auto-save

> Added in PowerShell 3.0

Windows PowerShell ISE now automatically saves your open scripts every two minutes, in a separate location. When Windows PowerShell ISE restarts after an unexpected crash or reboot, it recovers scripts that were open in the last session, even if the scripts weren't saved.

To change the automatic saving interval, run the following command in the Console pane: `$psise.Options.AutoSaveMinuteInterval`.

What value does this change add?

You can now work within Windows PowerShell ISE knowing that your open scripts are automatically saved.

What works differently?

Windows PowerShell ISE 2.0 doesn't save the scripts automatically.

Most-recently used list

> Added in PowerShell 3.0

Windows PowerShell ISE now has a most-recently used list for files. When you open a file in Windows PowerShell ISE, the file is added to the most-recently used list on the **File** menu.

To change the default number of files in the most-recently used list, run the following command in the Console Pane: `$psise.Options.MruCount`.

What value does this change add?

You can now use the most-recently used list to easily access your frequently used files.

What works differently?

Windows PowerShell ISE 2.0 doesn't have a most-recently used list.

Console Pane

> Added in PowerShell 3.0

The separate Command and Output Panes that were available in the first release of Windows PowerShell ISE have been combined into a single Console Pane. The Console Pane is similar in function and appearance to a typical Windows PowerShell console, but it includes the following enhancements:

- Syntax coloring for input text (not output text), including XML syntax
- IntelliSense
- Brace matching
- Error indication
- Full Unicode support
- `F1` context-sensitive help
- `Ctrl`+`F1` context-sensitive Show-Command
- Complex script and right-to-left support
- Font support
- Zoom
- Line-select and block-select modes
- Preservation of typed content at the command line when you press the `UpArrow` to view history in the console

What value does this change add?

The addition of these Console Pane changes provides a scripting experience that is more consistent with the console interface.

What works differently?

Windows PowerShell ISE 2.0 has separate Command and Output Panes.

Command-line switches

> Added in PowerShell 3.0

If you start Windows PowerShell ISE from the command line (by typing **powershell_ise.exe**), you can add the following new command-line switches.

- `-NoProfile`: Starts Windows PowerShell ISE without running `$profile`
- `-Help`: Displays a Help window
- `-mta`: Starts Windows PowerShell ISE in multithreaded apartment mode. The default operation mode for Windows PowerShell ISE is single-threaded apartment mode, or `-sta`.

What value does this change add?

The addition of these command-line switches allows you to control the environment in which the Windows PowerShell ISE runs.

What works differently?

Windows PowerShell ISE 2.0 doesn't recognize these command-line switches.

New editor features

> Added in PowerShell 3.0

Other Windows PowerShell ISE editing features include:

- **XML syntax coloring** - Windows PowerShell ISE now colors XML syntax in the same way as it colors Windows PowerShell syntax.
- **Brace matching** - Windows PowerShell ISE includes brace matching and highlighting, and can be used in the following ways: (for example, using the **Go to Match** command or `Ctrl`+`]` locates the closing brace, if you have an opening brace selected).
- **Outline view** The Script Pane supports outlining, which allows collapsing or expanding sections of code by clicking plus or minus signs in the left margin. You can use braces or the `#region` and `#endregion` tags to mark the beginning or end of a collapsible section. To expand or collapse all regions, press `Ctrl`+`M`.
- **Drag and drop text editing** - Windows PowerShell ISE now supports drag and drop text editing. You can select any block of text and drag that text to another location in the editor or the console to move the text. If you hold down the `Ctrl`

key while you drag the selected text, when you release the mouse button the text is copied to the new location. In this version of Windows PowerShell ISE, when you drag and drop files onto Windows PowerShell ISE, Windows PowerShell ISE opens the file.

- **Parse error display** - Parse errors are indicated with red underlines. When you hover over an indicated error, tooltip text displays the problem that was found in the code.
- **Zoom** - The zoom percentage of the console's content can be set by using the zoom slider (in the lower right corner of Windows PowerShell ISE window), or by entering the command `$psise.options.Zoom` in the Console Pane.
- **Rich text copy and paste** - Copying to the clipboard in Windows PowerShell ISE preserves the font, size, and color information of the original selection.
- **Block selection** - You can select a block of text by holding down the `ALT` key while selecting text in the Script Pane with your mouse, or by pressing `Alt`+`Shift`+`Arrow`.

What value does this change add?

The additional editing features provide a more consistent and powerful editing environment.

What works differently?

These editing enhancements weren't present in Windows PowerShell ISE 2.0.

New Help viewer window

> Added in PowerShell 3.0

If you press `F1` when your cursor is in a cmdlet, or you have part of a cmdlet highlighted, the new Help viewer opens context-sensitive Help about the highlighted cmdlet. To display Windows PowerShell **About** help, type `operators` in the console pane, and then press `F1`.

Before you use this feature, download the most current version of Windows PowerShell Help topics from the Microsoft website. The simplest method for downloading the Help topics is to run the `Update-Help` cmdlet in the Console Pane when running Windows PowerShell ISE as administrator.

You can alter where the `F1` key looks for Help. In the **Tools**/**Options** menu, on the **General Settings** tab, under **Other Settings**, you can set or clear the checkbox **Use local help content instead of online content**. When checked, the client looks for the cmdlet

Help in the downloaded Help found in the modules folder. If the checkbox is cleared, the client looks for help online.

What value does this change add?

Context-sensitive Help without leaving your current cmdlet or script provides an integrated learning experience.

What works differently?

Pressing `F1` in previous versions of Windows PowerShell ISE opened the help file on the local computer. In Windows PowerShell ISE 3.0 and later, a window opens that contains the help for the cmdlet that is searchable and configurable. This Help experience is new for Windows PowerShell ISE 3.0, and Updatable Help is new for Windows PowerShell 3.0.

Show-Command cmdlet

> Added in PowerShell 3.0

The `Show-Command` cmdlet enables you to compose or run a cmdlet or function by filling in a graphical form. The form lets users work with Windows PowerShell in a graphical environment. `Show-Command` also enables advanced scripters to create a quick Windows PowerShell-based GUI.

What value does this change add?

By using `Show-Command` in your Windows PowerShell scripts, you can provide your users with the graphical environment with which they're familiar. `Show-Command` can also help introductory users learn Windows PowerShell.

What works differently?

`Show-Command` is new Windows PowerShell ISE 3.0.

See also

For more information about using Windows PowerShell ISE, see Exploring the Windows PowerShell Integrated Scripting Environment.

The Windows PowerShell ISE

Article • 10/07/2021

The Windows PowerShell Integrated Scripting Environment (ISE) is a host application for Windows PowerShell. In the ISE, you can run commands and write, test, and debug scripts in a single Windows-based graphic user interface. The ISE provides multiline editing, tab completion, syntax coloring, selective execution, context-sensitive help, and support for right-to-left languages. Menu items and keyboard shortcuts are mapped to many of the same tasks that you would do in the Windows PowerShell console. For example, when you debug a script in the ISE, you can right-click on a line of code in the edit pane to set a breakpoint.

Support

The ISE was first introduced with Windows PowerShell V2 and was re-designed with PowerShell V3. The ISE is supported in all supported versions of Windows PowerShell up to and including Windows PowerShell V5.1.

> **Note**
>
> The PowerShell ISE is no longer in active feature development. As a shipping component of Windows, it continues to be officially supported for security and high-priority servicing fixes. We currently have no plans to remove the ISE from Windows.
>
> There is no support for the ISE in PowerShell v6 and beyond. Users looking for replacement for the ISE should use **Visual Studio Code** with the **PowerShell Extension**.

Key Features

Key features in Windows PowerShell ISE include:

- Multiline editing: To insert a blank line under the current line in the Command pane, press `SHIFT`+`ENTER`.
- Selective execution: To run part of a script, select the text you want to run, and then click the **Run Script** button. Or, press `F5`.
- Context-sensitive help: Type `Invoke-Item`, and then press `F1`. The Help file opens to the article for the `Invoke-Item` cmdlet.

The Windows PowerShell ISE lets you customize some aspects of its appearance. It also has its own Windows PowerShell profile script.

To start the Windows PowerShell ISE

Click **Start**, select **Windows PowerShell**, and then click **Windows PowerShell ISE**. Alternately, you can type `powershell_ise.exe` in any command shell or in the Run box.

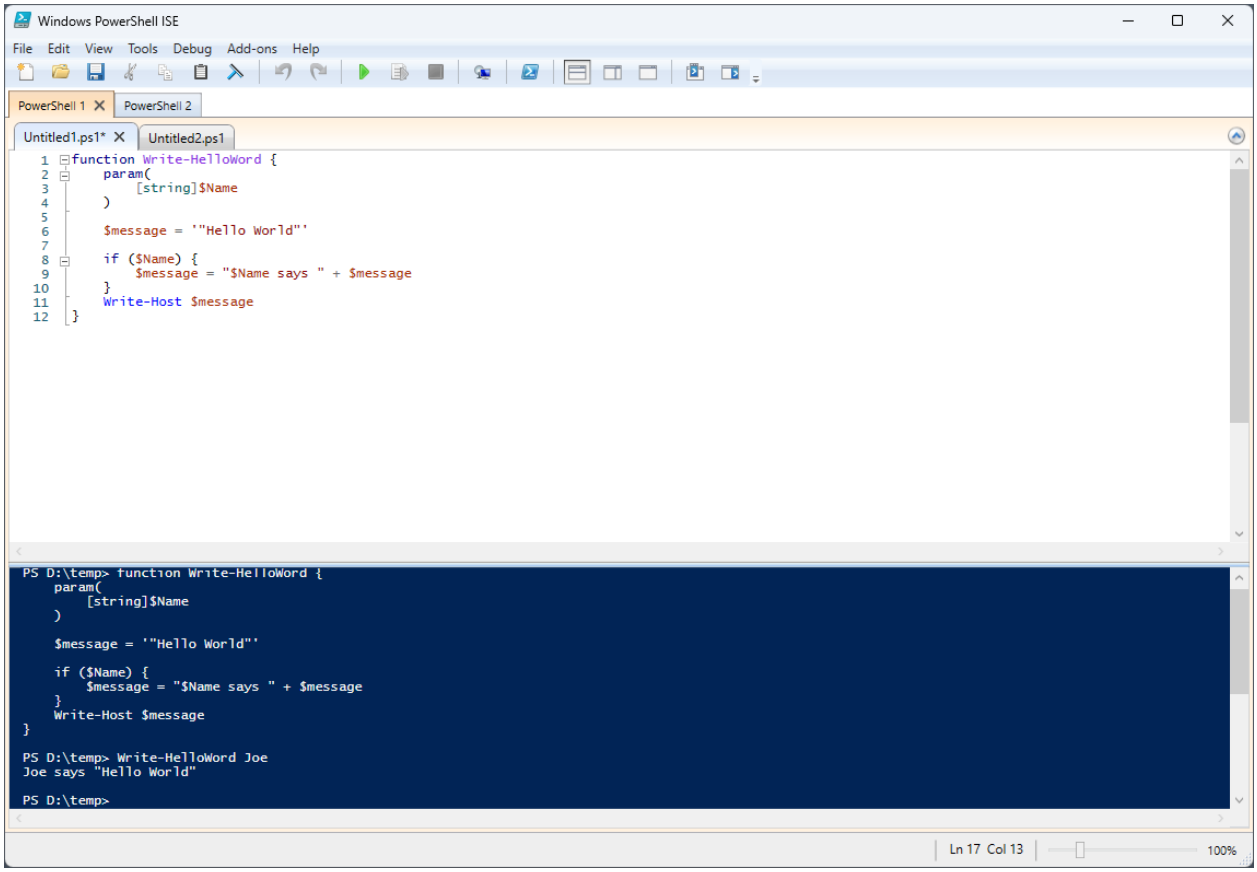
To get Help in the Windows PowerShell ISE

On the **Help** menu, click **Windows PowerShell Help**. Or, press `F1`. The file that opens describes Windows PowerShell ISE and Windows PowerShell, including all the help available from the `Get-Help` cmdlet.

Exploring the Windows PowerShell ISE

Article • 05/04/2023

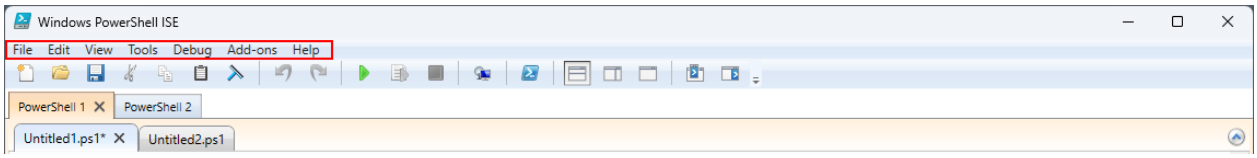
You can use the Windows PowerShell Integrated Scripting Environment (ISE) to create, run, and debug commands and scripts.



The Windows PowerShell ISE consists of the menu bar, Windows PowerShell tabs, the toolbar, script tabs, a Script Pane, a Console Pane, a status bar, a text-size slider and context-sensitive Help.

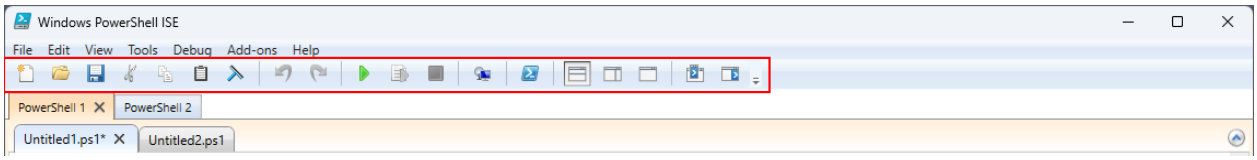
Menu Bar

The menu bar contains the **File**, **Edit**, **View**, **Tools**, **Debug**, **Add-ons**, and **Help** menus.



The buttons on the menus allow you to perform tasks related to writing and running scripts and running commands in the Windows PowerShell ISE. Additionally, an add-on tool may be placed on the menu bar by running scripts that use the The ISE Object Model Hierarchy.

Toolbar

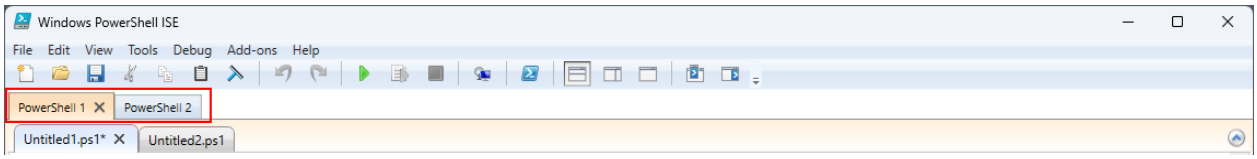


The following buttons are located on the toolbar.

Button	Function
New	Opens a new script.
Open	Opens an existing script or file.
Save	Saves a script or file.
Cut	Cuts the selected text and copies it to the clipboard.
Copy	Copies the selected text to the clipboard.
Paste	Pastes the contents of the clipboard at the cursor location.
Clear Console Pane	Clears all content in the Console Pane.
Undo	Reverses the action that was just performed.
Redo	Performs the action that was just undone.
Run Script	Runs a script.
Run Selection	Runs a selected portion of a script.
Stop Operation	Stops a script that's running.
New Remote PowerShell Tab	Creates a new PowerShell Tab that establishes a session on a remote computer. A dialog box appears and prompts you to enter details required to establish the remote connection.
Start PowerShell.exe	Opens a PowerShell Console.
Show Script Pane Top	Moves the Script Pane to the top in the display.
Show Script Pane Right	Moves the Script Pane to the right in the display.

Button	Function
Show Script Pane Maximized	Maximizes the Script Pane.
Show Command Window	Shows the Commands Pane for installed Modules, as a separate Window.
Show Command Add-on	Shows the Commands Pane for installed Modules, as a sidebar Add-on.

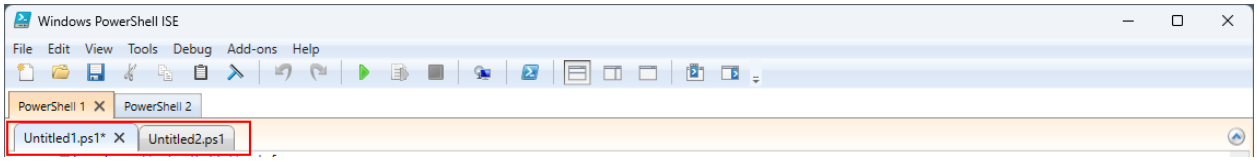
Windows PowerShell Tabs



A Windows PowerShell tab is the environment in which a Windows PowerShell script runs. You can open new Windows PowerShell tabs in the Windows PowerShell ISE to create separate environments on your local computer or on remote computers. You may have a maximum of eight PowerShell tabs simultaneously open.

For more information, see How to Create a PowerShell Tab in Windows PowerShell ISE.

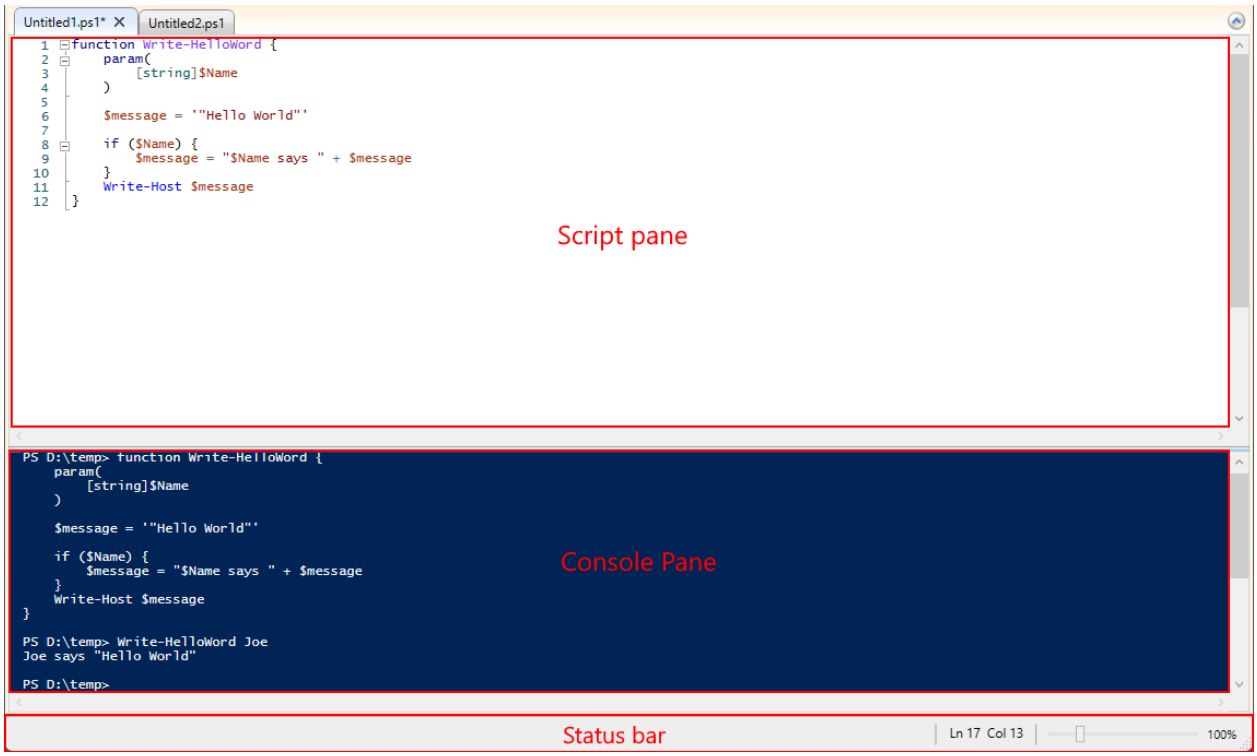
Script Tab



Displays the name of the script you are editing. You can click a script tab to select the script you want to edit.

When you point to the script tab, the fully qualified path to the script file appears in a tooltip.

Script Pane



Allows you to create and run scripts. You can open, edit and run existing scripts in the Script Pane. For more information, see How to Write and Run Scripts in the Windows PowerShell ISE.

Console Pane

Displays the results of the commands and scripts you have run. You can run commands in the Console pane. You can also copy and clear the contents in the Console Pane.

For more information, see the following articles:

- How to Use the Console Pane in the Windows PowerShell ISE
- How to Debug Scripts in Windows PowerShell ISE
- How to Use Tab Completion in the Script Pane and Console Pane

Status Bar

Allows you to see whether the commands and scripts that you run are complete. The status bar is at the bottom of the window. Selected portions of error messages are displayed on the status bar.

Text-Size Slider

Increases or decreases the size of the text on the screen.

Help

Help for Windows PowerShell ISE is available on Microsoft Learn. You can open the Help by clicking **Windows PowerShell ISE Help** on the **Help** menu or by pressing the `F1` key anywhere except when the cursor is on a cmdlet name in either the Script Pane or the Console Pane. From the **Help** menu you can also run the `Update-Help` cmdlet, and display the Command Window which assists you in constructing commands by showing you all the parameters for a cmdlet and enabling you to fill in the parameters in an easy-to-use form.

See Also

- Introducing the Windows PowerShell ISE
- How to Use Profiles in Windows PowerShell ISE
- Accessibility in Windows PowerShell ISE
- Keyboard Shortcuts for the Windows PowerShell ISE

How to Create a PowerShell Tab in Windows PowerShell ISE

Article • 10/07/2021

Tabs in the Windows PowerShell Integrated Scripting Environment (ISE) allow you to simultaneously create and use several execution environments within the same application. Each PowerShell tab corresponds to a separate execution environment or session.

> **Note**
>
> Variables, functions, and aliases that you create in one tab do not carry over to another. They are different Windows PowerShell sessions.

Use the following steps to open or close a tab in Windows PowerShell. To rename a tab, set the DisplayName property on the Windows PowerShell Tab scripting object.

To create and use a new PowerShell Tab

On the **File** menu, click **New PowerShell Tab**. The new PowerShell tab always opens as the active window. PowerShell tabs are incrementally numbered in the order that they are opened. Each tab is associated with its own Windows PowerShell console window. You can have up to 32 PowerShell tabs with their own session open at a time (this is limited to 8 on Windows PowerShell ISE 2.0.)

Note that clicking the **New** or **Open** icons on the toolbar does not create a new tab with a separate session. Instead, those buttons open a new or existing script file on the currently active tab with a session. You can have multiple script files open with each tab and session. The script tabs for a session only appear below the session tabs when the associated session is active.

To make a PowerShell tab active, click the tab. To select from all PowerShell tabs that are open, on the **View** menu, click the PowerShell tab you want to use.

To create and use a new Remote PowerShell tab

On the **File** menu, click **New Remote PowerShell Tab** to establish a session on a remote computer. A dialog box appears and prompts you to enter details required to establish the remote connection. The remote tab functions just like a local PowerShell tab, but the commands and scripts are run on the remote computer.

To close a PowerShell Tab

To close a tab, you can use any of the following techniques:

- Click the tab that you want to close.
- On the **File** menu, click **Close PowerShell Tab**, or click the Close button (**X**) on an active tab to close the tab.

If you have unsaved files open in the PowerShell tab that you are closing, you are prompted to save or discard them. For more information about how to save a script, see How to Save a Script.

See Also

- Introducing the Windows PowerShell ISE
- How to Use the Console Pane in the Windows PowerShell ISE

How to Debug Scripts in Windows PowerShell ISE

Article • 03/20/2023

This article describes how to debug scripts on a local computer by using the Windows PowerShell Integrated Scripting Environment (ISE) visual debugging features.

How to manage breakpoints

A breakpoint is a designated spot in a script where you would like operation to pause so that you can examine the current state of the variables and the environment in which your script is running. Once your script is paused by a breakpoint, you can run commands in the Console Pane to examine the state of your script. You can output variables or run other commands. You can even modify the value of any variables that are visible to the context of the currently running script. After you have examined what you want to see, you can resume operation of the script.

You can set three types of breakpoints in the Windows PowerShell debugging environment:

1. **Line breakpoint**. The script pauses when the designated line is reached during the operation of the script
2. **Variable breakpoint.** The script pauses whenever the designated variable's value changes.
3. **Command breakpoint.** The script pauses whenever the designated command is about to be run during the operation of the script. It can include parameters to further filter the breakpoint to only the operation you want. The command can also be a function you created.

Of these, in the Windows PowerShell ISE debugging environment, only line breakpoints can be set by using the menu or the keyboard shortcuts. The other two types of breakpoints can be set, but they are set from the Console Pane by using the Set-PSBreakpoint cmdlet. This section describes how you can perform debugging tasks in Windows PowerShell ISE by using the menus where available, and perform a wider range of commands from the Console Pane by using scripting.

To set a breakpoint

A breakpoint can be set in a script only after it has been saved. Right-click the line where you want to set a line breakpoint, and then click **Toggle Breakpoint**. Or, click the line where you want to set a line breakpoint, and press F9 or, on the **Debug** menu, click **Toggle Breakpoint**.

The following script is an example of how you can set a variable breakpoint from the Console Pane by using the Set-PSBreakpoint cmdlet.

PowerShell

```
# This command sets a breakpoint on the Server variable in the Sample.ps1
script.
Set-PSBreakpoint -Script sample.ps1 -Variable Server
```

List all breakpoints

Displays all breakpoints in the current Windows PowerShell session.

On the **Debug** menu, click **List Breakpoints**. The following script is an example of how you can list all breakpoints from the Console Pane by using the Get-PSBreakpoint cmdlet.

PowerShell

```
# This command lists all breakpoints in the current session.
Get-PSBreakpoint
```

Remove a breakpoint

Removing a breakpoint deletes it.

If you think you might want to use it again later, consider Disable a Breakpoint it instead. Right-click the line where you want to remove a breakpoint, and then click **ToggleBreakpoint**. Or, click the line where you want to remove a breakpoint, and on the **Debug** menu, click **Toggle Breakpoint**. The following script is an example of how to remove a breakpoint with a specified ID from the Console Pane by using the Remove-PSBreakpoint cmdlet.

PowerShell

```
# This command deletes the breakpoint with breakpoint ID 2.
Remove-PSBreakpoint -Id 2
```

Remove All Breakpoints

To remove all breakpoints defined in the current session, on the **Debug** menu, click **Remove All Breakpoints**.

The following script is an example of how to remove all breakpoints from the Console Pane by using the Remove-PSBreakpoint cmdlet.

PowerShell

```
# This command deletes all of the breakpoints in the current session.
Get-PSBreakpoint | Remove-PSBreakpoint
```

Disable a Breakpoint

Disabling a breakpoint does not remove it. It turns it off until it is enabled. To disable a specific line breakpoint, right-click the line where you want to disable a breakpoint, and then click **Disable Breakpoint**.

Or, click the line where you want to disable a breakpoint, and press F9 or, on the **Debug** menu, click **Disable Breakpoint**. The following script is an example of how you can remove a breakpoint with a specified ID from the Console Pane using the Disable-PSBreakpoint cmdlet.

PowerShell

```
# This command disables the breakpoint with breakpoint ID 0.
Disable-PSBreakpoint -Id 0
```

Disable All Breakpoints

Disabling a breakpoint does not remove it; it turns it off until it is enabled. To disable all breakpoints in the current session, on the **Debug** menu, click **Disable all Breakpoints**. The following script is an example of how you can disable all breakpoints from the Console Pane by using the Disable-PSBreakpoint cmdlet.

PowerShell

```
# This command disables all breakpoints in the current session.
# You can abbreviate this command as: "gbp | dbp".
Get-PSBreakpoint | Disable-PSBreakpoint
```

Enable a Breakpoint

To enable a specific breakpoint, right-click the line where you want to enable a breakpoint, and then click **Enable Breakpoint**. Or, click the line where you want to enable a breakpoint, and then press F9 or, on the **Debug** menu, click **Enable Breakpoint**. The following script is an example of how you can enable specific breakpoints from the Console Pane by using the Enable-PSBreakpoint cmdlet.

PowerShell

```
# This command enables breakpoints with breakpoint IDs 0, 1, and 5.
Enable-PSBreakpoint -Id 0, 1, 5
```

Enable All Breakpoints

To enable all breakpoints defined in the current session, on the **Debug** menu, click **Enable all Breakpoints**. The following script is an example of how you can enable all breakpoints from the Console Pane by using the Enable-PSBreakpoint cmdlet.

PowerShell

```
# This command enables all breakpoints in the current session.
# You can abbreviate the command by using their aliases: "gbp | ebp".
Get-PSBreakpoint | Enable-PSBreakpoint
```

How to manage a debugging session

Before you start debugging, you must set one or more breakpoints. You cannot set a breakpoint unless the script that you want to debug is saved. For directions on of how to set a breakpoint, see How to manage breakpoints or Set-PSBreakpoint. After you start debugging, you cannot edit a script until you stop debugging. A script that has one or more breakpoints set is automatically saved before it is run.

To start debugging

Press F5 or, on the toolbar, click the **Run Script** icon, or on the **Debug** menu click **Run/Continue**. The script runs until it encounters the first breakpoint. It pauses operation there and highlights the line on which it paused.

To continue debugging

Press F5 or, on the toolbar, click the **Run Script** icon, or on the **Debug** menu, click **Run/Continue** or, in the Console Pane, type `C` and then press ENTER. This causes the script to continue running to the next breakpoint or to the end of the script if no further breakpoints are encountered.

To view the call stack

The call stack displays the current run location in the script. If the script is running in a function that was called by a different function, then that is represented in the display by additional rows in the output. The bottom-most row displays the original script and the line in it in which a function was called. The next line up shows that function and the line in it in which another function might have been called. The top-most row shows the current context of the current line on which the breakpoint is set.

While paused, to see the current call stack, press CTRL+SHIFT+D or, on the **Debug** menu, click **Display Call Stack** or, in the Console Pane, type `K` and then press ENTER.

To stop debugging

Press SHIFT+F5 or, on the **Debug** menu, click **Stop Debugger**, or, in the Console Pane, type `Q` and then press ENTER.

How to step over, step into, and step out while debugging

Stepping is the process of running one statement at a time. You can stop on a line of code, and examine the values of variables and the state of the system. The following table describes common debugging tasks such as stepping over, stepping into, and stepping out.

Debugging Task	Description	How to accomplish it in PowerShell ISE
Step Into	Executes the current statement and then stops at the next statement. If the current statement is a function or script call, then the debugger steps into that function or script, otherwise it stops at the next statement.	Press F11 or, on the **Debug** menu, click **Step Into**, or in the Console Pane, type `S` and press ENTER.

Debugging Task	Description	How to accomplish it in PowerShell ISE
Step Over	Executes the current statement and then stops at the next statement. If the current statement is a function or script call, then the debugger executes the whole function or script, and it stops at the next statement after the function call.	Press `F10` or, on the **Debug** menu, click **Step Over**, or in the Console Pane, type `V` and press `ENTER`.
Step Out	Steps out of the current function and up one level if the function is nested. If in the main body, the script is executed to the end, or to the next breakpoint. The skipped statements are executed, but not stepped through.	Press `SHIFT`+`F11`, or on the **Debug** menu, click **Step Out**, or in the Console Pane, type `O` and press `ENTER`.
Continue	Continues execution to the end, or to the next breakpoint. The skipped functions and invocations are executed, but not stepped through.	Press `F5` or, on the **Debug** menu, click **Run/Continue**, or in the Console Pane, type `C` and press `ENTER`.

How to display the values of variables while debugging

You can display the current values of variables in the script as you step through the code.

To display the values of standard variables

Use one of the following methods:

- In the Script Pane, hover over the variable to display its value as a tool tip.
- In the Console Pane, type the variable name and press `ENTER`.

All panes in ISE are always in the same scope. Therefore, while you are debugging a script, the commands that you type in the Console Pane run in script scope. This allows you to use the Console Pane to find the values of variables and call functions that are defined only in the script.

To display the values of automatic variables

You can use the preceding method to display the value of almost all variables while you are debugging a script. However, these methods do not work for the following

automatic variables.

- `$_`
- `$Input`
- `$MyInvocation`
- `$PSBoundParameters`
- `$Args`

If you try to display the value of any of these variables, you get the value of that variable for in an internal pipeline the debugger uses, not the value of the variable in the script. You can work around this for a few variables (`$_`, `$Input`, `$MyInvocation`, `$PSBoundParameters`, and `$Args`) by using the following method:

1. In the script, assign the value of the automatic variable to a new variable.
2. Display the value of the new variable, either by hovering over the new variable in the Script Pane, or by typing the new variable in the Console Pane.

For example, to display the value of the `$MyInvocation` variable, in the script, assign the value to a new variable, such as `$scriptName`, and then hover over or type the `$scriptName` variable to display its value.

PowerShell

```
# In C:\ps-test\MyScript.ps1
$scriptName = $MyInvocation.PSCommandPath
```

PowerShell

```
# In the Console Pane:
.\MyScript.ps1
$scriptName
```

Output

```
C:\ps-test\MyScript.ps1
```

See Also

Exploring the Windows PowerShell ISE

How to Use Profiles in Windows PowerShell ISE

Article • 10/07/2021

This article explains how to use Profiles in Windows PowerShell® Integrated Scripting Environment (ISE). We recommend that before performing the tasks in this section, you review about_Profiles, or in the Console Pane, type, `Get-Help about_Profiles` and press `ENTER`.

A profile is a Windows PowerShell ISE script that runs automatically when you start a new session. You can create one or more Windows PowerShell profiles for Windows PowerShell ISE and use them to add the configure the Windows PowerShell or Windows PowerShell ISE environment, preparing it for your use, with variables, aliases, functions, and color and font preferences that you want available. A profile affects every Windows PowerShell ISE session that you start.

> **Note**
>
> The Windows PowerShell execution policy determines whether you can run scripts and load a profile. The default execution policy, "Restricted," prevents all scripts from running, including profiles. If you use the "Restricted" policy, the profile cannot load. For more information about execution policy, see **about_Execution_Policies**.

Selecting a profile to use in the Windows PowerShell ISE

Windows PowerShell ISE supports profiles for the current user and all users. It also supports the Windows PowerShell profiles that apply to all hosts.

The profile that you use is determined by how you use Windows PowerShell and Windows PowerShell ISE.

- If you use only Windows PowerShell ISE to run Windows PowerShell, then save all your items in one of the ISE-specific profiles, such as the **CurrentUserCurrentHost** profile for Windows PowerShell ISE or the **AllUsersCurrentHost** profile for Windows PowerShell ISE.

- If you use multiple host programs to run Windows PowerShell, save your functions, aliases, variables, and commands in a profile that affects all host programs, such as the CurrentUserAllHosts or the **AllUsersAllHosts** profile, and save ISE-specific features, like color and font customization in the **CurrentUserCurrentHost** profile for Windows PowerShell ISE profile or the **AllUsersCurrentHost** profile for Windows PowerShell ISE.

The following are profiles that can be created and used in Windows PowerShell ISE. Each profile is saved to its own specific path.

Profile Type	Profile Path
Current user, PowerShell ISE	`$PROFILE.CurrentUserCurrentHost`, or `$PROFILE`
All users, PowerShell ISE	`$PROFILE.AllUsersCurrentHost`
Current user, All hosts	`$PROFILE.CurrentUserAllHosts`
All users, All hosts	`$PROFILE.AllUsersAllHosts`

To create a new profile

To create a new "Current user, Windows PowerShell ISE" profile, run this command:

PowerShell

```
if (!(Test-Path -Path $PROFILE ))
{ New-Item -Type File -Path $PROFILE -Force }
```

To create a new "All users, Windows PowerShell ISE" profile, run this command:

PowerShell

```
if (!(Test-Path -Path $PROFILE.AllUsersCurrentHost))
{ New-Item -Type File -Path $PROFILE.AllUsersCurrentHost -Force }
```

To create a new "Current user, All Hosts" profile, run this command:

PowerShell

```
if (!(Test-Path -Path $PROFILE.CurrentUserAllHosts))
{ New-Item -Type File -Path $PROFILE.CurrentUserAllHosts -Force }
```

To create a new "All users, All Hosts" profile, type:

PowerShell

```
if (!(Test-Path -Path $PROFILE.AllUsersAllHosts))
{ New-Item -Type File -Path $PROFILE.AllUsersAllHosts -Force }
```

To edit a profile

1. To open the profile, run the command `psEdit` with the variable that specifies the profile you want to edit. For example, to open the "Current user, Windows PowerShell ISE" profile, type: `psEdit $PROFILE`

2. Add some items to your profile. The following are a few examples to get you started:

   - To change the default background color of the Console Pane to blue, in the profile file type: `$psISE.Options.OutputPaneBackground = 'blue'` . For more information about the `$psISE` variable, see Windows PowerShell ISE Object Model Reference.

   - To change font size to 20, in the profile file type: `$psISE.Options.FontSize =20`

3. To save your profile file, on the **File** menu, click **Save**. Next time you open the Windows PowerShell ISE, your customizations are applied.

See Also

- about_Profiles
- Introducing the Windows PowerShell ISE

How to Use Tab Completion in the Script Pane and Console Pane

Article • 09/17/2021

Tab completion provides automatic help when you are typing in the Script Pane or in the Command Pane. Use the following steps to take advantage of this feature:

To automatically complete a command entry

In the Command Pane or Script Pane, type a few characters of a command and then press `TAB` to select the desired completion text. If multiple items begin with the text that you initially typed, then continue pressing `TAB` until the item you want appears. Tab completion can help with typing a cmdlet name, parameter name, variable name, object property name, or a file path.

> **Note**
>
> In the Script Pane, pressing `TAB` will automatically complete a command only when you are editing `.ps1`, `.psd1`, or `.psm1` files. Tab completion works any time when you are typing in the Command Pane.

To automatically complete a cmdlet parameter entry

In the Command Pane or Script pane, type a cmdlet followed by a dash and then press `TAB`.

For example, type `Get-Process -` and then press `TAB` multiple times to display each of the parameters for the cmdlet in turn.

See Also

- Introducing the Windows PowerShell ISE
- How to Create a PowerShell Tab

How to Use the Console Pane in the Windows PowerShell ISE

Article • 09/17/2021

The Console pane in the Windows PowerShell Integrated Scripting Environment (ISE) operates exactly like the stand-alone Windows PowerShell ISE console window.

To run a command in the Console Pane, type a command, and then press ENTER. To enter multiple commands that you want to execute in sequence, type SHIFT+ENTER between commands. See How to Use Tab Completion in the Script Pane and Console Pane for help in typing commands.

To stop a command, on the toolbar, click **Stop Operation**, or press CTRL+BREAK. You can also use CTRL+C to stop a command if the context is unambiguous. For example, if some text has been selected in the current Pane, then CTRL+C maps to the copy operation.

Beginning in Windows PowerShell v3, the Output pane was combined with the Console pane. This has the benefit of behaving like the stand-alone Windows PowerShell console and eliminates the differences in procedures that were needed when they were separate. You can:

- Select and copy text from the Console pane to the Clipboard for pasting in any other window. To select text, click and hold the mouse in the output pane while dragging the mouse over the text you want to capture. You can also use the cursor arrow keys while holding SHIFT to select text. Then press CTRL+C or click the **Copy** icon in the toolbar.
- Paste the selected text at a current cursor position. Click the **Paste** icon on the toolbar.
- Clear all the text in the Console pane. To clear the Console pane, you can click the **Clear Console Pane** icon on the toolbar, or run the command `Clear-Host` or its alias, `cls`.

See Also

- Introducing the Windows PowerShell ISE

How to Write and Run Scripts in the Windows PowerShell ISE

Article • 06/29/2022

This article describes how to create, edit, run, and save scripts in the Script Pane.

How to create and run scripts

You can open and edit Windows PowerShell files in the Script Pane. Specific file types of interest in Windows PowerShell are script files (`.ps1`), script data files (`.psd1`), and script module files (`.psm1`). These file types are syntax colored in the Script Pane editor. Other common file types you may open in the Script Pane are configuration files (`.ps1xml`), XML files, and text files.

> **Note**
>
> The Windows PowerShell execution policy determines whether you can run scripts and load Windows PowerShell profiles and configuration files. The default execution policy, Restricted, prevents all scripts from running, and prevents loading profiles. To change the execution policy to allow profiles to load and be used, see **Set-ExecutionPolicy** and **about_Signing**.

To create a new script file

On the toolbar, click **New**, or on the **File** menu, click **New**. The created file appears in a new file tab under the current PowerShell tab. Remember that the PowerShell tabs are only visible when there are more than one. By default a file of type script (`.ps1`) is created, but it can be saved with a new name and extension. Multiple script files can be created in the same PowerShell tab.

To open an existing script

On the toolbar, click **Open**, or on the **File** menu, click **Open**. In the **Open** dialog box, select the file you want to open. The opened file appears in a new tab.

To close a script tab

Click the **Close** icon (**X**) of the file tab you want to close or select the **File** menu and click **Close**.

If the file has been altered since it was last saved, you're prompted to save or discard it.

To display the file path

On the file tab, point to the file name. The fully qualified path to the script file appears in a tooltip.

To run a script

On the toolbar, click **Run Script**, or on the **File** menu, click **Run**.

To run a portion of a script

1. In the Script Pane, select a portion of a script.
2. On the **File** menu, click **Run Selection**, or on the toolbar, click **Run Selection**.

To stop a running script

There are several ways to stop a running script.

- Click **Stop Operation** on the toolbar
- Press CTRL+BREAK
- Select the **File** menu and click **Stop Operation**.

Pressing CTRL+C also works unless some text is currently selected, in which case CTRL+C maps to the copy function for the selected text.

How to write and edit text in the Script Pane

You can copy, cut, paste, find, and replace text in the Script Pane. You can also undo and redo the last action you just performed. The keyboard shortcuts for these actions are the same shortcuts used for all Windows applications.

To enter text in the Script Pane

1. Move the cursor to the Script Pane by clicking anywhere in the Script Pane, or by clicking **Go to Script Pane** in the **View** menu.

2. Create a script. Syntax coloring and tab completion provide a richer editing experience in Windows PowerShell ISE.
3. See How to Use Tab Completion in the Script Pane and Console Pane for details about using the tab completion feature to help in typing.

To find text in the Script Pane

1. To find text anywhere, press CTRL+F or, on the **Edit** menu, click **Find in Script**.
2. To find text after the cursor, press F3 or, on the **Edit** menu, click **Find Next in Script**.
3. To find text before the cursor, press SHIFT+F3 or, on the **Edit** menu, click **Find Previous in Script**.

To find and replace text in the Script Pane

Press CTRL+H or, on the **Edit** menu, click **Replace in Script**. Enter the text you want to find and the replacement text, then press ENTER.

To go to a particular line of text in the Script Pane

1. In the Script Pane, press CTRL+G or, on the **Edit** menu, click **Go to Line**.
2. Enter a line number.

To copy text in the Script Pane

1. In the Script Pane, select the text that you want to copy.
2. Press CTRL+C or, on the toolbar, click the **Copy** icon, or on the **Edit** menu, click **Copy**.

To cut text in the Script Pane

1. In the Script Pane, select the text that you want to cut.
2. Press CTRL+X or, on the toolbar, click the **Cut** icon, or on the **Edit** menu, click **Cut**.

To paste text into the Script Pane

Press CTRL+V or, on the toolbar, click the **Paste** icon, or on the **Edit** menu, click **Paste**.

To undo an action in the Script Pane

Press CTRL+Z or, on the toolbar, click the **Undo** icon, or on the **Edit** menu, click **Undo**.

To redo an action in the Script Pane

Press CTRL+Y or, on the toolbar, click the **Redo** icon, or on the **Edit** menu, click **Redo**.

How to save a script

An asterisk appears next to the script name to mark a file that hasn't been saved since it was changed. The asterisk disappears when the file is saved.

To save a script

Press CTRL+S or, on the toolbar, click the **Save** icon, or on the **File** menu, click **Save**.

To save and name a script

1. On the **File** menu, click **Save As**. The **Save As** dialog box will appear.
2. In the **File name** box, enter a name for the file.
3. In the **Save as type** box, select a file type. For example, in the **Save as type** box, select 'PowerShell Scripts (`*.ps1`)'.
4. Click **Save**.

To save a script in ASCII encoding

By default, Windows PowerShell ISE saves new script files (`.ps1`), script data files (`.psd1`), and script module files (`.psm1`) as Unicode (BigEndianUnicode). To save a script in another encoding, such as ASCII (ANSI), use the **Save** or **SaveAs** methods on the $psISE.CurrentFile object.

The following command saves a new script as MyScript.ps1 with ASCII encoding.

```
PowerShell

$psISE.CurrentFile.SaveAs("MyScript.ps1", [System.Text.Encoding]::ASCII)
```

The following command replaces the current script file with a file with the same name, but with ASCII encoding.

PowerShell

```
$psISE.CurrentFile.Save([System.Text.Encoding]::ASCII)
```

The following command gets the encoding of the current file.

PowerShell

```
$psISE.CurrentFile.encoding
```

Windows PowerShell ISE supports the following encoding options: ASCII, BigEndianUnicode, Unicode, UTF32, UTF7, UTF8, and Default. The value of the Default option varies with the system.

Windows PowerShell ISE doesn't change the encoding of script files when you use the Save or Save As commands.

See Also

- Exploring the Windows PowerShell ISE

Keyboard Shortcuts for the Windows PowerShell ISE

Article • 10/25/2022

Use the following keyboard shortcuts to perform actions in Windows PowerShell Integrated Scripting Environment (ISE). Windows PowerShell ISE is available as part of the Windows Server and Windows client operating systems.

Keyboard shortcuts for editing text

You can use the following keyboard shortcuts when you edit text.

Action	Keyboard Shortcuts	Use in
Help	`F1`	Script Pane **Important:** You can specify that `F1` help comes from Microsoft Learn or downloaded Help (see `Update-Help`). To select, click **Tools**, **Options**, then on the **General Settings** tab, set or clear **Use local help content instead of online content**.
Select All	`CTRL`+`A`	Script Pane
Copy	`CTRL`+`C`	Script Pane, Command Pane, Output Pane
Cut	`CTRL`+`X`	Script Pane, Command Pane
Expand or Collapse Outlining	`CTRL`+`M`	Script Pane
Find in Script	`CTRL`+`F`	Script Pane
Find Next in Script	`F3`	Script Pane
Find Previous in Script	`SHIFT`+ `F3`	Script Pane
Find Matching Brace	`CTRL`+`]`	Script Pane
Paste	`CTRL`+`V`	Script Pane, Command Pane

Action	Keyboard Shortcuts	Use in
Make Lowercase	CTRL + U	Script Pane, Command Pane
Make Uppercase	CTRL + SHIFT + U	Script Pane, Command Pane
Redo	CTRL + Y	Script Pane, Command Pane
Replace in Script	CTRL + H	Script Pane
Save	CTRL + S	Script Pane
Select All	CTRL + A	Script Pane, Command Pane, Output Pane
Show Snippets	CTRL + J	Script Pane, Command Pane
Undo	CTRL + Z	Script Pane, Command Pane
Show Intellisense Help	CTRL + Space	Script Pane
Delete word to left	CTRL + Backspace	Script Pane
Delete word to right	CTRL + Delete	Script Pane

Keyboard shortcuts for running scripts

You can use the following keyboard shortcuts when you run scripts in the Script Pane.

Action	Keyboard Shortcut
New	CTRL + N
Open	CTRL + O
Run	F5
Run Selection	F8

Action	Keyboard Shortcut
Stop Execution	CTRL+BREAK. CTRL+C can be used when the context is unambiguous (when there is no text selected).
Tab (to next script)	CTRL+TAB **Note:** Tab to next script works only when you have a single Windows PowerShell tab open, or when you have more than one Windows PowerShell tab open, but the focus is in the Script Pane.
Tab (to previous script)	CTRL+SHIFT+TAB **Note:** Tab to previous script works when you have only one Windows PowerShell tab open, or if you have more than one Windows PowerShell tab open, and the focus is in the Script Pane.

Keyboard shortcuts for customizing the view

You can use the following keyboard shortcuts to customize the view in Windows PowerShell ISE. They are accessible from all the panes in the application.

Action	Keyboard Shortcut
Go to Command (v2) or Console (v3 and later) Pane	CTRL+D
Go to Output Pane (v2 only)	CTRL+SHIFT+O
Go to Script Pane	CTRL+I
Show Script Pane	CTRL+R
Hide Script Pane	CTRL+R
Move Script Pane Up	CTRL+1
Move Script Pane Right	CTRL+2
Maximize Script Pane	CTRL+3
Zoom In	CTRL++
Zoom Out	CTRL+-

Keyboard shortcuts for debugging scripts

You can use the following keyboard shortcuts when you debug scripts.

Action	Keyboard Shortcut	Use in

Action	Keyboard Shortcut	Use in
Run/Continue	`F5`	Script Pane, when debugging a script
Step Into	`F11`	Script Pane, when debugging a script
Step Over	`F10`	Script Pane, when debugging a script
Step Out	`SHIFT`+`F11`	Script Pane, when debugging a script
Display Call Stack	`CTRL`+`SHIFT`+`D`	Script Pane, when debugging a script
List Breakpoints	`CTRL`+`SHIFT`+`L`	Script Pane, when debugging a script
Toggle Breakpoint	`F9`	Script Pane, when debugging a script
Remove All Breakpoints	`CTRL`+`SHIFT`+`F9`	Script Pane, when debugging a script
Stop Debugger	`SHIFT`+`F5`	Script Pane, when debugging a script

> **Note**
>
> You can also use the keyboard shortcuts designed for the Windows PowerShell console when you debug scripts in Windows PowerShell ISE. To use these shortcuts, you must type the shortcut in the Command Pane and press `ENTER`.

Action	Keyboard Shortcut	Use in
Continue	`C`	Console Pane, when debugging a script
Step Into	`S`	Console Pane, when debugging a script
Step Over	`V`	Console Pane, when debugging a script
Step Out	`O`	Console Pane, when debugging a script
Repeat Last Command (for Step Into or Step Over)	`ENTER`	Console Pane, when debugging a script
Display Call Stack	`K`	Console Pane, when debugging a script

Action	Keyboard Shortcut	Use in
Stop Debugging	`Q`	Console Pane, when debugging a script
List the Script	`L`	Console Pane, when debugging a script
Display Console Debugging Commands	`H` or `?`	Console Pane, when debugging a script

Keyboard shortcuts for Windows PowerShell tabs

You can use the following keyboard shortcuts when you use Windows PowerShell tabs.

Action	Keyboard Shortcut
Close PowerShell Tab	`CTRL`+`W`
New PowerShell Tab	`CTRL`+`T`
Previous PowerShell tab	`CTRL`+`SHIFT`+`TAB`. This shortcut works only when no files are open on any Windows PowerShell tab.
Next Windows PowerShell tab	`CTRL`+`TAB`. This shortcut works only when no files are open on any Windows PowerShell tab.

Keyboard shortcuts for starting and exiting

You can use the following keyboard shortcuts to start the Windows PowerShell console (PowerShell.exe) or to exit Windows PowerShell ISE.

Action	Keyboard Shortcut
Exit	`ALT`+`F4`
Start PowerShell.exe(Windows PowerShell console)	`CTRL`+`SHIFT`+`P`

See Also

- PowerShell Magazine: The Complete List of Windows PowerShell ISE Keyboard Shortcuts

Accessibility in Windows PowerShell ISE

Article • 09/17/2021

This topic describes the accessibility features of Windows PowerShell Integrated Scripting Environment (ISE) that you might find helpful.

- How to change the size and location of the Console and Script Panes
- Keyboard shortcuts for editing text
- Keyboard shortcuts for running scripts
- Keyboard shortcuts for customizing the view
- Keyboard shortcuts for debugging scripts
- Keyboard shortcuts for Windows PowerShell tabs
- Keyboard shortcuts for starting and exiting
- Breakpoint management with cmdlets

Microsoft is committed to making its products and services easier for everyone to use. The following topics provide information about the features, products, and services that make Windows PowerShell ISE more accessible for people with disabilities.

In addition to accessibility features and utilities in Microsoft Windows, the following features make Windows PowerShell ISE more accessible for people with disabilities:

- Keyboard Shortcuts
- Syntax Coloring Table and the ability to modify several other color settings using the $psISE.Options scripting object.
- Text Size Change

How to change the size and location of the Console and Script Panes

You can use the following steps to change the size and location of the Console Pane and the Script Pane. When you open the Windows PowerShell ISE again, the size and location changes you made will be retained.

To resize the Script Pane and Console Pane

1. Pause the pointer on the split line between the Script Pane and Console Pane.

2. When the mouse pointer changes to a two-headed arrow, drag the border to change the size of the pane.

To move the Script Pane and Console Pane

Do one of the following:

- To move the Script Pane above the Console Pane, press CTRL+1 or, on the toolbar, click the **Show Script Pane Top** icon, or in the **View** menu, click **Show Script Pane Top**.
- To move the Script Pane to the right of the Console Pane, press CTRL+2 or, on the toolbar, click the **Show Script Pane Right** icon, or in the **View** menu, click **Show Script Pane Right**.
- To maximize the Script Pane, press CTRL+3 or, on the toolbar, click the **Show Script Pane Maximized** icon, or in the **View** menu, click **Show Script Pane Maximized**.
- To maximize the Console Pane and hide the Script Pane, on the far right edge of the row of tabs, click the **Hide Script Pane** icon, in the **View** menu, click to deselect the **Show Script Pane** menu option.
- To display the Script Pane when the Console Pane is maximized, on the far right edge of the row of tabs, click the **Show Script Pane** icon, or in the **View** menu, click to select the **Show Script Pane** menu option.

Keyboard shortcuts for editing text

You can use the following keyboard shortcuts when you edit text.

Action	Keyboard Shortcuts	Use in
Copy	CTRL+C	Script Pane, Console Pane
Cut	CTRL+X	Script Pane, Console Pane
Find in Script	CTRL+F	Script Pane
Find Next in Script	F3	Script Pane
Find Previous in Script	SHIFT+F3	Script Pane
Paste	CTRL+V	Script Pane, Console Pane

Action	Keyboard Shortcuts	Use in
Redo	CTRL+Y	Script Pane, Console Pane
Replace in Script	CTRL+H	Script Pane
Save	CTRL+S	Script Pane
Select All	CTRL+A	Script Pane, Console Pane
Undo	CTRL+Z	Script Pane, Console Pane

Keyboard shortcuts for running scripts

You can use the following keyboard shortcuts when you run scripts in the Script Pane.

Action	Keyboard Shortcut
New	CTRL+N
Open	CTRL+O
Run	F5
Run Selection	F8
Stop Execution	CTRL+BREAK. CTRL+C can be used when the context is unambiguous (when there is no text selected).
Tab (to next script)	CTRL+TAB **Note:** Tab to next script works only when you have a single PowerShell tab open, or when you have more than one PowerShell tab open, but the focus is in the Script Pane.
Tab (to previous script)	CTRL+SHIFT+TAB **Note:** Tab to previous script works when you have only one PowerShell tab open, or if you have more than one PowerShell tab open, and the focus is in the Script Pane.

Keyboard shortcuts for customizing the view

You can use the following keyboard shortcuts to customize the view in Windows PowerShell ISE. They are accessible from all the panes in the application.

Action	Keyboard Shortcut
Go to Console Pane	CTRL+D

Action	Keyboard Shortcut
Go to Script Pane	CTRL + I
Show Script Pane	CTRL + R
Hide Script Pane	CTRL + R
Move Script Pane Up	CTRL + 1
Move Script Pane Right	CTRL + 2
Maximize Script Pane	CTRL + 3
Zoom In	CTRL + PLUS
Zoom Out	CTRL + MINUS

Keyboard shortcuts for debugging scripts

You can use the following keyboard shortcuts when you debug scripts.

Action	Keyboard Shortcut	Use in
Run/Continue	F5	Script Pane, when debugging a script
Step Into	F11	Script Pane, when debugging a script
Step Over	F10	Script Pane, when debugging a script
Step Out	SHIFT + F11	Script Pane, when debugging a script
Display Call Stack	CTRL + SHIFT + D	Script Pane, when debugging a script
List Breakpoints	CTRL + SHIFT + L	Script Pane, when debugging a script
Toggle Breakpoint	F9	Script Pane, when debugging a script
Remove All Breakpoints	CTRL + SHIFT + F9	Script Pane, when debugging a script
Stop Debugger	SHIFT + F5	Script Pane, when debugging a script

> ⓘ Note
>
> You can also use the keyboard shortcuts designed for the Windows PowerShell console when you debug scripts in Windows PowerShell ISE. To use these shortcuts, you must type the shortcut in the Console Pane and press ENTER.

Action	Keyboard Shortcut	Use in
Continue	`C`	Console Pane, when debugging a script
Step Into	`S`	Console Pane, when debugging a script
Step Over	`V`	Console Pane, when debugging a script
Step Out	`O`	Console Pane, when debugging a script
Repeat Last Command(Step Into/Over)	`ENTER`	Console Pane, when debugging a script
Display Call Stack	`K`	Console Pane, when debugging a script
Stop Debugging	`Q`	Console Pane, when debugging a script
List the Script	`L`	Console Pane, when debugging a script
Display Console Debugging Commands	`H` or `?`	Console Pane, when debugging a script

Keyboard shortcuts for Windows PowerShell tabs

You can use the following keyboard shortcuts when you use Windows PowerShell tabs.

Action	Keyboard Shortcut
Close PowerShell Tab	`CTRL`+`W`
New PowerShell Tab	`CTRL`+`T`
Previous PowerShell tab	`CTRL`+`SHIFT`+`TAB` (Only when no files are open on any PowerShell tab)
Next Windows PowerShell tab	`CTRL`+`TAB` (Only when no files are open on any PowerShell tab)

Keyboard shortcuts for starting and exiting

You can use the following keyboard shortcuts to start the Windows PowerShell console (**PowerShell.exe**) or to exit Windows PowerShell ISE.

Action	Keyboard Shortcut
Exit	ALT + F4
Start PowerShell.exe (Windows PowerShell console)	CTRL + SHIFT + P

Breakpoint Management

For the visually impaired, breakpoint information is available through the cmdlets for managing breakpoints, such as Get-PSBreakpoint and Set-PSBreakpoint. For more information please see 'How to manage breakpoints' in How to Debug Scripts in the Windows PowerShell ISE.

See Also

Introducing the Windows PowerShell ISE

Purpose of the Windows PowerShell ISE Scripting Object Model

Article • 09/17/2021

Objects are associated with the form and function of Windows PowerShell Integrated Scripting Environment (ISE). The object model reference provides details about the member properties and methods that these objects expose. Examples are provided to show how you can use scripts to directly access these methods and properties. The scripting object model makes the following range of tasks easier.

Customizing the appearance of Windows PowerShell ISE

You can use the object model to modify the application settings and options. For example, you can modify them as follows:

- Change the color of errors, warnings, verbose outputs, and debug outputs.
- Get or set the background colors for the Command pane, the Output pane, and the Script pane.
- Set the foreground color for the Output pane.
- Set the font name and font size for Windows PowerShell ISE.
- Configure warnings. This setting includes warnings that are issued when a file is opened in multiple PowerShell tabs or when a script in the file is run before the file has been saved.
- Switch between a view where the Script pane and the Output pane are side-by-side and a view where the Script pane is on top of the Output pane.
- Dock the Command pane to the bottom or the top of the Output pane.

Enhancing the functionality of Windows PowerShell ISE

You can use the object model to enhance the functionality of Windows PowerShell ISE. For example, you can:

- Add and modify the instance of Windows PowerShell ISE itself. For example, to change the menus, you can add new menu items and map the new menu items to scripts.

- Create scripts that perform some of the tasks that you can perform by using the menu commands and buttons in Windows PowerShell ISE. For example, you can add, remove, or select a PowerShell tab.
- Complement tasks that can be performed by using menu commands and buttons. For example, you can rename a PowerShell tab.
- Manipulate text buffers for the Command pane, the Output pane, and the Script pane that are associated with a file. For example, you can:
  - Get or set all text.
  - Get or set a text selection.
  - Run a script or run a selected portion of a script.
  - Scroll a line into view.
  - Insert text at a caret position.
  - Select a block of text.
  - Get the last line number.
- Perform file operations. For example, you can:
  - Open a file, save a file, or save a file by using a different name.
  - Determine whether a file has been changed after it was last saved.
  - Get the file name.
  - Select a file.

Automating tasks

You can use the scripting object model to create keyboard shortcuts for frequent operations.

See also

- The ISE Object Model Hierarchy

The ISE Object Model Hierarchy

Article • 09/17/2021

This article shows the hierarchy of objects that are part of Windows PowerShell Integrated Scripting Environment (ISE). Windows PowerShell ISE is included in Windows PowerShell 3.0, 4.0, and 5.1. Click an object to take you to the reference documentation for the class that defines the object.

$psISE Object

The `$psISE` object is the root object of the Windows PowerShell ISE object hierarchy. Located at the top level, it makes the following objects available for scripting:

$psISE.CurrentFile

The `$psISE.CurrentFile` object is an instance of the ISEFile class.

$psISE.CurrentPowerShellTab

The `$psISE.CurrentPowerShellTab` object is an instance of the PowerShellTab class.

$psISE.CurrentVisibleHorizontalTool

The `$psISE.CurrentVisibleHorizontalTool` object is an instance of the ISEAddOnTool class. It represents the installed add-on tool that is currently docked to the top edge of the Windows PowerShell ISE window.

$psISE.CurrentVisibleVerticalTool

The `$psISE.CurrentVisibleHorizontalTool` object is an instance of the ISEAddOnTool class. It represents the installed add-on tool that is currently docked to the right-hand edge of the Windows PowerShell ISE window.

$psISE.Options

The `$psISE.Options` object is an instance of the ISEOptions class. The ISEOptions object represents various settings for Windows PowerShell ISE. It is an instance of the

Microsoft.PowerShell.Host.ISE.ISEOptions class.

$psISE.PowerShellTabs

The `$psISE.PowerShellTabs` object is an instance of the PowerShellTabCollection class. It is a collection of all the currently open PowerShell tabs that represent the available Windows PowerShell run environments on the local computer or on connected remote computers. Each member in the collection is an instance of the PowerShellTab class.

See Also

- Purpose of the Windows PowerShell ISE Scripting Object Model
- The ISE Object Model Hierarchy

The ObjectModelRoot Object

Article • 09/17/2021

The `$psISE` object, which is the principal root object in Windows PowerShell® Integrated Scripting Environment (ISE) is an instance of the Microsoft.PowerShell.Host.ISE.ObjectModelRoot class. This topic describes the properties of the **ObjectModelRoot** object.

Properties

CurrentFile

> Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the file, which is associated with this host object that currently has the focus.

CurrentPowerShellTab

> Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the PowerShell tab that has the focus.

CurrentVisibleHorizontalTool

> Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the currently visible Windows PowerShell ISE add-on tool that is located in the horizontal tool pane at the bottom of the editor.

CurrentVisibleVerticalTool

> Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the currently visible Windows PowerShell ISE add-on tool that is located in the vertical tool pane on the right side of the editor.

Options

> Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the various options that can change settings in Windows PowerShell ISE.

PowerShellTabs

> Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the collection of the PowerShell tabs, which are open in Windows PowerShell ISE. By default, this object contains one PowerShell tab. However, you can add more PowerShell tabs to this object by using scripts or by using the menus in Windows PowerShell ISE.

See Also

- Purpose of the Windows PowerShell ISE Scripting Object Model
- The ISE Object Model Hierarchy

The ISEAddOnToolCollection Object

Article • 09/17/2021

The **ISEAddOnToolCollection** object is a collection of **ISEAddOnTool** objects. An example is the `$psISE.CurrentPowerShellTab.VerticalAddOnTools` object.

Methods

Add(Name, ControlType, [IsVisible])

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Adds a new add-on tool to the collection. It returns the newly added add-on tool. Before you run this command, you must install the add-on tool on the local computer and load the assembly.

Name - String Specifies the display name of the add-on tool that is added to Windows PowerShell ISE.

ControlType -Type Specifies the control that is added.

[IsVisible] - optional Boolean If set to `$true`, the add-on tool is immediately visible in the associated tool pane.

PowerShell

```
# Load a DLL with an add-on and then add it to the ISE
[reflection.assembly]::LoadFile("c:\test\ISESimpleSolution\ISESimpleSolution
.dll")
$psISE.CurrentPowerShellTab.VerticalAddOnTools.Add("Solutions",
[ISESimpleSolution.Solution], $true)
```

Remove(Item)

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Removes the specified add-on tool from the collection.

Item - Microsoft.PowerShell.Host.ISE.ISEAddOnTool Specifies the object to be removed from Windows PowerShell ISE.

PowerShell

```
# Load a DLL with an add-on and then add it to the ISE
[reflection.assembly]::LoadFile("c:\test\ISESimpleSolution\ISESimpleSolution
.dll")
$psISE.CurrentPowerShellTab.VerticalAddOnTools.Add("Solutions",
[ISESimpleSolution.Solution], $true)
```

SetSelectedPowerShellTab(psTab)

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Selects the PowerShell tab that the **psTab** parameter specifies.

psTab - Microsoft.PowerShell.Host.ISE.PowerShellTab The PowerShell tab to select.

PowerShell

```
$newTab = $psISE.PowerShellTabs.Add()
# Change the DisplayName of the new PowerShell tab.
$newTab.DisplayName = 'Brand New Tab'
```

Remove(psTab)

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Removes the PowerShell tab that the **psTab** parameter specifies.

psTab - Microsoft.PowerShell.Host.ISE.PowerShellTab The PowerShell tab to remove.

PowerShell

```
$newTab = $psISE.PowerShellTabs.Add()
Change the DisplayName of the new PowerShell tab.
$newTab.DisplayName = 'This tab will go away in 5 seconds'
sleep 5
$psISE.PowerShellTabs.Remove($newTab)
```

See Also

- The PowerShellTab Object
- Purpose of the Windows PowerShell ISE Scripting Object Model
- The ISE Object Model Hierarchy

The ISEAddOnTool Object

Article • 09/17/2021

An **ISEAddonTool** object represents an installed add-on tool that provides additional functionality to Windows PowerShell ISE. An example is the **Commands** tool that you can display by clicking **View**, then **Show Command Add-on**. This tool is then accessible to you by manipulating the various available **ISEAddOnTool** objects.

Each add-on tool can be associated with either the vertical pane or the horizontal pane. The vertical pane is docked to the right edge of Windows PowerShell ISE. The horizontal pane is docked to the bottom edge.

Each PowerShell tab in Windows PowerShell ISE can have its own set of add-on tools installed. See $psISE.CurrentPowerShellTab.HorizontalAddOnTools and $psISE.CurrentPowerShellTab.VerticalAddOnTools to access the collection of tools available to the currently selected tab or the same properties on any of the **PowerShellTab** objects in the $psISE.PowerShellTabs collection object.

Methods

There are no Windows PowerShell ISE-specific methods available for objects of this class.

Properties

Control

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

The **Control** property provides read access to many of the details of the Commands add-on tool.

PowerShell

```
# View the properties of the Commands add-on tool.
# (assumes that it is visible in the vertical pane)
$psISE.CurrentVisibleVerticalTool.Control
```

Output

```
HostObject                  : Microsoft.PowerShell.Host.ISE.ObjectModelRoot
Content                     :
HasContent                  :
ContentTemplate             :
ContentTemplateSelector     :
ContentStringFormat         :
BorderBrush                 :
BorderThickness             :
Background                  :
Foreground                  :
FontFamily                  :
FontSize                    :
FontStretch                 :
FontStyle                   :
FontWeight                  :
HorizontalContentAlignment  :
VerticalContentAlignment    :
TabIndex                    :
IsTabStop                   :
Padding                     :
Template                    : System.Windows.Controls.ControlTemplate
Style                       :
OverridesDefaultStyle       :
UseLayoutRounding           :
Triggers                    : {}
TemplatedParent             :
Resources                   : {System.Windows.Controls.TabItem}
DataContext                 :
BindingGroup                :
Language                    :
Name                        :
Tag                         :
InputScope                  :
ActualWidth                 : 370.75
ActualHeight                : 676.559097412109
LayoutTransform             :
Width                       :
MinWidth                    :
MaxWidth                    :
Height                      :
MinHeight                   :
MaxHeight                   :
FlowDirection               : LeftToRight
Margin                      :
HorizontalAlignment         :
VerticalAlignment           :
FocusVisualStyle            :
Cursor                      :
ForceCursor                 :
IsInitialized               : True
IsLoaded                    :
ToolTip                     :
ContextMenu                 :
Parent                      :
```

```
HasAnimatedProperties       :
InputBindings               :
CommandBindings             :
AllowDrop                   :
DesiredSize                 : 227.66,676.559097412109
IsMeasureValid              : True
IsArrangeValid              : True
RenderSize                  : 370.75,676.559097412109
RenderTransform             :
RenderTransformOrigin       :
IsMouseDirectlyOver         : False
IsMouseOver                 : False
IsStylusOver                : False
IsKeyboardFocusWithin       : False
IsMouseCaptured             :
IsMouseCaptureWithin        : False
IsStylusDirectlyOver        : False
IsStylusCaptured            :
IsStylusCaptureWithin       : False
IsKeyboardFocused           : False
IsInputMethodEnabled        :
Opacity                     :
OpacityMask                 :
BitmapEffect                :
Effect                      :
BitmapEffectInput           :
CacheMode                   :
Uid                         :
Visibility                  : Visible
ClipToBounds                : False
Clip                        :
SnapsToDevicePixels         : False
IsFocused                   :
IsEnabled                   :
IsHitTestVisible            :
IsVisible                   : True
Focusable                   :
PersistId                   : 1
IsManipulationEnabled       :
AreAnyTouchesOver           : False
AreAnyTouchesDirectlyOver   :
AreAnyTouchesCapturedWithin : False
AreAnyTouchesCaptured       :
TouchesCaptured             : {}
TouchesCapturedWithin       : {}
TouchesOver                 : {}
TouchesDirectlyOver         : {}
DependencyObjectType        : System.Windows.DependencyObjectType
IsSealed                    : False
Dispatcher                  : System.Windows.Threading.Dispatcher
```

IsVisible

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

The Boolean property that indicates whether the add-on tool is currently visible in its assigned pane. If it is visible, you can set the **IsVisible** property to `$false` to hide the tool, or set the **IsVisible** property to `$true` to make an add-on tool visible on its PowerShell tab. Note that after an add-on tool is hidden, it is no longer accessible through the **CurrentVisibleHorizontalTool** or **CurrentVisibleVerticalTool** objects, and therefore cannot be made visible by using this property on that object.

PowerShell

```
# Hide the current tool in the vertical tool pane
$psISE.CurrentVisibleVerticalTool.IsVisible = $false
# Show the first tool on the currently selected PowerShell tab
$psISE.CurrentPowerShellTab.VerticalAddOnTools[0].IsVisible = $true
```

Name

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

The read-only property that gets the name of the add-on tool.

PowerShell

```
# Gets the name of the visible vertical pane add-on tool.
$psISE.CurrentVisibleVerticalTool.Name
```

Output

```
Commands
```

See Also

- The ISEAddOnToolCollection Object
- Purpose of the Windows PowerShell ISE Scripting Object Model
- The ISE Object Model Hierarchy

The ISEEditor Object

Article • 09/17/2021

An **ISEEditor** object is an instance of the Microsoft.PowerShell.Host.ISE.ISEEditor class. The Console pane is an **ISEEditor** object. Each ISEFile object has an associated **ISEEditor** object. The following sections list the methods and properties of an **ISEEditor** object.

Methods

Clear()

Supported in Windows PowerShell ISE 2.0 and later.

Clears the text in the editor.

PowerShell

```
# Clears the text in the Console pane.
$psISE.CurrentPowerShellTab.ConsolePane.Clear()
```

EnsureVisible(int lineNumber)

Supported in Windows PowerShell ISE 2.0 and later.

Scrolls the editor so that the line that corresponds to the specified **lineNumber** parameter value is visible. It throws an exception if the specified line number is outside the range of 1,last line number, which defines the valid line numbers.

lineNumber The number of the line that is to be made visible.

PowerShell

```
# Scrolls the text in the Script pane so that the fifth line is in view.
$psISE.CurrentFile.Editor.EnsureVisible(5)
```

Focus()

Supported in Windows PowerShell ISE 2.0 and later.

Sets the focus to the editor.

PowerShell

```
# Sets focus to the Console pane.
$psISE.CurrentPowerShellTab.ConsolePane.Focus()
```

GetLineLength(int lineNumber)

Supported in Windows PowerShell ISE 2.0 and later.

Gets the line length as an integer for the line that is specified by the line number.

lineNumber The number of the line of which to get the length.

Returns The line length for the line at the specified line number.

PowerShell

```
# Gets the length of the first line in the text of the Command pane.
$psISE.CurrentPowerShellTab.ConsolePane.GetLineLength(1)
```

GoToMatch()

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Moves the caret to the matching character if the **CanGoToMatch** property of the editor object is `$true`, which occurs when the caret is immediately before an opening parenthesis, bracket, or brace - `(`,`[`,`{` - or immediately after a closing parenthesis, bracket, or brace - `)`,`]`,`}`. The caret is placed before an opening character or after a closing character. If the **CanGoToMatch** property is `$false`, then this method does nothing.

PowerShell

```
# Goes to the matching character if CanGoToMatch() is $true
$psISE.CurrentPowerShellTab.ConsolePane.GoToMatch()
```

InsertText(text)

Supported in Windows PowerShell ISE 2.0 and later.

Replaces the selection with text or inserts text at the current caret position.

text - String The text to insert.

See the Scripting Example later in this topic.

Select(startLine, startColumn, endLine, endColumn)

Supported in Windows PowerShell ISE 2.0 and later.

Selects the text from the **startLine**, **startColumn**, **endLine**, and **endColumn** parameters.

startLine - Integer The line where the selection starts.

startColumn - Integer The column within the start line where the selection starts.

endLine - Integer The line where the selection ends.

endColumn - Integer The column within the end line where the selection ends.

See the Scripting Example later in this topic.

SelectCaretLine()

Supported in Windows PowerShell ISE 2.0 and later.

Selects the entire line of text that currently contains the caret.

PowerShell

```
# First, set the caret position on line 5.
$psISE.CurrentFile.Editor.SetCaretPosition(5,1)
# Now select that entire line of text
$psISE.CurrentFile.Editor.SelectCaretLine()
```

SetCaretPosition(lineNumber, columnNumber)

Supported in Windows PowerShell ISE 2.0 and later.

Sets the caret position at the line number and the column number. It throws an exception if either the caret line number or the caret column number are out of their respective valid ranges.

lineNumber - Integer The caret line number.

columnNumber - Integer The caret column number.

PowerShell

```
# Set the CaretPosition.
$psISE.CurrentFile.Editor.SetCaretPosition(5,1)
```

ToggleOutliningExpansion()

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Causes all the outline sections to expand or collapse.

PowerShell

```
# Toggle the outlining expansion
$psISE.CurrentFile.Editor.ToggleOutliningExpansion()
```

Properties

CanGoToMatch

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

The read-only Boolean property to indicate whether the caret is next to a parenthesis, bracket, or brace - `()`, `[]`, `{}`. If the caret is immediately before the opening character or immediately after the closing character of a pair, then this property value is `$true`. Otherwise, it is `$false`.

PowerShell

```
# Test to see if the caret is next to a parenthesis, bracket, or brace
$psISE.CurrentFile.Editor.CanGoToMatch
```

CaretColumn

Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the column number that corresponds to the position of the caret.

PowerShell

```
# Get the CaretColumn.
$psISE.CurrentFile.Editor.CaretColumn
```

CaretLine

Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the number of the line that contains the caret.

```
PowerShell

# Get the CaretLine.
$psISE.CurrentFile.Editor.CaretLine
```

CaretLineText

Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the complete line of text that contains the caret.

```
PowerShell

# Get all of the text on the line that contains the caret.
$psISE.CurrentFile.Editor.CaretLineText
```

LineCount

Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the line count from the editor.

```
PowerShell

# Get the LineCount.
$psISE.CurrentFile.Editor.LineCount
```

SelectedText

Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the selected text from the editor.

See the Scripting Example later in this topic.

Text

Supported in Windows PowerShell ISE 2.0 and later.

The read/write property that gets or sets the text in the editor.

See the Scripting Example later in this topic.

Scripting Example

PowerShell

```
# This illustrates how you can use the length of a line to
# select the entire line and shows how you can make it lowercase.
# You must run this in the Console pane. It will not run in the Script pane.
# Begin by getting a variable that points to the editor.
$myEditor = $psISE.CurrentFile.Editor
# Clear the text in the current file editor.
$myEditor.Clear()

# Make sure the file has five lines of text.
$myEditor.InsertText("LINE1 `n")
$myEditor.InsertText("LINE2 `n")
$myEditor.InsertText("LINE3 `n")
$myEditor.InsertText("LINE4 `n")
$myEditor.InsertText("LINE5 `n")

# Use the GetLineLength method to get the length of the third line.
$endColumn = $myEditor.GetLineLength(3)
# Select the text in the first three lines.
$myEditor.Select(1, 1, 3, $endColumn + 1)
$selection = $myEditor.SelectedText
# Clear all the text in the editor.
$myEditor.Clear()
# Add the selected text back, but in lower case.
$myEditor.InsertText($selection.ToLower())
```

See Also

- The ISEFile Object
- The PowerShellTab Object
- Purpose of the Windows PowerShell ISE Scripting Object Model
- The ISE Object Model Hierarchy

The ISEFileCollection Object

Article • 09/17/2021

The **ISEFileCollection** object is a collection of **ISEFile** objects. An example is the `$psISE.CurrentPowerShellTab.Files` collection.

Methods

Add([FullPath])

Supported in Windows PowerShell ISE 2.0 and later.

Creates and returns a new untitled file and adds it to the collection. The **IsUntitled** property of the newly created file is `$true`.

[FullPath] - Optional string The fully specified path of the file. An exception is generated if you include the **FullPath** parameter and a relative path, or if you use a file name instead of the full path.

PowerShell

```
# Adds a new untitled file to the collection of files in the current
PowerShell tab.
$newFile = $psISE.CurrentPowerShellTab.Files.Add()

# Adds a file specified by its full path to the collection of files in the
current PowerShell tab.
$psISE.CurrentPowerShellTab.Files.Add("$pshome\Examples\profile.ps1")
```

Remove(File, [Force])

Supported in Windows PowerShell ISE 2.0 and later.

Removes a specified file from the current PowerShell tab.

File - String The ISEFile file that you want to remove from the collection. If the file has not been saved, this method throws an exception. Use the **Force** switch parameter to force the removal of an unsaved file.

[Force] - optional Boolean If set to `$true`, grants permission to remove the file even if it has not been saved after last use. The default is `$false`.

PowerShell

```
# Removes the first opened file from the file collection associated with the
current PowerShell tab.
# If the file has not yet been saved, then an exception is generated.
$firstfile = $psISE.CurrentPowerShellTab.Files[0]
$psISE.CurrentPowerShellTab.Files.Remove($firstfile)

# Removes the first opened file from the file collection associated with the
current PowerShell tab, even if it has not been saved.
$firstfile = $psISE.CurrentPowerShellTab.Files[0]
$psISE.CurrentPowerShellTab.Files.Remove($firstfile, $true)
```

SetSelectedFile(selectedFile)

Supported in Windows PowerShell ISE 2.0 and later.

Selects the file that is specified by the **SelectedFile** parameter.

SelectedFile - Microsoft.PowerShell.Host.ISE.ISEFile The ISEFile file that you want to select.

PowerShell

```
# Selects the specified file.
$firstfile = $psISE.CurrentPowerShellTab.Files[0]
$psISE.CurrentPowerShellTab.Files.SetSelectedFile($firstfile)
```

See Also

- The ISEFile Object
- Purpose of the Windows PowerShell ISE Scripting Object Model
- The ISE Object Model Hierarchy

The ISEFile Object

Article • 09/17/2021

An **ISEFile** object represents a file in Windows PowerShell Integrated Scripting Environment (ISE). It is an instance of the **Microsoft.PowerShell.Host.ISE.ISEFile** class. This topic lists its member methods and member properties. The `$psISE.CurrentFile` and the files in the Files collection in a PowerShell tab are all instances of the **Microsoft.PowerShell.Host.ISE.ISEFile** class.

Methods

Save([saveEncoding])

Supported in Windows PowerShell ISE 2.0 and later.

Saves the file to disk.

`[saveEncoding]` - optional System.Text.Encoding An optional character encoding parameter to be used for the saved file. The default value is **UTF8**.

Exceptions

- **System.IO.IOException**: The file could not be saved.

PowerShell

```
# Save the file using the default encoding (UTF8)
$psISE.CurrentFile.Save()

# Save the file as ASCII.
$psISE.CurrentFile.Save([System.Text.Encoding]::ASCII)

# Gets the current encoding.
$myfile = $psISE.CurrentFile
$myfile.Encoding
```

SaveAs(filename, [saveEncoding])

Supported in Windows PowerShell ISE 2.0 and later.

Saves the file with the specified file name and encoding.

filename - String The name to be used to save the file.

`[saveEncoding]` - optional System.Text.Encoding An optional character encoding parameter to be used for the saved file. The default value is **UTF8**.

Exceptions

- **System.ArgumentNullException**: The **filename** parameter is null.
- **System.ArgumentException**: The **filename** parameter is empty.
- **System.IO.IOException**: The file could not be saved.

PowerShell

```
# Save the file with a full path and name.
$fullpath = "c:\temp\newname.txt"
$psISE.CurrentFile.SaveAs($fullPath)
# Save the file with a full path and name and explicitly as UTF8.
$psISE.CurrentFile.SaveAs($fullPath, [System.Text.Encoding]::UTF8)
```

Properties

DisplayName

Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the string that contains the display name of this file. The name is shown on the **File** tab at the top of the editor. The presence of an asterisk `(*)` at the end of the name indicates that the file has changes that have not been saved.

PowerShell

```
# Shows the display name of the file.
$psISE.CurrentFile.DisplayName
```

Editor

Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the editor object that is used for the specified file.

PowerShell

```
# Gets the editor and the text.
$psISE.CurrentFile.Editor.Text
```

Encoding

Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the original file encoding. This is a **System.Text.Encoding** object.

PowerShell

```
# Shows the encoding for the file.
$psISE.CurrentFile.Encoding
```

FullPath

Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the string that specifies the full path of the opened file.

PowerShell

```
# Shows the full path for the file.
$psISE.CurrentFile.FullPath
```

IsSaved

Supported in Windows PowerShell ISE 2.0 and later.

The read-only Boolean property that returns `$true` if the file has been saved after it was last modified.

PowerShell

```
# Determines whether the file has been saved since it was last modified.
$myfile = $psISE.CurrentFile
$myfile.IsSaved
```

IsUntitled

Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that returns `$true` if the file has never been given a title.

PowerShell

```
# Determines whether the file has never been given a title.
$psISE.CurrentFile.IsUntitled
$psISE.CurrentFile.SaveAs("temp.txt")
$psISE.CurrentFile.IsUntitled
```

See Also

- The ISEFileCollectionObject
- Purpose of the Windows PowerShell ISE Scripting Object Model
- The ISE Object Model Hierarchy

The ISEMenuItemCollection Object

Article • 10/06/2021

An **ISEMenuItemCollection** object is a collection of **ISEMenuItem** objects. It is an instance of the **Microsoft.PowerShell.Host.ISE.ISEMenuItemCollection** class. An example is the `$psISE.CurrentPowerShellTab.AddOnsMenu.Submenus` object that is used to customize the **Add-On** menu in Windows PowerShell® Integrated Scripting Environment (ISE).

Method

Add(string DisplayName, System.Management.Automation.ScriptBlock Action, System.Windows.Input.KeyGesture Shortcut)

Supported in Windows PowerShell ISE 2.0 and later.

Adds a menu item to the collection.

DisplayName The display name of the menu to be added.

Action The **System.Management.Automation.ScriptBlock** object that specifies the action that is associated with this menu item.

Shortcut The keyboard shortcut for the action.

Returns The **ISEMenuItem** object that was just added.

PowerShell

```
# Create an Add-ons menu with an fast access key and a shortcut.
# Note the use of "_"  as opposed to the "&" for mapping to the fast access
key letter for the menu item.
$menuAdded = $psISE.CurrentPowerShellTab.AddOnsMenu.Submenus.Add('_Process',
{Get-Process}, 'Alt+P')
```

Clear()

Supported in Windows PowerShell ISE 2.0 and later.

Removes all submenus from the menu item.

PowerShell

```
# Remove all custom submenu items from the AddOns menu
$psISE.CurrentPowerShellTab.AddOnsMenu.Submenus.Clear()
```

See Also

- The ISEMenuItem Object
- Purpose of the Windows PowerShell ISE Scripting Object Model
- The ISE Object Model Hierarchy

The ISEMenuItem Object

Article • 10/06/2021

An **ISEMenuItem** object is an instance of the **Microsoft.PowerShell.Host.ISE.ISEMenuItem** class. All menu objects on the **Add-ons** menu are instances of the **Microsoft.PowerShell.Host.ISE.ISEMenuItem** class.

Properties

DisplayName

Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the display name of the menu item.

PowerShell

```
# Get the display name of the Add-ons menu item
$psISE.CurrentPowerShellTab.AddOnsMenu.Submenus.Clear()
$psISE.CurrentPowerShellTab.AddOnsMenu.Submenus.Add('_Process', {Get-
Process}, 'Alt+P')
$psISE.CurrentPowerShellTab.AddOnsMenu.DisplayName
```

Action

Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the block of script. It invokes the action when you click the menu item.

PowerShell

```
# Get the action associated with the first submenu item.
$psISE.CurrentPowerShellTab.AddOnsMenu.Submenus.Clear()
$psISE.CurrentPowerShellTab.AddOnsMenu.Submenus.Add('_Process', {Get-
Process}, 'Alt+P')
$psISE.CurrentPowerShellTab.AddOnsMenu.Submenus[0].Action

# Invoke the script associated with the first submenu item
$psISE.CurrentPowerShellTab.AddOnsMenu.Submenus[0].Action.Invoke()
```

Shortcut

Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the Windows input keyboard shortcut for the menu item.

PowerShell

```
# Get the shortcut for the first submenu item.
$psISE.CurrentPowerShellTab.AddOnsMenu.Submenus.Clear()
$psISE.CurrentPowerShellTab.AddOnsMenu.Submenus.Add('_Process', {Get-
Process}, 'Alt+P')
$psISE.CurrentPowerShellTab.AddOnsMenu.Submenus[0].Shortcut
```

Submenus

Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the list of submenus of the menu item.

PowerShell

```
# List the submenus of the Add-ons menu
$psISE.CurrentPowerShellTab.AddOnsMenu.Submenus.Clear()
$psISE.CurrentPowerShellTab.AddOnsMenu.Submenus.Add('_Process', {Get-
Process}, 'Alt+P')
$psISE.CurrentPowerShellTab.AddOnsMenu.Submenus
```

Scripting example

To better understand the use of the Add-ons menu and its scriptable properties, read through the following scripting example.

PowerShell

```
# This is a scripting example that shows the use of the Add-ons menu.
# Clear the Add-ons menu if any entries currently exist
$psISE.CurrentPowerShellTab.AddOnsMenu.Submenus.Clear()

# Add an Add-ons menu item with an shortcut and fast access key.
# Note the use of "_"  as opposed to the "&" for mapping to the fast access
key letter for the menu item.
$menuAdded = $psISE.CurrentPowerShellTab.AddOnsMenu.SubMenus.Add('_Process',
{Get-Process}, 'Alt+P')
# Add a nested menu - a parent and a child submenu item.
$parentAdded = $psISE.CurrentPowerShellTab.AddOnsMenu.Submenus.Add('Parent',
$null, $null)
$parentAdded.SubMenus.Add('_Dir', {dir}, 'Alt+D')
```

See Also

- The ISEMenuItemCollection Object
- Purpose of the Windows PowerShell ISE Scripting Object Model
- The ISE Object Model Hierarchy

The ISEOptions Object

Article • 09/22/2022

The **ISEOptions** object represents various settings for Windows PowerShell ISE. It is an instance of the **Microsoft.PowerShell.Host.ISE.ISEOptions** class.

The **ISEOptions** object provides the following methods and properties.

Methods

RestoreDefaultConsoleTokenColors()

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Restores the default values of the token colors in the Console pane.

PowerShell

```
# Changes the color of the commands in the Console pane to red and then
restores it to its default value.
$psISE.Options.ConsoleTokenColors["Command"] = 'red'
$psISE.Options.RestoreDefaultConsoleTokenColors()
```

RestoreDefaults()

Supported in Windows PowerShell ISE 2.0 and later.

Restores the default values of all options settings in the Console pane. It also resets the behavior of various warning messages that provide the standard check box to prevent the message from being shown again.

PowerShell

```
# Changes the background color in the Console pane and then restores it to
its default value.
$psISE.Options.ConsolePaneBackgroundColor = 'orange'
$psISE.Options.RestoreDefaults()
```

RestoreDefaultTokenColors()

Supported in Windows PowerShell ISE 2.0 and later.

Restores the default values of the token colors in the Script pane.

```PowerShell
# Changes the color of the comments in the Script pane to red and then
restores it to its default value.
$psISE.Options.TokenColors["Comment"] = 'red'
$psISE.Options.RestoreDefaultTokenColors()
```

RestoreDefaultXmlTokenColors()

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Restores the default values of the token colors for XML elements that are displayed in Windows PowerShell ISE. Also see XmlTokenColors.

```PowerShell
# Changes the color of the comments in XML data to red and then restores it
to its default value.
$psISE.Options.XmlTokenColors["Comment"] = 'red'
$psISE.Options.RestoreDefaultXmlTokenColors()
```

Properties

AutoSaveMinuteInterval

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Specifies the number of minutes between automatic save operations of your files by Windows PowerShell ISE. The default value is 2 minutes. The value is an integer.

```PowerShell
# Changes the number of minutes between automatic save operations to every 3
minutes.
$psISE.Options.AutoSaveMinuteInterval = 3
```

CommandPaneBackgroundColor

This feature is present in Windows PowerShell ISE 2.0, but was removed or renamed in later versions of the ISE. For later versions, see ConsolePaneBackgroundColor.

Specifies the background color for the Command pane. It is an instance of the **System.Windows.Media.Color** class.

```PowerShell
# Changes the background color of the Command pane to orange.
$psISE.Options.CommandPaneBackgroundColor = 'orange'
```

CommandPaneUp

This feature is present in Windows PowerShell ISE 2.0, but was removed or renamed in later versions of the ISE.

Specifies whether the Command pane is located above the Output pane.

```PowerShell
# Moves the Command pane to the top of the screen.
$psISE.Options.CommandPaneUp  = $true
```

ConsolePaneBackgroundColor

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Specifies the background color for the Console pane. It is an instance of the **System.Windows.Media.Color** class.

```PowerShell
# Changes the background color of the Console pane to red.
$psISE.Options.ConsolePaneBackgroundColor = 'red'
```

ConsolePaneForegroundColor

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Specifies the foreground color of the text in the Console pane.

```PowerShell
# Changes the foreground color of the text in the Console pane to yellow.
$psISE.Options.ConsolePaneForegroundColor  = 'yellow'
```

ConsolePaneTextBackgroundColor

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Specifies the background color of the text in the Console pane.

PowerShell

```
# Changes the background color of the Console pane text to pink.
$psISE.Options.ConsolePaneTextBackgroundColor = 'pink'
```

ConsoleTokenColors

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Specifies the colors of the IntelliSense tokens in the Windows PowerShell ISE Console pane. This property is a dictionary object that contains name/value pairs of token types and colors for the Console pane. To change the colors of the IntelliSense tokens in the Script pane, see TokenColors. To reset the colors to the default values, see RestoreDefaultConsoleTokenColors. Token colors can be set for the following: Attribute, Command, CommandArgument, CommandParameter, Comment, GroupEnd, GroupStart, Keyword, LineContinuation, LoopLabel, Member, NewLine, Number, Operator, Position, StatementSeparator, String, Type, Unknown, Variable.

PowerShell

```
# Sets the color of commands to green.
$psISE.Options.ConsoleTokenColors["Command"] = 'green'
# Sets the color of keywords to magenta.
$psISE.Options.ConsoleTokenColors["Keyword"] = 'magenta'
```

DebugBackgroundColor

Supported in Windows PowerShell ISE 2.0 and later.

Specifies the background color for the debug text that appears in the Console pane. It is an instance of the **System.Windows.Media.Color** class.

PowerShell

```
# Changes the background color for the debug text that appears in the
Console pane to blue.
$psISE.Options.DebugBackgroundColor = '#0000FF'
```

DebugForegroundColor

Supported in Windows PowerShell ISE 2.0 and later.

Specifies the foreground color for the debug text that appears in the Console pane. It is an instance of the **System.Windows.Media.Color** class.

PowerShell

```
# Changes the foreground color for the debug text that appears in the
Console pane to yellow.
$psISE.Options.DebugForegroundColor = 'yellow'
```

DefaultOptions

Supported in Windows PowerShell ISE 2.0 and later.

A collection of properties that specify the default values to be used when the Reset methods are used.

PowerShell

```
# Displays the name of the default options. This example is from ISE 4.0.
$psISE.Options.DefaultOptions
```

Output

```
SelectedScriptPaneState                 : Top
ShowDefaultSnippets                     : True
ShowToolBar                             : True
ShowOutlining                           : True
ShowLineNumbers                         : True
TokenColors                             : {[Attribute, #FF00BFFF],
[Command, #FF0000FF], [CommandArgument, #FF8A2BE2], [CommandParameter,
#FF000080]...}
ConsoleTokenColors                      : {[Attribute, #FFB0C4DE],
[Command, #FFE0FFFF], [CommandArgument, #FFEE82EE], [CommandParameter,
#FFFFE4B5]...}
XmlTokenColors                          : {[Comment, #FF006400],
[CommentDelimiter, #FF008000], [ElementName, #FF8B0000], [MarkupExtension,
#FFFF8C00]...}
DefaultOptions                          :
Microsoft.PowerShell.Host.ISE.ISEOptions
FontSize                                : 9
Zoom                                    : 100
FontName                                : Lucida Console
ErrorForegroundColor                    : #FFFF0000
ErrorBackgroundColor                    : #00FFFFFF
```

```
WarningForegroundColor                      : #FFFF8C00
WarningBackgroundColor                      : #00FFFFFF
VerboseForegroundColor                      : #FF00FFFF
VerboseBackgroundColor                      : #00FFFFFF
DebugForegroundColor                        : #FF00FFFF
DebugBackgroundColor                        : #00FFFFFF
ConsolePaneBackgroundColor                  : #FF012456
ConsolePaneTextBackgroundColor              : #FF012456
ConsolePaneForegroundColor                  : #FFF5F5F5
ScriptPaneBackgroundColor                   : #FFFFFFFF
ScriptPaneForegroundColor                   : #FF000000
ShowWarningForDuplicateFiles                : True
ShowWarningBeforeSavingOnRun                : True
UseLocalHelp                                : True
AutoSaveMinuteInterval                      : 2
MruCount                                    : 10
ShowIntellisenseInConsolePane               : True
ShowIntellisenseInScriptPane                : True
UseEnterToSelectInConsolePaneIntellisense : True
UseEnterToSelectInScriptPaneIntellisense  : True
IntellisenseTimeoutInSeconds                : 3
```

ErrorBackgroundColor

Supported in Windows PowerShell ISE 2.0 and later.

Specifies the background color for error text that appears in the Console pane. It is an instance of the **System.Windows.Media.Color** class.

PowerShell

```
# Changes the background color for the error text that appears in the
Console pane to black.
$psISE.Options.ErrorBackgroundColor = 'black'
```

ErrorForegroundColor

Supported in Windows PowerShell ISE 2.0 and later.

Specifies the foreground color for error text that appears in the Console pane. It is an instance of the **System.Windows.Media.Color** class.

PowerShell

```
# Changes the foreground color for the error text that appears in the
console pane to green.
$psISE.Options.ErrorForegroundColor = 'green'
```

FontName

Supported in Windows PowerShell ISE 2.0 and later.

Specifies the font name currently in use in both the Script pane and the Console pane.

PowerShell

```
# Changes the font used in both panes.
$psISE.Options.FontName = 'Courier New'
```

FontSize

Supported in Windows PowerShell ISE 2.0 and later.

Specifies the font size as an integer. It is used in the Script pane, the Command pane, and the Output pane. The valid range of values is 8 through 32.

PowerShell

```
# Changes the font size in all panes.
$psISE.Options.FontSize = 20
```

IntellisenseTimeoutInSeconds

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Specifies the number of seconds that IntelliSense uses to try to resolve the currently typed text. After this number of seconds, IntelliSense times out and enables you to continue typing. The default value is 3 seconds. The value is an integer.

PowerShell

```
# Changes the number of seconds for IntelliSense syntax recognition to 5.
$psISE.Options.IntellisenseTimeoutInSeconds = 5
```

MruCount

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Specifies the number of recently opened files that Windows PowerShell ISE tracks and displays at the bottom of the **File Open** menu. The default value is 10. The value is an integer.

PowerShell

```
# Changes the number of recently used files that appear at the bottom of the
File Open menu to 5.
$psISE.Options.MruCount = 5
```

OutputPaneBackgroundColor

This feature is present in Windows PowerShell ISE 2.0, but was removed or renamed in later versions of the ISE. For later versions, see ConsolePaneBackgroundColor.

The read/write property that gets or sets the background color for the Output pane itself. It is an instance of the **System.Windows.Media.Color** class.

PowerShell

```
# Changes the background color of the Output pane to gold.
$psISE.Options.OutputPaneForegroundColor = 'gold'
```

OutputPaneTextForegroundColor

This feature is present in Windows PowerShell ISE 2.0, but was removed or renamed in later versions of the ISE. For later versions, see ConsolePaneForegroundColor.

The read/write property that changes the foreground color of the text in the Output pane in Windows PowerShell ISE 2.0.

PowerShell

```
# Changes the foreground color of the text in the Output Pane to blue.
$psISE.Options.OutputPaneTextForegroundColor  = 'blue'
```

OutputPaneTextBackgroundColor

This feature is present in Windows PowerShell ISE 2.0, but was removed or renamed in later versions of the ISE. For later versions, see ConsolePaneTextBackgroundColor.

The read/write property that changes the background color of the text in the Output pane.

PowerShell

```
# Changes the background color of the Output pane text to pink.
$psISE.Options.OutputPaneTextBackgroundColor = 'pink'
```

ScriptPaneBackgroundColor

Supported in Windows PowerShell ISE 2.0 and later.

The read/write property that gets or sets the background color for files. It is an instance of the **System.Windows.Media.Color** class.

PowerShell

```
# Sets the color of the script pane background to yellow.
$psISE.Options.ScriptPaneBackgroundColor = 'yellow'
```

ScriptPaneForegroundColor

Supported in Windows PowerShell ISE 2.0 and later.

The read/write property that gets or sets the foreground color for non-script files in the Script pane. To set the foreground color for script files, use the TokenColors.

PowerShell

```
# Sets the foreground to color of non-script files in the script pane to
green.
$psISE.Options.ScriptPaneBackgroundColor = 'green'
```

SelectedScriptPaneState

Supported in Windows PowerShell ISE 2.0 and later.

The read/write property that gets or sets the position of the Script pane on the display. The string can be either 'Maximized', 'Top', or 'Right'.

PowerShell

```
# Moves the Script Pane to the top.
$psISE.Options.SelectedScriptPaneState = 'Top'
# Moves the Script Pane to the right.
$psISE.Options.SelectedScriptPaneState = 'Right'
# Maximizes the Script Pane
$psISE.Options.SelectedScriptPaneState = 'Maximized'
```

ShowDefaultSnippets

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Specifies whether the CTRL+J list of snippets includes the starter set that is included in Windows PowerShell. When set to `$false`, only user-defined snippets appear in the CTRL+J list. The default value is `$true`.

PowerShell

```
# Hide the default snippets from the CTRL+J list.
$psISE.Options.ShowDefaultSnippets = $false
```

ShowIntellisenseInConsolePane

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Specifies whether IntelliSense offers syntax, parameter, and value suggestions in the Console pane. The default value is `$true`.

PowerShell

```
# Turn off IntelliSense in the console pane.
$psISE.Options.ShowIntellisenseInConsolePane = $false
```

ShowIntellisenseInScriptPane

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Specifies whether IntelliSense offers syntax, parameter, and value suggestions in the Script pane. The default value is `$true`.

PowerShell

```
# Turn off IntelliSense in the Script pane.
$psISE.Options.ShowIntellisenseInScriptPane = $false
```

ShowLineNumbers

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Specifies whether the Script pane displays line numbers in the left margin. The default value is `$true`.

```PowerShell
# Turn off line numbers in the Script pane.
$psISE.Options.ShowLineNumbers = $false
```

ShowOutlining

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Specifies whether the Script pane displays expandable and collapsible brackets next to sections of code in the left margin. When they are displayed, you can click the minus `-` icons next to a block of text to collapse it or click the plus `+` icon to expand a block of text. The default value is `$true`.

```PowerShell
# Turn off outlining in the Script pane.
$psISE.Options.ShowOutlining = $false
```

ShowToolBar

Supported in Windows PowerShell ISE 2.0 and later.

Specifies whether the ISE toolbar appears at the top of the Windows PowerShell ISE window. The default value is `$true`.

```PowerShell
# Show the toolbar.
$psISE.Options.ShowToolBar = $true
```

ShowWarningBeforeSavingOnRun

Supported in Windows PowerShell ISE 2.0 and later.

Specifies whether a warning message appears when a script is saved automatically before it is run. The default value is `$true`.

```PowerShell
```

```
# Enable the warning message when an attempt
# is made to run a script without saving it first.
$psISE.Options.ShowWarningBeforeSavingOnRun = $true
```

ShowWarningForDuplicateFiles

Supported in Windows PowerShell ISE 2.0 and later.

Specifies whether a warning message appears when the same file is opened in different PowerShell tabs. If set to `$true`, to open the same file in multiple tabs displays this message: "A copy of this file is open in another Windows PowerShell tab. Changes made to this file will affect all open copies." The default value is `$true`.

PowerShell

```
# Enable the warning message when a file is
# opened in multiple PowerShell tabs.
$psISE.Options.ShowWarningForDuplicateFiles = $true
```

TokenColors

Supported in Windows PowerShell ISE 2.0 and later.

Specifies the colors of the IntelliSense tokens in the Windows PowerShell ISE Script pane. This property is a dictionary object that contains name/value pairs of token types and colors for the Script pane. To change the colors of the IntelliSense tokens in the Console pane, see ConsoleTokenColors. To reset the colors to the default values, see RestoreDefaultTokenColors. Token colors can be set for the following: Attribute, Command, CommandArgument, CommandParameter, Comment, GroupEnd, GroupStart, Keyword, LineContinuation, LoopLabel, Member, NewLine, Number, Operator, Position, StatementSeparator, String, Type, Unknown, Variable.

PowerShell

```
# Sets the color of commands to green.
$psISE.Options.TokenColors["Command"] = "green"
# Sets the color of keywords to magenta.
$psISE.Options.TokenColors["Keyword"] = "magenta"
```

UseEnterToSelectInConsolePaneIntellisense

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Specifies whether you can use the Enter key to select an IntelliSense provided option in the Console pane. The default value is `$true`.

```PowerShell
# Turn off using the ENTER key to select an IntelliSense provided option in
the Console pane.
$psISE.Options.UseEnterToSelectInConsolePaneIntellisense = $false
```

UseEnterToSelectInScriptPaneIntellisense

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Specifies whether you can use the Enter key to select an IntelliSense-provided option in the Script pane. The default value is `$true`.

```PowerShell
# Turn on using the Enter key to select an IntelliSense provided option in
the Console pane.
$psISE.Options.UseEnterToSelectInConsolePaneIntellisense = $true
```

UseLocalHelp

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Specifies whether the locally installed Help or the online Help appears when you press `F1` with the cursor positioned in a keyword. If set to `$true`, then a pop-up window shows content from the locally installed Help. You can install the Help files by running the `Update-Help` command. If set to `$false`, then your browser opens to a page on Microsoft Learn.

```PowerShell
# Sets the option for the online help to be displayed.
$psISE.Options.UseLocalHelp = $false
# Sets the option for the local Help to be displayed.
$psISE.Options.UseLocalHelp = $true
```

VerboseBackgroundColor

Supported in Windows PowerShell ISE 2.0 and later.

Specifies the background color for verbose text that appears in the Console pane. It is a **System.Windows.Media.Color** object.

```PowerShell
# Changes the background color for verbose text to blue.
$psISE.Options.VerboseBackgroundColor ='#0000FF'
```

VerboseForegroundColor

Supported in Windows PowerShell ISE 2.0 and later.

Specifies the foreground color for verbose text that appears in the Console pane. It is a **System.Windows.Media.Color** object.

```PowerShell
# Changes the foreground color for verbose text to yellow.
$psISE.Options.VerboseForegroundColor = 'yellow'
```

WarningBackgroundColor

Supported in Windows PowerShell ISE 2.0 and later.

Specifies the background color for warning text that appears in the Console pane. It is a **System.Windows.Media.Color** object.

```PowerShell
# Changes the background color for warning text to blue.
$psISE.Options.WarningBackgroundColor = '#0000FF'
```

WarningForegroundColor

Supported in Windows PowerShell ISE 2.0 and later.

Specifies the foreground color for warning text that appears in the Output pane. It is a **System.Windows.Media.Color** object.

```PowerShell
# Changes the foreground color for warning text to yellow.
$psISE.Options.WarningForegroundColor = 'yellow'
```

XmlTokenColors

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Specifies a dictionary object that contains name/value pairs of token types and colors for XML content that is displayed in Windows PowerShell ISE. Token colors can be set for the following: Attribute, Command, CommandArgument, CommandParameter, Comment, GroupEnd, GroupStart, Keyword, LineContinuation, LoopLabel, Member, NewLine, Number, Operator, Position, StatementSeparator, String, Type, Unknown, Variable. Also see RestoreDefaultXmlTokenColors.

PowerShell

```
# Sets the color of XML element names to green.
$psISE.Options.XmlTokenColors["ElementName"] = 'green'
# Sets the color of XML comments to magenta.
$psISE.Options.XmlTokenColors["Comment"] = 'magenta'
```

Zoom

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Specifies the relative size of text in both the Console and Script panes. The default value is 100. Smaller values cause the text in Windows PowerShell ISE to appear smaller while larger numbers cause text to appear larger. The value is an integer that ranges from 20 to 400.

PowerShell

```
# Changes the text in the Windows PowerShell ISE to be double its normal
size.
$psISE.Options.Zoom = 200
```

See Also

- Purpose of the Windows PowerShell ISE Scripting Object Model
- The ISE Object Model Hierarchy

The ISESnippetCollection Object

Article • 09/17/2021

The **ISESnippetCollection** object is a collection of **ISESnippet** objects. The files collection that is associated with a **PowerShellTab** object is a member of this class. An example is the `$psISE.CurrentPowerShellTab.Files` collection.

Methods

Load(FilePathName)

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Loads a `.snippets.ps1xml` file that contains user-defined snippets. The easiest way to create snippets is to use the `New-IseSnippet` cmdlet, which automatically stores them in your profile folder so that they are loaded every time that you start Windows PowerShell ISE.

FilePathName - String The path and file name to a .snippets.ps1xml file that contains snippet definitions.

PowerShell

```
# Loads a custom snippet file into the current PowerShell tab.
$SnipFile = Join-Path ( Split-Path $profile)
'Snippets\MySnips.snippets.ps1xml'
$psISE.CurrentPowerShellTab.Snippets.Add($SnipPath)
```

See Also

- The ISESnippetObject
- Purpose of the Windows PowerShell ISE Scripting Object Model
- The ISE Object Model Hierarchy

The ISESnippetObject

Article • 09/17/2021

An **ISESnippet** object is an instance of the Microsoft.PowerShell.Host.ISE.ISESnippet class. The members of the `$psISE.CurrentPowerShellTab.Snippets` collection are all examples of **ISESnippet** objects. The easiest way to create a snippet is to use the New-IseSnippet cmdlet.

Properties

Author

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

The read-only property that gets the name of the author of the snippet.

PowerShell

```
# Get the author of the first snippet item
$psISE.CurrentPowerShellTab.Snippets.Item(0).Author
```

CodeFragment

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

The read-only property that gets the code fragment to be inserted into the editor.

PowerShell

```
# Get the code fragment associated with the first snippet item.
$psISE.CurrentPowerShellTab.Snippets.Item(0).CodeFragment
```

Shortcut

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

The read-only property that gets the Windows keyboard shortcut for the menu item.

PowerShell

```
# Get the shortcut for the first submenu item.
$psISE.CurrentPowerShellTab.AddOnsMenu.Submenus.Clear()
$psISE.CurrentPowerShellTab.AddOnsMenu.Submenus.Add('_Process', {Get-
Process}, 'Alt+P')
$psISE.CurrentPowerShellTab.AddOnsMenu.Submenus[0].Shortcut
```

See Also

- The ISESnippetCollection Object
- Purpose of the Windows PowerShell ISE Scripting Object Model
- The ISE Object Model Hierarchy

The PowerShellTabCollection Object

Article • 09/17/2021

The **PowerShellTab** collection object is a collection of **PowerShellTab** objects. Each **PowerShellTab** object functions as a separate runtime environment. It is an instance of Microsoft.PowerShell.Host.ISE.PowerShellTabs class. An example is the `$psISE.PowerShellTabs` object.

Methods

Add()

Supported in Windows PowerShell ISE 2.0 and later.

Adds a new PowerShell tab to the collection. It returns the newly added tab.

PowerShell

```
$newTab = $psISE.PowerShellTabs.Add()
$newTab.DisplayName = 'Brand New Tab'
```

Remove(Microsoft.PowerShell.Host.ISE.PowerShellTab psTab)

Supported in Windows PowerShell ISE 2.0 and later.

Removes the tab that is specified by the **psTab** parameter.

psTab The PowerShell tab to remove.

PowerShell

```
$newTab = $psISE.PowerShellTabs.Add()
Change the DisplayName of the new PowerShell tab.
$newTab.DisplayName = 'This tab will go away in 5 seconds'
sleep 5
$psISE.PowerShellTabs.Remove($newTab)
```

SetSelectedPowerShellTab(Microsoft.PowerShell.Host.ISE.PowerShellTab psTab)

Supported in Windows PowerShell ISE 2.0 and later.

Selects the PowerShell tab that is specified by the **psTab** parameter to make it the currently active PowerShell tab.

psTab The PowerShell tab to select.

PowerShell

```
# Save the current tab in a variable and rename it
$oldTab = $psISE.CurrentPowerShellTab
$psISE.CurrentPowerShellTab.DisplayName = 'Old Tab'
# Create a new tab and give it a new display name
$newTab = $psISE.PowerShellTabs.Add()
$newTab.DisplayName = 'Brand New Tab'
# Switch back to the original tab
$psISE.PowerShellTabs.SelectedPowerShellTab = $oldTab
```

See Also

- The PowerShellTab Object
- Purpose of the Windows PowerShell ISE Scripting Object Model
- The ISE Object Model Hierarchy

The PowerShellTab Object

Article • 09/17/2021

The **PowerShellTab** object represents a Windows PowerShell runtime environment.

Methods

Invoke(Script)

Supported in Windows PowerShell ISE 2.0 and later.

Runs the given script in the PowerShell tab.

> ⓘ Note
>
> This method only works on other PowerShell tabs, not the PowerShell tab from which it is run. It does not return any object or value. If the code modifies any variable, then those changes persist on the tab against which the command was invoked.

Script - System.Management.Automation.ScriptBlock or String The script block to run.

PowerShell

```
# Manually create a second PowerShell tab before running this script.
# Return to the first PowerShell tab and type the following command
$psISE.PowerShellTabs[1].Invoke({dir})
```

InvokeSynchronous(Script, [useNewScope], millisecondsTimeout)

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

Runs the given script in the PowerShell tab.

> ⓘ Note
>
> This method only works on other PowerShell tabs, not the PowerShell tab from which it is run. The script block is run and any value that is returned from the script is returned to the run environment from which you invoked the command. If the

command takes longer to run than the **millesecondsTimeout** value specifies, then the command fails with an exception: "The operation has timed out."

Script - System.Management.Automation.ScriptBlock or String The script block to run.

[useNewScope] - Optional Boolean that defaults to `$true` If set to `$true`, then a new scope is created within which to run the command. It does not modify the runtime environment of the PowerShell tab that is specified by the command.

[millisecondsTimeout] - Optional integer that defaults to **500**. If the command does not finish within the specified time, then the command generates a **TimeoutException** with the message "The operation has timed out."

PowerShell

```
# Create a new PowerShell tab and then switch back to the first
$psISE.PowerShellTabs.Add()
$psISE.PowerShellTabs.SetSelectedPowerShellTab($psISE.PowerShellTabs[0])

# Invoke a simple command on the other tab, in its own scope
$psISE.PowerShellTabs[1].InvokeSynchronous('$x=1', $false)
# You can switch to the other tab and type '$x' to see that the value is
saved there.

# This example sets a value in the other tab (in a different scope)
# and returns it through the pipeline to this tab to store in $a
$a = $psISE.PowerShellTabs[1].InvokeSynchronous('$z=3;$z')
$a

# This example runs a command that takes longer than the allowed timeout
value
# and measures how long it runs so that you can see the impact
Measure-Command {$psISE.PowerShellTabs[1].InvokeSynchronous('sleep 10',
$false, 5000)}
```

Properties

AddOnsMenu

Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the Add-ons menu for the PowerShell tab.

PowerShell

```
# Clear the Add-ons menu if one exists.
$psISE.CurrentPowerShellTab.AddOnsMenu.SubMenus.Clear()
# Create an AddOns menu with an accessor.
# Note the use of "_"  as opposed to the "&" for mapping to the fast key
letter for the menu item.
$menuAdded = $psISE.CurrentPowerShellTab.AddOnsMenu.SubMenus.Add('_Process',
{Get-Process}, 'Alt+P')
# Add a nested menu.
$parentAdded = $psISE.CurrentPowerShellTab.AddOnsMenu.SubMenus.Add('Parent',
$null, $null)
$parentAdded.SubMenus.Add('_Dir', {dir}, 'Alt+D')
# Show the Add-ons menu on the current PowerShell tab.
$psISE.CurrentPowerShellTab.AddOnsMenu
```

CanInvoke

Supported in Windows PowerShell ISE 2.0 and later.

The read-only Boolean property that returns a `$true` value if a script can be invoked with the Invoke(Script) method.

PowerShell

```
# CanInvoke will be false if the PowerShell
# tab is running a script that takes a while, and you
# check its properties from another PowerShell tab. It is
# always false if checked on the current PowerShell tab.
# Manually create a second PowerShell tab before running this script.
# Return to the first tab and type
$secondTab = $psISE.PowerShellTabs[1]
$secondTab.CanInvoke
$secondTab.Invoke({sleep 20})
$secondTab.CanInvoke
```

ConsolePane

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions. In Windows PowerShell ISE 2.0 this was named **CommandPane**.

The read-only property that gets the Console pane editor object.

PowerShell

```
# Gets the Console Pane editor.
$psISE.CurrentPowerShellTab.ConsolePane
```

DisplayName

Supported in Windows PowerShell ISE 2.0 and later.

The read-write property that gets or sets the text that is displayed on the PowerShell tab. By default, tabs are named "PowerShell #", where the # represents a number.

PowerShell

```
$newTab = $psISE.PowerShellTabs.Add()
# Change the DisplayName of the new PowerShell tab.
$newTab.DisplayName = 'Brand New Tab'
```

ExpandedScript

Supported in Windows PowerShell ISE 2.0 and later.

The read-write Boolean property that determines whether the Script pane is expanded or hidden.

PowerShell

```
# Toggle the expanded script property to see its effect.
$psISE.CurrentPowerShellTab.ExpandedScript =
!$psISE.CurrentPowerShellTab.ExpandedScript
```

Files

Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the collection of script files that are open in the PowerShell tab.

PowerShell

```
$newFile = $psISE.CurrentPowerShellTab.Files.Add()
$newFile.Editor.Text = "a`r`nb"
# Gets the line count
$newFile.Editor.LineCount
```

Output

This feature is present in Windows PowerShell ISE 2.0, but was removed or renamed in later versions of the ISE. In later versions of Windows PowerShell ISE, you can use the **ConsolePane** object for the same purposes.

The read-only property that gets the Output pane of the current editor.

PowerShell

```
# Clears the text in the Output pane.
$psISE.CurrentPowerShellTab.output.clear()
```

Prompt

Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the current prompt text. Note: the **Prompt** function can be overridden by the user'™s profile. If the result is other than a simple string, then this property returns nothing.

PowerShell

```
# Gets the current prompt text.
$psISE.CurrentPowerShellTab.Prompt
```

ShowCommands

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

The read-write property that indicates if the Commands pane is currently displayed.

PowerShell

```
# Gets the current status of the Commands pane and stores it in the $a
variable
$a = $psISE.CurrentPowerShellTab.ShowCommands
# if $a is $false, then turn the Commands pane on by changing the value to
$true
if (!$a) {$psISE.CurrentPowerShellTab.ShowCommands = $true}
```

StatusText

Supported in Windows PowerShell ISE 2.0 and later.

The read-only property that gets the **PowerShellTab** status text.

PowerShell

```
# Gets the current status text,
$psISE.CurrentPowerShellTab.StatusText
```

HorizontalAddOnToolsPaneOpened

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

The read-only property that indicates whether the horizontal Add-Ons tool pane is currently open.

PowerShell

```
# Gets the current state of the horizontal Add-ons tool pane.
$psISE.CurrentPowerShellTab.HorizontalAddOnToolsPaneOpened
```

VerticalAddOnToolsPaneOpened

Supported in Windows PowerShell ISE 3.0 and later, and not present in earlier versions.

The read-only property that indicates whether the vertical Add-Ons tool pane is currently open.

PowerShell

```
# Turns on the Commands pane
$psISE.CurrentPowerShellTab.ShowCommands = $true
# Gets the current state of the vertical Add-ons tool pane.
$psISE.CurrentPowerShellTab.HorizontalAddOnToolsPaneOpened
```

See Also

- The PowerShellTabCollection Object
- Purpose of the Windows PowerShell ISE Scripting Object Model
- The ISE Object Model Hierarchy

Other Useful Scripting Objects

Article • 09/17/2021

The following objects provide additional scripting functionality in Windows PowerShell ISE. They are not part of the **$psISE** hierarchy.

Useful Scripting objects

$psUnsupportedConsoleApplications

There are some limitations on how Windows PowerShell ISE interacts with console applications. A command or an automation script that requires user intervention might not work the way it works from the Windows PowerShell console. You might want to block these commands or scripts from running in the Windows PowerShell ISE Command pane. The **$psUnsupportedConsoleApplications** object keeps a list of such commands. If you try to run the commands in this list, you get a message that they are not supported. The following script adds an entry to the list.

PowerShell

```
# List the unsupported commands
$psUnsupportedConsoleApplications

# Add a command to this list
$psUnsupportedConsoleApplications.Add('Mycommand')

# Show the augmented list of commands
$psUnsupportedConsoleApplications
```

$psLocalHelp

This is a dictionary object that maintains a context-sensitive mapping between Help topics and their associated links in the local compiled HTML Help file. It is used to locate the local Help for a particular topic. You can add or delete topics from this list. The following code example shows some example key-value pairs that are contained in `$psLocalHelp`.

PowerShell

```
# See the local help map
$psLocalHelp | Format-List
```

Output

```
Key   : Add-Computer
Value : WindowsPowerShellHelp.chm::/html/093f660c-b8d5-43cf-aa0c-
54e5e54e76f9.htm

Key   : Add-Content
Value : WindowsPowerShellHelp.chm::/html/0c836a1b-f389-4e9a-9325-
0f415686d194.htm
```

The following script adds an entry to the list.

PowerShell

```
$psLocalHelp.Add("get-myNoun", "c:\MyFolder\MyHelpChm.chm::/html/0198854a-
1298-57ae-aa0c-87b5e5a84712.htm")
```

$psOnlineHelp

This is a dictionary object that maintains a context-sensitive mapping between topic titles of Help topics and their associated external URLs. It is used to locate the Help for a particular topic on the web. You can add or delete topics from this list.

PowerShell

```
$psOnlineHelp | Format-List
```

Output

```
Key   : Add-Computer
Value : https://go.microsoft.com/fwlink/p/?LinkID=135194

Key   : Add-Content
Value : https://go.microsoft.com/fwlink/p/?LinkID=113278
```

The following script adds an entry to the list.

PowerShell

```
$psOnlineHelp.Add("get-myNoun", "https://www.mydomain.com/MyNoun.html")
```

See Also

Purpose of the Windows PowerShell ISE Scripting Object Model

Windows Management Framework

Article • 10/25/2022

Windows Management Framework (WMF) provides a consistent management interface for Windows. WMF provides a seamless way to manage various versions of Windows client and Windows Server. WMF installer packages contain updates to management functionality and are available for older versions of Windows.

WMF installation adds and/or updates the following features:

- Windows PowerShell
- Windows PowerShell Desired State Configuration (DSC)
- Windows PowerShell Integrated Script Environment (ISE)
- Windows Remote Management (WinRM)
- Windows Management Instrumentation (WMI)
- Windows PowerShell Web Services (Management OData IIS Extension)
- Software Inventory Logging (SIL)
- Server Manager CIM Provider

WMF Release Notes

To learn about various enhancements in PowerShell and other components of a given WMF, please refer to the links below to review the release notes:

- WMF 5.1
- WMF 5.0

WMF availability across Windows operating systems

OS Version	**End of Support**	**WMF 5.1**	**WMF 5.0** ***Out of support***	**WMF 4.0** ***Out of support***	**WMF 3.0** ***Out of support***	**WMF 2.0** ***Out of support***
Windows Server 2022		Ships in-box				
Windows Server 2019		Ships in-box				

OS Version	End of Support	WMF 5.1	WMF 5.0 *Out of support*	WMF 4.0 *Out of support*	WMF 3.0 *Out of support*	WMF 2.0 *Out of support*
Windows Server 2016	Jan 12, 2027	Ships in-box				
Windows 11		Ships in-box				
Windows 10		Ships in-box	Ships in-box			
Windows Server 2012 R2	Oct 10, 2023	Yes	Yes	Ships in-box		
Windows 8.1	Jan 10, 2023	Yes	Yes	Ships in-box		
Windows Server 2012	Oct 10, 2023	Yes	Yes	Yes	Ships in-box	
Windows 8	*Out of support*				Ships in-box	
Windows Server 2008 R2 SP1	*Out of support*	Yes	Yes	Yes	Yes	Ships in-box
Windows 7 SP1	*Out of support*	Yes	Yes	Yes	Yes	Ships in-box
Windows Server 2008 SP2	*Out of support*				Yes	Yes
Windows Vista	*Out of support*					Yes
Windows Server 2003	*Out of support*					Yes
Windows XP	*Out of support*				Yes	Yes

- **Ships in-box**: The features of the specified version of WMF were shipped in the indicated version of Windows client or Windows Server.
- **Out of support**: These products are no longer supported by Microsoft. You must upgrade to a supported version. For more information, see the Microsoft Lifecycle Policy page.

> **Note**
>
> The installer for WMF 4.0 is no longer available or supported.

Install and Configure WMF 5.1

Article • 10/07/2021

> **Important**
>
> WMF 5.0 is superseded by WMF 5.1. Users with WMF 5.0 must upgrade to WMF 5.1 to receive support. **WMF 5.1 requires the .NET Framework 4.5.2** (or above). Installation will succeed, but key features will fail if .NET 4.5.2 (or above) is not installed.

Download and install the WMF 5.1 package

Download the WMF 5.1 package for the operating system and architecture you wish to install it on:

Operating System	Prerequisites	Package Links
Windows Server 2012 R2		Win8.1AndW2K12R2-KB3191564-x64.msu
Windows Server 2012		W2K12-KB3191565-x64.msu
Windows Server 2008 R2	.NET Framework 4.5.2	Win7AndW2K8R2-KB3191566-x64.ZIP
Windows 8.1		**x64:** Win8.1AndW2K12R2-KB3191564-x64.msu **x86:** Win8.1-KB3191564-x86.msu
Windows 7 SP1	.NET Framework 4.5.2	**x64:** Win7AndW2K8R2-KB3191566-x64.ZIP **x86:** Win7-KB3191566-x86.ZIP

- WMF 5.1 Preview must be uninstalled before installing WMF 5.1 RTM.
- WMF 5.1 may be installed directly over WMF 5.0 or WMF 4.0.
- It is **not required** to install WMF 4.0 prior to installing WMF 5.1 on Windows 7 and Windows Server 2008 R2.

Install WMF 5.1 for Windows Server 2008 R2 and Windows 7

> **Note**
>
> Installation instructions for Windows Server 2008 R2 and Windows 7 have changed, and differ from the instructions for the other packages. Installation instructions for Windows Server 2012 R2, Windows Server 2012, and Windows 8.1 are below.

WMF 5.1 Prerequisites for Windows Server 2008 R2 SP1 and Windows 7 SP1

Installation of WMF 5.1 on either Windows Server 2008 R2 SP1 or Windows 7 SP1, requires the following:

- Latest service pack must be installed.
- WMF 3.0 **must not** be installed. Installing WMF 5.1 over WMF 3.0 will result in the loss of the **PSModulePath** (`$env:PSModulePath`), which can cause other applications to fail. Before installing WMF 5.1, you must either un-install WMF 3.0, or save the **PSModulePath** and then restore it manually after WMF 5.1 installation is complete.
- WMF 5.1 requires at least .NET Framework 4.5.2. You can install Microsoft .NET Framework 4.5.2 by following the instructions at the download location.

Installing WMF 5.1 on Windows Server 2008 R2 and Windows 7

1. Navigate to the folder into which you downloaded the ZIP file.

2. Right-click on the ZIP file, and select **Extract All...**. The ZIP file contains two files: an MSU and the `Install-WMF5.1.ps1` script file. Once you have unpacked the ZIP file, you can copy the contents to any machine running Windows 7 or Windows Server 2008 R2.

3. After extracting the ZIP file contents, open PowerShell as administrator, then navigate to the folder containing the contents of the ZIP file.

4. Run the `Install-WMF5.1.ps1` script in that folder, and follow the instructions. This script will check the prerequisites on the local machine, and install WMF 5.1 if the prerequisites have been met. The prerequisites are listed below.

   `Install-WMF5.1.ps1` takes the following parameters to ease automating the installation on Windows Server 2008 R2 and Windows 7:

- **AcceptEula**: When this parameter is included, the EULA is automatically accepted and will not be displayed.
- **AllowRestart**: This parameter can only be used if AcceptEula is specified. If this parameter is included, and a restart is required after installing WMF 5.1, the restart will happen without prompting immediately after the installation is completed.

WinRM Dependency

Windows PowerShell Desired State Configuration (DSC) depends on WinRM. WinRM is not enabled by default on Windows Server 2008 R2 and Windows 7. Run `Set-WSManQuickConfig`, in a Windows PowerShell elevated session, to enable WinRM.

Install WMF 5.1 for Windows Server 2012 R2, Windows Server 2012, and Windows 8.1

Install from Windows File Explorer

1. Navigate to the folder into which you downloaded the MSU file.
2. Double-click the MSU to run it.

Installing from the Command Prompt

1. After downloading the correct package for your computer's architecture, open a Command Prompt window with elevated user rights (Run as Administrator). On the Server Core installation options of Windows Server 2012 R2, Windows Server 2012, or Windows Server 2008 R2 SP1, Command Prompt opens with elevated user rights by default.

2. Change directories to the folder into which you have downloaded or copied the WMF 5.1 installation package.

3. Run one of the following commands:

    - On computers that are running Windows Server 2012 R2 or Windows 8.1 x64, run `Win8.1AndW2K12R2-KB3191564-x64.msu /quiet /norestart`.
    - On computers that are running Windows Server 2012, run `W2K12-KB3191565-x64.msu /quiet /norestart`.

- On computers that are running Windows 8.1 x86, run `Win8.1-KB3191564-x86.msu /quiet /norestart`.

> **Note**
>
> Installing WMF 5.1 requires a reboot. Using the `/quiet` option alone will reboot the system without warning. Use the `/norestart` option to avoid rebooting. However, WMF 5.1 will not be installed until you have rebooted.

Uninstallation Instructions

Article • 09/17/2021

Using Command Prompt

1. Open **Command Prompt.**
2. Run the Windows Update Standalone Launcher as shown below:

On Windows Server 2012 R2 and Windows 8.1:

```
PowerShell

wusa /uninstall /kb:3134758
```

On Windows Server 2012:

```
PowerShell

wusa /uninstall /kb:3134759
```

On Windows Server 2008 R2 SP1 and Windows 7 SP1:

```
PowerShell

wusa /uninstall /kb:3134760
```

Using Control Panel

1. Open **Control Panel.**
2. Open **Programs**, then open **Uninstall a program.**
3. Click **View installed updates.**
4. Select **Windows Management Framework 5.0** from the list of installed updates. This corresponds to *KB3134758*, *KB3134759*, or *KB3134760*. Click **Uninstall.**

Windows Management Framework (WMF) 5.x Release Notes

Article • 01/24/2022

WMF 5.0 Changes

- PowerShell 5.0 adds a new structured **Information** stream
- Improvements to DSC including four new DSC resources:
  - WindowsFeatureSet
  - WindowsOptionalFeatureSet
  - ServiceSet
  - ProcessSet
- Added Just Enough Administration to enable role-based administration through PowerShell remoting
- PowerShell 5.0 extends the language to include user-defined classes and enumerations
- Improved debugging features in PowerShell ISE and added remote debugging
- Added the PowerShellGet and PackageManagement modules
- Enhanced PowerShell script logging and transcripts
- Add Cryptographic Message Syntax cmdlets
- WMF 5.0 includes the NetworkSwitchManager module for Windows
- Added the Microsoft.PowerShell.ODataUtils module
- Added support for Software Inventory Logging (SIL)
- Sever new or update cmdlets in response to user requests and issues

WMF 5.1 Changes

WMF 5.1 includes the PowerShell, WMI, WinRM, and Software Inventory Logging (SIL) components that were released with Windows Server 2016. WMF 5.1 can be installed on Windows 7, Windows 8.1, Windows Server 2008 R2, 2012, and 2012 R2, and provides several improvements over WMF 5.0 including:

- New cmdlets
- PowerShellGet improvements include enforcing signed modules, and installing JEA modules
- PackageManagement added support for Containers, CBS Setup, EXE-based setup, CAB packages
- Debugging improvements for DSC and PowerShell classes

- Security enhancements including enforcement of catalog-signed modules coming from the Pull Server and when using PowerShellGet cmdlets
- Responses to a number of user requests and issues

> **ⓘ Important**
>
> Before you install WMF 5.1 on Windows Server 2008 or Windows 7, confirm that WMF 3.0 isn't installed. For more information, see **WMF 5.1 Prerequisites for Windows Server 2008 R2 SP1 and Windows 7 SP1**.

PowerShell Editions

Starting with version 5.1, PowerShell is available in different editions that denote varying feature sets and platform compatibility.

- **Desktop Edition:** Built on .NET Framework and provides compatibility with scripts and modules targeting versions of PowerShell running on full footprint editions of Windows such as Server Core and Windows Desktop.
- **Core Edition:** Built on .NET Core and provides compatibility with scripts and modules targeting versions of PowerShell running on reduced footprint editions of Windows such as Nano Server and Windows IoT.

Learn more about using PowerShell Editions

- Determine running edition of PowerShell using $PSVersionTable
- Filter Get-Module results by CompatiblePSEditions using PSEdition parameter
- Prevent script execution unless run on a compatible edition of PowerShell
- Declare a module's compatibility to specific PowerShell versions

Module Analysis Cache

Starting with WMF 5.1, PowerShell provides control over the file that is used to cache data about a module, such as the commands it exports.

By default, this cache is stored in the file `${env:LOCALAPPDATA}\Microsoft\Windows\PowerShell\ModuleAnalysisCache`. The cache is typically read at startup while searching for a command and is written on a background thread sometime after a module is imported.

To change the default location of the cache, set the `$env:PSModuleAnalysisCachePath` environment variable before starting PowerShell. Changes to this environment variable will only affect children processes. The value should name a full path (including filename) that PowerShell has permission to create and write files. To disable the file cache, set this value to an invalid location, for example:

PowerShell

```
$env:PSModuleAnalysisCachePath = 'nul'
```

This sets the path to an invalid device. If PowerShell can't write to the path, no error is returned, but you can see error reporting by using a tracer:

PowerShell

```
Trace-Command -PSHost -Name Modules -Expression { Import-Module
Microsoft.PowerShell.Management -Force }
```

When writing out the cache, PowerShell will check for modules that no longer exist to avoid an unnecessarily large cache. Sometimes these checks are not desirable, in which case you can turn them off by setting:

PowerShell

```
$env:PSDisableModuleAnalysisCacheCleanup = 1
```

Setting this environment variable will take effect immediately in the current process.

Specifying module version

In WMF 5.1, `using module` behaves the same way as other module-related constructions in PowerShell. Previously, you had no way to specify a particular module version; if there were multiple versions present, this resulted in an error.

In WMF 5.1:

- You can use ModuleSpecification Constructor (Hashtable).

  This hash table has the same format as `Get-Module -FullyQualifiedName`.

  Example: `using module @{ModuleName = 'PSReadLine'; RequiredVersion = '1.1'}`

- If there are multiple versions of the module, PowerShell uses the **same resolution logic** as `Import-Module` and doesn't return an error--the same behavior as `Import-Module` and `Import-DscResource`.

Improvements to Pester

In WMF 5.1, the version of Pester that ships with PowerShell has been updated from 3.3.5 to 3.4.0. This update enables better behavior for Pester on Nano Server.

You can review the changes in Pest by inspecting the CHANGELOG in the GitHub repository.

Bug Fixes in WMF 5.1

Article • 09/17/2021

Bug fixes

The following notable bugs are fixed in WMF 5.1:

Module auto-discovery fully honors PSModulePath

Module auto-discovery (loading modules automatically without an explicit Import-Module when calling a command) was introduced in WMF 3. When introduced, PowerShell checked for commands in `$PSHome\Modules` before using `$env:PSModulePath`.

WMF 5.1 changes this behavior to honor `$env:PSModulePath` completely. This allows for a user-authored module that defines commands provided by PowerShell (e.g. `Get-ChildItem`) to be auto-loaded and correctly overriding the built-in command.

File redirection no longer hard-codes -Encoding Unicode

In all previous versions of PowerShell, it was impossible to control the file encoding used by the file redirection operator.

Starting with WMF 5.1, you can now change the file encoding of redirection by setting `$PSDefaultParameterValues`:

PowerShell

```
$PSDefaultParameterValues["Out-File:Encoding"] = "Ascii"
```

Fixed a regression in accessing members of System.Reflection.TypeInfo

A regression introduced in WMF 5.0 broke accessing members of `System.Reflection.RuntimeType`, for example, `[int].ImplementedInterfaces`. This bug has been fixed in WMF 5.1.

Fixed some issues with COM objects

WMF 5.0 introduced a new COM binder for invoking methods on COM objects and accessing properties of COM objects. This new binder improved performance significantly but also introduced some bugs which have been fixed in WMF 5.1.

Argument conversions were not always performed correctly

In the following example:

PowerShell

```
$obj = New-Object -ComObject WScript.Shell
$obj.SendKeys([char]173)
```

The **SendKeys** method expects a string, but PowerShell did not convert the char to a string, deferring the conversion to **IDispatch::Invoke**, which uses **VariantChangeType** to do the conversion. In this example, this resulted in sending the keys '1', '7', and '3' instead of the expected **Volume.Mute** key.

Enumerable COM objects not always handled correctly

PowerShell normally enumerates most enumerable objects, but a regression introduced in WMF 5.0 prevented the enumeration of COM objects that implement IEnumerable. For example:

PowerShell

```
function Get-COMDictionary
{
    $d = New-Object -ComObject Scripting.Dictionary
    $d.Add('a', 2)
    $d.Add('b', 2)
    return $d
}

$x = Get-COMDictionary
```

In the above example, WMF 5.0 incorrectly wrote the **Scripting.Dictionary** to the pipeline instead of enumerating the key/value pairs.

[ordered] was not allowed inside classes

WMF 5.0 introduced classes with validation of type literals used in classes. `[ordered]` looks like a type literal but is not a true .NET type. WMF 5.0 incorrectly reported an error

on `[ordered]` inside a class:

PowerShell

```
class CThing
{
    [object] foo($i)
    {
        [ordered]@{ Thing = $i }
    }
}
```

Help on About topics with multiple versions does not work

Before WMF 5.1, if you had multiple versions of a module installed and they all shared a help topic, for example, about_PSReadline, `help about_PSReadline` would return multiple topics with no obvious way to view the real help.

WMF 5.1 fixes this by returning the help for the latest version of the topic.

`Get-Help` does not provide a way to specify which version you want help for. To work around this, navigate to the modules directory and view the help directly with a tool like your favorite editor.

powershell.exe reading from STDIN stopped working

Customers use `powershell -command -` from native apps to execute PowerShell passing in the script via STDIN unfortunately this was broken by other changes in the console host.

This is fixed for version 5.1 in the Windows 10 Anniversary Update.

powershell.exe creates spike in CPU usage on startup

PowerShell uses a WMI query to check if it was started via Group Policy to avoid causing delay in login. The WMI query ends up injecting tzres.mui.dll into every process on the system since the WMI **Win32_Process** class attempts to retrieve local timezone information. This results in a large CPU spike in **wmiprvse** (the WMI provider host). Fix is to use Win32 API calls to get the same information instead of using WMI.

New and updated cmdlets

Article • 01/05/2022

We have added new and updated existing cmdlets based on feedback from the community.

Archive cmdlets

Two new cmdlets, `Compress-Archive` and `Expand-Archive`, let you compress and expand ZIP files.

For more information, see the Microsoft.Powershell.Archive module documentation.

Catalog Cmdlets

Two new cmdlets have been added in the Microsoft.PowerShell.Security module.

- New-FileCatalog
- Test-FileCatalog

These generate and validate Windows catalog files.

Clipboard cmdlets

`Get-Clipboard` and `Set-Clipboard` make it easier for you to transfer content to and from a Windows PowerShell session. The Clipboard cmdlets support images, audio files, file lists, and text.

For more information, see:

- Get-Clipboard
- Set-Clipboard

Cryptographic Message Syntax (CMS) cmdlets

The Cryptographic Message Syntax cmdlets support encryption and decryption of content using the IETF standard format for cryptographically protecting messages as documented by RFC5652.

The CMS encryption standard implements public key cryptography, where the key used to encrypt content (the *public key*) and the key used to decrypt content (the *private key*) are separate.

Your public key can be shared widely and is not sensitive data. Any content encrypted with the public key can only be decrypted using the private key. For more information, see Public-key cryptography.

For more information see:

- Get-CmsMessage
- Protect-CmsMessage
- Unprotect-CmsMessage

Certificates require a unique key usage identifier (EKU), such as 'Code Signing' or 'Encrypted Mail', to identify them as data encryption certificates in PowerShell. To view document encryption certificates in the certificate provider, you can use the **DocumentEncryptionCert** dynamic parameter of `Get-ChildItem`:

```PowerShell
Get-ChildItem Cert:\CurrentUser -DocumentEncryptionCert -Recurse
```

Extract and parse structured objects from string content

ConvertFrom-String

The new `ConvertFrom-String` cmdlet supports two modes:

- Basic delimited parsing
- Auto generated example-driven parsing

Delimited parsing, by default, splits the input at white space, and assigns property names to the resulting groups.

The **UpdateTemplate** parameter saves the results of the learning algorithm into a comment in the template file. This makes the learning process (the slowest stage) a one-time cost. Running `ConvertFrom-String` with a template that contains the encoded learning algorithm is now nearly instantaneous.

For more information, see ConvertFrom-String.

Convert-String

`Convert-String` allows you to provide before and after examples of how you want text to look. The cmdlet formats your text automatically.

For more information, see Convert-String.

Updates to FileInfo object

File version information can be misleading, especially in cases where the file was patched. WMF 5.0 adds new **FileVersionRaw** and **ProductVersionRaw** script properties to **FileInfo** objects. Here are the properties as displayed for powershell.exe (assuming $pid is the ID of the PowerShell process):

PowerShell

```
Get-Process -Id $pid -FileVersionInfo | Format-List *version*
```

Output

```
FileVersionRaw    : 10.0.17763.1
ProductVersionRaw : 10.0.17763.1
FileVersion       : 10.0.17763.1 (WinBuild.160101.0800)
ProductVersion    : 10.0.17763.1
```

Format-Hex

`Format-Hex` lets you view text or binary data in hexadecimal format.

For more information, see Format-Hex.

Get-ChildItem has -Depth parameter

`Get-ChildItem` now has a **Depth** parameter for use with **Recurse** to limit the recursion:

Modules support for declaring version ranges (1.*, etc)

You can now combine **MinimumVersion** and **MaximumVersion** to import module within specific range. The parameters also support wildcards.

PowerShell

```
Import-Module psreadline -Verbose -MinimumVersion 1.0 -MaximumVersion 1.2.*
```

Output

```
VERBOSE: Loading module from path 'C:\Program
Files\WindowsPowerShell\Modules\psreadline\1.1\psreadline.psd1'.
VERBOSE: Importing cmdlet 'Get-PSReadlineKeyHandler'.
VERBOSE: Importing cmdlet 'Get-PSReadlineOption'.
VERBOSE: Importing cmdlet 'Remove-PSReadlineKeyHandler'.
VERBOSE: Importing cmdlet 'Set-PSReadlineKeyHandler'.
VERBOSE: Importing cmdlet 'Set-PSReadlineOption'.
VERBOSE: Importing function 'PSConsoleHostReadline'.
```

New-Guid

There are many scenarios where youneed for unique identifier. The `New-GUID` cmdlet provides a simple way to create a new GUID.

PowerShell

```
New-Guid
```

Output

```
Guid
----
e19d6ea5-3cc2-4db9-8095-0cdaed5a703d
```

NoNewLine parameter

`Out-File`, `Add-Content`, and `Set-Content` now have a new **NoNewline** switch which omits a new line after the output. For example:

PowerShell

```
"This is " | Out-File -FilePath Example.txt -NoNewline
"a single " | Add-Content -Path Example.txt -NoNewline
"sentence." | Add-Content -Path Example.txt -NoNewline
Get-Content .\Example.txt
```

Output

```
This is a single sentence.
```

Without **NoNewline** specified, each fragment would be on a separate line:

PowerShell

```powershell
"This is " | Out-File -FilePath Example.txt
"a single " | Add-Content -Path Example.txt
"sentence." | Add-Content -Path Example.txt
Get-Content .\Example.txt
```

Output

```
This is
a single
sentence.
```

Interact with Symbolic links using improved Item cmdlets

The Item cmdlet and a few related cmdlets have been extended to support symbolic links.

Symbolic link files

In this example, we create a new symbolic link file named MySymLinkFile.txt in C:\Temp which links to $pshome\profile.ps1. These examples produce the same result.

PowerShell

```powershell
New-Item -ItemType SymbolicLink -Path C:\Temp -Name MySymLinkFile.txt -Value
$pshome\profile.ps1
New-Item -ItemType SymbolicLink -Path C:\Temp\MySymLinkFile.txt -Value
$pshome\profile.ps1
```

Symbolic link directories

In this example, we create a new symbolic link directory named MySymLinkDir in C:\Temp which links to the $pshome folder. These examples produce the same result.

PowerShell

```
New-Item -ItemType SymbolicLink -Path C:\Temp -Name MySymLinkDir -Value
$pshome
New-Item -ItemType SymbolicLink -Path C:\Temp\MySymLinkDir -Value $pshome
```

Hard links

The same combinations of **Path** and **Name** allowed as described above.

PowerShell

```
New-Item -ItemType HardLink -Path C:\Temp -Name MyHardLinkFile.txt -Value
$pshome\profile.ps1
```

Directory junctions

The same combinations of **Path** and **Name** allowed as described above.

PowerShell

```
New-Item -ItemType Junction -Path C:\Temp\MyJunctionDir -Value $pshome
```

Get-ChildItem

`Get-ChildItem` now displays an 'l' in the **Mode** property to indicate a symbolic link file or directory.

PowerShell

```
Get-ChildItem C:\Temp | sort LastWriteTime -Descending

Directory: C:\Temp

Mode       LastWriteTime Length Name
----       ------------- ------ ----
-a---- 6/13/2014 3:00 PM     16 File.txt
d----- 6/13/2014 3:00 PM        Directory
-a---l 6/13/2014 3:21 PM      0 MySymLinkFile.txt
d----l 6/13/2014 3:22 PM        MySymLinkDir
-a---l 6/13/2014 3:23 PM  23304 MyHardLinkFile.txt
d----l 6/13/2014 3:24 PM        MyJunctionDir
```

Remove-Item

Removing symbolic links works like removing any other item type.

PowerShell

```
Remove-Item C:\Temp\MySymLinkFile.txt
Remove-Item C:\Temp\MySymLinkDir
```

Use the **Force** parameter to remove the files in the target directory and the symbolic link.

PowerShell

```
Remove-Item C:\Temp\MySymLinkDir -Force
```

New-TemporaryFile

Sometimes in your scripts, you must create a temporary file. You can now do this with the `New-TemporaryFile` cmdlet:

PowerShell

```
$tempFile = New-TemporaryFile
$tempFile.FullName
```

Output

```
C:\Users\user1\AppData\Local\Temp\tmp375.tmp
```

Network Switch Management with PowerShell

The Network Switch cmdlets, introduced in WMF 5.0, enable you to apply switch, virtual LAN (VLAN), and basic Layer 2 network switch port configuration to Windows Server 2012 R2 logo-certified network switches. Using these cmdlets you can perform:

- Global switch configuration, such as:
  - Set host name
  - Set switch banner
  - Persist configuration
  - Enable or disable feature
- VLAN configuration:

    - Create or remove VLAN
    - Enable or disable VLAN
    - Enumerate VLAN
    - Set friendly name to a VLAN

- Layer 2 port configuration:
    - Enumerate ports
    - Enable or disable ports
    - Set port modes and properties
    - Add or associate VLAN to Trunk or Access on the port

For more information, see the NetworkSwitchManager documentation.

Generate PowerShell cmdlets based on an OData endpoint with ODataUtils

The ODataUtils module allows generation of PowerShell cmdlets from REST endpoints that support OData. The Microsoft.PowerShell.ODataUtils module includes the following features:

- Channel additional information from server-side endpoint to client side.
- Client-side paging support
- Server-side filtering by using the -Select parameter
- Support for web request headers

The proxy cmdlets generated by the `Export-ODataEndPointProxy` cmdlet provide additional information from the server-side OData endpoint on the **Information** stream.

PowerShell

```
Import-Module Microsoft.PowerShell.ODataUtils -Force
$generatedProxyModuleDir = Join-Path -Path $env:SystemDrive -ChildPath
'ODataDemoProxy'
$uri =
"http://services.odata.org/V3/(S(fhleiief23wrm5a5nhf542q5))/OData/OData.svc/
"
Export-ODataEndpointProxy -Uri $uri -OutputModule $generatedProxyModuleDir -
Force -AllowUnSecureConnection -Verbose -AllowClobber
```

In the following example, we are retrieving top product and capturing the output in the `$infoStream` variable.

By specifying **IncludeTotalResponseCount** parameter, we get the total count of all the **Product** records available on the server.

PowerShell

```
Import-Module $generatedProxyModuleDir -Force
$product = Get-Product -Top 1 -AllowUnsecureConnection -AllowAdditionalData
-IncludeTotalResponseCount -InformationVariable infoStream
$additionalInfo = $infoStream.GetEnumerator() | % MessageData
$additionalInfo['odata.count']
```

You can get the records from the server in batches using client-side paging support. This is useful when you must get a large amount of data from the server over the network.

PowerShell

```
$skipCount = 0
$batchSize = 3
while($skipCount -le $additionalInfo['odata.count'])
{
  Get-Product -AllowUnsecureConnection -AllowAdditionalData -Top $batchSize
-Skip $skipCount
  $skipCount += $batchSize
}
```

The generated proxy cmdlets support the **Select** parameter that is used as a filter to receive only the record properties that the client needs. The filtering occurs on the server, which reduces the amount of data that is transferred over the network.

PowerShell

```
Get-Product -Top 2 -AllowUnsecureConnection -AllowAdditionalData -Select
Name
```

The `Export-ODataEndpointProxy` cmdlet, and the proxy cmdlets generated by it, now support the **Headers** parameter. The header can be used to channel additional information expected by the OData endpoint.

In the following example, a hash table containing a Subscription key is provided to the **Headers** parameter. This is a typical example for services that are expecting a Subscription key for authentication.

PowerShell

```
Export-ODataEndpointProxy -Uri $endPointUri -OutputModule
$generatedProxyModuleDir -Force -AllowUnSecureConnection -Verbose -Headers
@{'subscription-key'='XXXX'}
```

New language features in PowerShell 5.0

Article • 09/17/2021

PowerShell 5.0 added the ability to define classes and other user-defined types using formal syntax and semantics like other object-oriented programming languages. The goal is to enable developers and IT professionals to embrace PowerShell for a wider range of use cases, simplify development of PowerShell artifacts (such as DSC resources), and accelerate coverage of management surfaces.

PowerShell 5.0 introduces the following new language elements in PowerShell:

Class keyword

The `class` keyword defines a new class. This is a true .NET Framework type. Class members are public, but only public within the module scope. You can't refer to the type name as a string (for example, `New-Object` doesn't work), and in this release, you can't use a type literal (for example, `[MyClass]`) outside the script or module file in which the class is defined.

PowerShell

```
class MyClass
{
    ...
}
```

Enum keyword and enumerations

Support for the `enum` keyword has been added, which uses newline as the delimiter. Currently, you cannot define an enumerator in terms of itself. However, you can initialize an enum in terms of another enum, as shown in the following example. Also, the base type cannot be specified; it is always `[int]`.

PowerShell

```
enum Color2
{
    Yellow = [Color]::Blue
}
```

An enumerator value must be a parse time constant. You cannot set it to the result of an invoked command.

```PowerShell
enum MyEnum
{
    Enum1
    Enum2
    Enum3 = 42
    Enum4 = [int]::MaxValue
}
```

Enums support arithmetic operations, as shown in the following example.

```PowerShell
enum SomeEnum { Max = 42 }
enum OtherEnum { Max = [SomeEnum]::Max + 1 }
```

Import-DscResource

`Import-DscResource` is now a true dynamic keyword. PowerShell parses the specified module's root module, searching for classes that contain the **DscResource** attribute.

ImplementingAssembly

A new field, **ImplementingAssembly**, has been added to **ModuleInfo**. It is set to the dynamic assembly created for a script module if the script defines classes, or the loaded assembly for binary modules. It is not set when **ModuleType** is **Manifest**.

Reflection on the **ImplementingAssembly** field discovers resources in a module. This means you can discover resources written in either PowerShell or other managed languages.

Further reading

- about_Classes
- about_Enum
- about_Classes_and_DSC

Console Improvements in WMF 5.1

Article • 10/13/2021

PowerShell console improvements

The following changes have been made to `powershell.exe` in WMF 5.1 to improve the console experience:

VT100 support

Windows 10 added support for VT100 escape sequences. PowerShell ignores certain VT100 formatting escape sequences when calculating table widths.

PowerShell also added a new API that can be used in formatting code to determine if VT100 is supported. For example:

PowerShell

```
if ($host.UI.SupportsVirtualTerminal)
{
    $esc = [char]0x1b
    "A yellow ${esc}[93mhello${esc}[0m"
}
else
{
    "A default hello"
}
```

Here is a complete example that can be used to highlight matches from `Select-String`. Save the example in a file named `MatchInfo.format.ps1xml`, then to use it, in your profile or elsewhere, run `Update-FormatData -Prepend MatchInfo.format.ps1xml`.

Note that VT100 escape sequences are only supported starting with the Windows 10 Anniversary update. They are not supported on earlier systems.

Vi mode support in PSReadline

PSReadline adds support for vi mode. To use vi mode, run `Set-PSReadlineOption -EditMode Vi`.

Redirected stdin with interactive input

In earlier versions, starting PowerShell with `powershell -File -` was required when stdin was redirected and you wanted to enter commands interactively.

With WMF 5.1, this hard to discover option is no longer necessary. You can start PowerShell without any options.

Note that PSReadline does not support redirected stdin, and the built-in command-line editing experience with redirected stdin is extremely limited, for example, arrow keys don't work. A future release of PSReadline should address this issue.

Improvements in PowerShell Script Debugging

Article • 09/17/2021

PowerShell 5.0 includes several improvements that enhance the debugging experience.

Break All

The PowerShell console and PowerShell ISE now allow you to break into the debugger for running scripts. This works in both local and remote sessions.

In the console, press `Ctrl`+`Break`.

In ISE, press `Ctrl`+`B`, or use the **Debug -> Break All** menu command.

Remote debugging and remote file editing in PowerShell ISE

PowerShell ISE now lets you open and edit files in a remote session by running the PSEdit command. For example, you can open a file for editing from the command line in a remote session as follows:

PowerShell

```
[RemoteComputer1]: PS C:\> PSEdit C:\DebugDemoScripts\Test-GetMutex.ps1
```

In addition, you can now edit and save changes in a remote file that is automatically opened in PowerShell ISE when you hit a breakpoint. Now, you can debug a script file that is running on a remote computer, edit the file to fix an error, and then rerun the modified script.

Advanced Script Debugging

There are new, advanced debugging features that let you attach to any local computer process that has loaded PowerShell, and debug arbitrary runspaces in that process.

Runspace Debugging

New cmdlets have been added that let you list current runspaces in a process, and attach the PowerShell console or PowerShell ISE debugger to that runspace for script debugging:

- Get-Runspace
- Debug-Runspace
- Enable-RunspaceDebug
- Disable-RunspaceDebug
- Get-RunspaceDebug

Attach to Process hosting PowerShell

You can now attach to any computer process that has PowerShell loaded. You do this by entering into an interactive session with the host process. For more information, see:

- Enter-PSHostProcess
- Exit-PSHostProcess

Script Tracing and Logging

Article • 11/02/2021

While PowerShell already has the **LogPipelineExecutionDetails** Group Policy setting to log the invocation of cmdlets, PowerShell's scripting language has several features that you might want to log and audit. The new Detailed Script Tracing feature provides detailed tracking and analysis of PowerShell script activity on a system. After enabling detailed script tracing, PowerShell logs all script blocks to the ETW event log, **Microsoft-Windows-PowerShell/Operational**. If a script block creates another script block, for example, by calling `Invoke-Expression`, the invoked script block also logged.

Logging is enabled through the **Turn on PowerShell Script Block Logging** Group Policy setting in **Administrative Templates** -> **Windows Components** -> **Windows PowerShell**.

The events are:

Channel	**Operational**
Level	Verbose
Opcode	Create
Task	CommandStart
Keyword	Runspace
EventId	Engine_ScriptBlockCompiled (0x1008 = 4104)
Message	Creating Scriptblock text (%1 of %2): %3 ScriptBlock ID: %4

The text embedded in the message is the extent of the script block compiled. The ID is a GUID that is retained for the life of the script block.

When you enable verbose logging, the feature writes begin and end markers:

Channel	**Operational**
Level	Verbose
Opcode	Open / Close
Task	CommandStart / CommandStop

Channel	Operational
Keyword	Runspace
EventId	ScriptBlock_Invoke_Start_Detail (0x1009 = 4105) / ScriptBlock_Invoke_Complete_Detail (0x100A = 4106)
Message	Started / Completed invocation of ScriptBlock ID: %1 Runspace ID: %2

The ID is the GUID representing the script block (that can be correlated with event ID 0x1008), and the Runspace ID represents the runspace in which this script block was run.

Percent signs in the invocation message represent structured ETW properties. While they are replaced with the actual values in the message text, a more robust way to access them is to retrieve the message with the Get-WinEvent cmdlet, and then use the **Properties** array of the message.

Here's an example of how this functionality can help unwrap a malicious attempt to encrypt and obfuscate a script:

PowerShell

```powershell
## Malware
function SuperDecrypt
{
    param($script)
    $bytes = [Convert]::FromBase64String($script)

    ## XOR "encryption"
    $xorKey = 0x42
    for($counter = 0; $counter -lt $bytes.Length; $counter++)
    {
        $bytes[$counter] = $bytes[$counter] -bxor $xorKey
    }
    [System.Text.Encoding]::Unicode.GetString($bytes)
}

$decrypted = SuperDecrypt "FUIwQitCNkInQm9CCkItQjFCNkJiQmVCEkI1QixCJkJlQg=="
Invoke-Expression $decrypted
```

Running this generates the following log entries:

Output

```
Compiling Scriptblock text (1 of 1):
function SuperDecrypt
{
    param($script)
```

```
    $bytes = [Convert]::FromBase64String($script)
    ## XOR "encryption"
    $xorKey = 0x42
    for($counter = 0; $counter -lt $bytes.Length; $counter++)
    {
        $bytes[$counter] = $bytes[$counter] -bxor $xorKey
    }
    [System.Text.Encoding]::Unicode.GetString($bytes)

}
ScriptBlock ID: ad8ae740-1f33-42aa-8dfc-1314411877e3

Compiling Scriptblock text (1 of 1):
$decrypted = SuperDecrypt "FUIwQitCNkInQm9CCkItQjFCNkJiQmVCEkI1QixCJkJlQg=="
ScriptBlock ID: ba11c155-d34c-4004-88e3-6502ecb50f52

Compiling Scriptblock text (1 of 1):
Invoke-Expression $decrypted
ScriptBlock ID: 856c01ca-85d7-4989-b47f-e6a09ee4eeb3

Compiling Scriptblock text (1 of 1):
Write-Host 'Pwnd'
ScriptBlock ID: 5e618414-4e77-48e3-8f65-9a863f54b4c8
```

If the script block length exceeds the capacity of a single event, PowerShell breaks the script into multiple parts. Here is sample code to recombine a script from its log messages:

PowerShell

```
$created = Get-WinEvent -FilterHashtable @{ ProviderName="Microsoft-Windows-
PowerShell"; Id = 4104 } |
  Where-Object { $_.<...> }
$sortedScripts = $created | sort { $_.Properties[0].Value }
$mergedScript = -join ($sortedScripts | % { $_.Properties[2].Value })
```

As with all logging systems that have a limited retention buffer, one way to attack this infrastructure is to flood the log with spurious events to hide earlier evidence. To protect yourself from this attack, ensure that you have some form of event log collection set up Windows Event Forwarding. For more information, see Use Azure Monitor to integrate with SIEM tools.

Improvements in Desired State Configuration (DSC) in WMF 5.1

Article • 09/17/2021

DSC class resource improvements

In WMF 5.1, we have fixed the following known issues:

- Get-DscConfiguration may return empty values (null) or errors if a complex/hash table type is returned by Get() function of a class-based DSC resource.
- Get-DscConfiguration returns error if RunAs credential is used in DSC configuration.
- Class-based resource cannot be used in a composite configuration.
- Start-DscConfiguration hangs if class-based resource has a property of its own type.
- Class-based resource cannot be used as an exclusive resource.

DSC resource debugging improvements

In WMF 5.0, the PowerShell debugger did not stop at the class-based resource method (Get/Set/Test) directly. In WMF 5.1, the debugger stops at the class-based resource method in the same way as for MOF-based resources methods.

DSC pull client supports TLS 1.1 and TLS 1.2

Previously, the DSC pull client only supported SSL3.0 and TLS1.0 over HTTPS connections. When forced to use more secure protocols, the pull client would stop functioning. In WMF 5.1, the DSC pull client no longer supports SSL 3.0 and adds support for the more secure TLS 1.1 and TLS 1.2 protocols.

Improved pull server registration

In the earlier versions of WMF, simultaneous registrations/reporting requests to a DSC pull server while using the ESENT database would lead to LCM failing to register and/or report. In such cases, the event logs on the pull server has the error "Instance Name already in use." This was caused by an incorrect pattern being used to access the ESENT database in a multi-threaded scenario. In WMF 5.1, this issue has been fixed. Concurrent

registrations or reporting (involving ESENT database) works fine in WMF 5.1. This issue is applicable only to the ESENT database and does not apply to the OLEDB database.

Enable Circular log on ESENT database instance

In eariler version of DSC-PullServer, the ESENT database log files were filling up the disk space of the pullserver because the database instance was being created without circular logging. In this release, you have the option to control the circular logging behavior of the instance using the web.config of the pullserver. By default CircularLogging is set to TRUE.

XML

```
<appSettings>
    <add key="dbprovider" value="ESENT" />
    <add key="dbconnectionstr" value="C:\Program
Files\WindowsPowerShell\DscService\Devices.edb" />
    <add key="CheckpointDepthMaxKB" value="512" />
    <add key="UseCircularESENTLogs" value="TRUE" />
  </appSettings>
```

WOW64 support for Configuration Keyword

The `Configuration` keyword is now supported in WOW64 on a 64-bit computer. This means that a DSC configuration can be defined and compiled within a 32-bit process such as Windows PowerShell ISE (x86) running on a 64-bit computer.

Pull partial configuration naming convention

In the previous release, the naming convention for a partial configuration was that the MOF file name in the pull server/service should match the partial configuration name specified in the local configuration manager settings that in turn must match the configuration name embedded in the MOF file.

See the snapshots below:

- Local configuration settings which defines a partial configuration that a node is allowed to receive.

```
[DscLocalConfigurationManager()]
Configuration RegistrationMetaConfig
{
    Settings
    {
        RefreshFrequencyMins = 30;
        RefreshMode = "PULL";
    }

    ConfigurationRepositoryWeb web
    {
        ServerURL =  $endPoint
        RegistrationKey = $registrationKey
        ConfigurationNames = $configurationName
    }

    PartialConfiguration PartialOne
    {
        ConfigurationSource = "[ConfigurationRepositoryWeb]Web"
        ExclusiveResources = @("File")
    }
}

RegistrationMetaConfig
slcm -Path .\RegistrationMetaConfig -Verbose
```

- Sample partial configuration definition

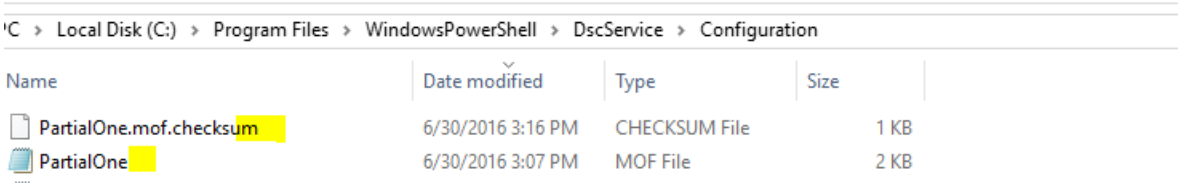
PowerShell

```
Configuration PartialOne
{
    Node('localhost')
    {
        File test
        {
            DestinationPath = "$env:TEMP\partialconfigexample.txt"
            Contents = 'Partial Config Example'
        }
    }
}
PartialOne
```

- 'ConfigurationName' embedded in the generated MOF file.

```
instance of MSFT_FileDirectoryConfiguration as $MSFT_FileDirectoryConfiguration1ref
{
ResourceID = "[File]test";
 Contents = "Partial Config Example";
 DestinationPath = "[redacted]ocal\\Temp\\partialconfigexample.txt";
 ModuleName = "PSDesiredStateConfiguration";
 SourceInfo = "::5::9::File";

ModuleVersion = "1.0";
 ConfigurationName = "PartialOne";
};
instance of OMI_ConfigurationDocument

                    {
 Version="2.0.0";

                        MinimumCompatibleVersion = "1.0.0";

                        CompatibleVersionAdditionalProperties= {"Omi_BaseResource:ConfigurationName"};

                        Author="[redacted]";

                        GenerationDate="06/30/2016 15:07:16";

                        GenerationHos[redacted]

                        Name="PartialOne";

                    };
```

- FileName in the pull configuration repository



Azure Automation service name generated MOF files as `<ConfigurationName>.<NodeName>.mof`. So the configuration below compiles to PartialOne.localhost.mof.

This made it impossible to pull one of your partial configuration from Azure Automation service.

PowerShell

```
Configuration PartialOne
{
    Node('localhost')
    {
        File test
        {
            DestinationPath = "$env:TEMP\partialconfigexample.txt"
            Contents = 'Partial Config Example'
        }
    }
}
PartialOne
```

In WMF 5.1, a partial configuration in the pull server/service can be named as `<ConfigurationName>.<NodeName>.mof`. Moreover, if a machine is pulling a single configuration from a pull server/service then the configuration file on the pull server configuration repository can have any file name. This naming flexibility allows you to manage your nodes partially by Azure Automation service, where some configuration for your node is coming from Azure Automation DSC and with a partial configuration that you manage locally.

The metaconfiguration below sets up a node to be managed both locally as well as by Azure Automation service.

PowerShell

```
[DscLocalConfigurationManager()]
Configuration RegistrationMetaConfig
{
    Settings
    {
        RefreshFrequencyMins = 30
        RefreshMode = "PULL"
    }
```

```
    ConfigurationRepositoryWeb web
    {
        ServerURL =  $endPoint
        RegistrationKey = $registrationKey
        ConfigurationNames = $configurationName
    }

    # Partial configuration managed by Azure Automation service.
    PartialConfiguration PartialConfigurationManagedByAzureAutomation
    {
        ConfigurationSource = "[ConfigurationRepositoryWeb]Web"
    }

    # This partial configuration is managed locally.
    PartialConfiguration OnPremisesConfig
    {
        RefreshMode = "PUSH"
        ExclusiveResources = @("Script")
    }

}

RegistrationMetaConfig
Set-DscLocalConfigurationManager -Path .\RegistrationMetaConfig -
Verbose
```

Using PsDscRunAsCredential with DSC composite resources

We have added support for using PsDscRunAsCredential with DSC Composite resources.

You can now specify a value for **PsDscRunAsCredential** when using composite resources inside configurations. When specified, all resources run inside a composite resource as a RunAs user. If a composite resource calls another composite resource, all those resources are also executed as RunAs user. RunAs credentials are propagated to any level of the composite resource hierarchy. If any resource inside a composite resource specifies its own value for **PsDscRunAsCredential**, a merge error results during configuration compilation.

This example shows usage with the WindowsFeatureSet composite resource included in PSDesiredStateConfiguration module.

PowerShell

```
Configuration InstallWindowsFeature
{
    Import-DscResource -ModuleName PSDesiredStateConfiguration
```

```
    Node $AllNodes.NodeName
    {
        WindowsFeatureSet features
        {
            Name = @("Telnet-Client","SNMP-Service")
            Ensure = "Present"
            IncludeAllSubFeature = $true
            PsDscRunAsCredential = Get-Credential
        }
    }
}

$configData = @{
    AllNodes = @(
        @{
            NodeName             = 'localhost'
            PSDscAllowDomainUser = $true
            CertificateFile      = 'C:\publicKeys\targetNode.cer'
            Thumbprint           = '7ee7f09d-4be0-41aa-a47f-96b9e3bdec25'
        }
    )
}

InstallWindowsFeature -ConfigurationData $configData
```

Allowing for Identical Duplicate Resources in a Configuration

DSC does not allow or handle conflicting resource definitions within a configuration. Instead of trying to resolve the conflict, it simply fails. As configuration reuse becomes more utilized through composite resources, etc. conflicts will occur more often. When conflicting resource definitions are identical, DSC should be smart and allow this. With this release, we support having multiple resource instances that have identical definitions:

PowerShell

```
Configuration IIS_FrontEnd
{
    WindowsFeature FE_IIS         #Identical resource
    {
        Ensure = 'Present'
        Name = 'Web-Server'
    }

    WindowsFeature FTP
    {
        Ensure = 'Present'
        Name = 'Web-FTP-Server'
```

```
    }
}

Configuration IIS_Worker
{
    WindowsFeature Worker_IIS      #Identical resource
    {
        Ensure = 'Present'
        Name = 'Web-Server'
    }

    WindowsFeature ASP
    {
        Ensure = 'Present'
        Name = 'Web-ASP-Net45'
    }
}

Configuration WebApplication
{
    IIS_Frontend Web {}

    IIS_Worker ASP {}
}
```

In previous releases, the result would be a failed compilation due to a conflict between the WindowsFeature FE_IIS and WindowsFeature Worker_IIS instances trying to ensure the 'Web-Server' role is installed. Notice that *all* of the properties that are being configured are identical in these two configurations. Since *all* of the properties in these two resources are identical, this will result in a successful compilation now.

If any of the properties are different between the two resources, they will not be considered identical and compilation will fail.

DSC module and configuration signing validations

In DSC, configurations and modules are distributed to managed computers from the pull server. If the pull server is compromised, an attacker can potentially modify the configurations and modules on the pull server and have it distributed to all managed nodes.

In WMF 5.1, DSC supports validating the digital signatures on catalog and configuration (.MOF) files. This feature prevents nodes from executing configurations or module files which are not signed by a trusted signer or which have been tampered with after they have been signed by trusted signer.

How to sign configuration and module

- Configuration Files (.MOFs): The existing PowerShell cmdlet Set-AuthenticodeSignature is extended to support signing of MOF files.
- Modules: Signing of modules is done by signing the corresponding module catalog using the following steps:

    1. Create a catalog file: A catalog file contains a collection of cryptographic hashes or thumbprints. Each thumbprint corresponds to a file that is included in the module. The new cmdlet New-FileCatalog, has been added to enable users to create a catalog file for their module.
    2. Sign the catalog file: Use Set-AuthenticodeSignature to sign the catalog file.
    3. Place the catalog file inside the module folder. By convention, module catalog file should be placed under the module folder with the same name as the module.

LocalConfigurationManager settings to enable signing validations

Pull

The LocalConfigurationManager of a node performs signing validation of modules and configurations based on its current settings. By default, signature validation is disabled. Signature validation can enabled by adding the 'SignatureValidation' block to the meta-configuration definition of the node as shown below:

PowerShell

```
[DSCLocalConfigurationManager()]
Configuration EnableSignatureValidation
{
    Settings
    {
        RefreshMode = 'PULL'
    }

    ConfigurationRepositoryWeb pullserver{
      ConfigurationNames = 'sql'
      ServerURL =
'http://localhost:8080/PSDSCPullServer/PSDSCPullServer.svc'
      AllowUnsecureConnection = $true
      RegistrationKey = 'd6750ff1-d8dd-49f7-8caf-7471ea9793fc' # Replace
this with correct registration key.
    }
    SignatureValidation validations{
```

```
        # If the TrustedStorePath property is provided then LCM will use the
custom path. Otherwise, the LCM will use default trusted store path
(Cert:\LocalMachine\DSCStore) to find the signing certificate.
        TrustedStorePath = 'Cert:\LocalMachine\DSCStore'
        SignedItemType = 'Configuration','Module'         # This is a list
of DSC artifacts, for which LCM need to verify their digital signature
before executing them on the node.
    }

}
EnableSignatureValidation
Set-DscLocalConfigurationManager -Path .\EnableSignatureValidation -Verbose
```

Setting the above metaconfiguration on a node enables signature validation on downloaded configurations and modules. The Local Configuration Manager performs the following steps to verify the digital signatures.

1. Verify the signature on a configuration file (.MOF) is valid using the `Get-AuthenticodeSignature` cmdlet.
2. Verify the certificate authority that authorized the signer is trusted.
3. Download module/resource dependencies of the configuration to a temp location.
4. Verify the signature of the catalog included inside the module.
    - Find a `<moduleName>.cat` file and verify its signature using `Get-AuthenticodeSignature`.
    - Verify the certification authority that authenticated the signer is trusted.
    - Verify the content of the modules has not been tampered using the new cmdlet `Test-FileCatalog`.
5. `Install-Module` to `$env:ProgramFiles\WindowsPowerShell\Modules\`
6. Process configuration

> **Note**
>
> Signature validation on module-catalog and configuration is only performed when the configuration is applied to the system for the first time or when the module is downloaded and installed. Consistency runs do not validate the signature of Current.mof or its module dependencies. If verification has failed at any stage, for instance, if the configuration pulled from the pull server is unsigned, then processing of the configuration terminates with the error shown below and all temporary files are deleted.

```
PS [redacted] glcm

ActionAfterReboot              : ContinueConfiguration
AgentId                        : 21A5DD4E-2784-11E6-B8F8-00155DADD701
AllowModuleOverWrite           : True
CertificateID                  :
ConfigurationDownloadManagers  : {[ConfigurationRepositoryWeb]ConfigurationManager}
ConfigurationID                :
ConfigurationMode              : ApplyAndAutoCorrect
ConfigurationModeFrequencyMins : 60
Credential                     :
DebugMode                      : {NONE}
DownloadManagerCustomData      :
DownloadManagerName            :
LCMCompatibleVersions          : {1.0, 2.0}
LCMState                       : Idle
LCMStateDetail                 :
LCMVersion                     : 2.0
StatusRetentionTimeInDays      : 10
SignatureValidationPolicy      : [SignatureValidation]validation
SignatureValidations           : {MSFT_SignatureValidation}
PartialConfigurations          :
RebootNodeIfNeeded             : True
RefreshFrequencyMins           : 30
RefreshMode                    : Pull
ReportManagers                 : {}
ResourceModuleManagers         : {}
PSComputerName                 :



PS [redacted] Update-DscConfiguration -Wait -Verbose
VERBOSE: Perform operation 'Invoke CimMethod' with following parameters, ''methodName' = PerformRequiredConfigurationChecks,'className' = MSFT_DSCLocalConfig
ationManager,'namespaceName' = root/Microsoft/Windows/DesiredStateConfiguration'.
VERBOSE: An LCM method call arrived from computer BERHA530 with user sid S-1-5-21-2800768176-829124343-4290817346-1106.
VERBOSE: [BERHA530]:                            [] Executing Get-Action with configuration (null)'s checksum: .
VERBOSE: [BERHA530]:                            [] Executing Get-Action with configuration 's checksum returned result status: GetConfiguration
VERBOSE: [BERHA530]:                            [] Checksum is different. LCM will execute GetConfiguration to pull configuration .
VERBOSE: [BERHA530]:                            [] Executing GetConfiguration failed. Configuration  is not pulled.
Validating the signature of the configuration document failed. The signature status on the document is NotSigned.
    + CategoryInfo          : SecurityError: (root/Microsoft/...gurationManager:String) [], CimException
    + FullyQualifiedErrorId : MOFSignatureVerificationFailed
    + PSComputerName        : localhost

VERBOSE: Operation 'Invoke CimMethod' complete.
VERBOSE: Time taken for configuration job to complete is 0.272 seconds
```

Similarly, pulling a module whose catalog is not signed results in the following error:

```
[redacted] glcm | % SignatureValidations


ResourceId       : [SignatureValidation]validation
SourceInfo       : C:\CISTEX\DSC\Tests\PullServerClient\BVT\SigningTestHelper.psm1::284::13::SignatureValidation
SignedItemType   : {Module}
TrustedStorePath : cert:\LocalMachine\DSCStore
PSComputerName   :



PS C:\CISTEX\dsc\Tests\PullServerClient\BVT> Start-DscConfiguration -ComputerName localhost -Path $testMofPath -Wait -Verbose -For
VERBOSE: Perform operation 'Invoke CimMethod' with following parameters, ''methodName' = SendConfigurationApply,'className' = MSFT_DSCLocalConfigura
,'namespaceName' = root/Microsoft/Windows/DesiredStateConfiguration'.
VERBOSE: An LCM method call arrived from computer BERHA530 with user sid S-1-5-21-2800768176-829124343-4290817346-1106.
VERBOSE: [BERHA530]: LCM:  [ Start  Set      ]
VERBOSE: [BERHA530]:                            [DSCEngine] Module SigningTest_1.0.zip downloaded.
VERBOSE: [BERHA530]: LCM:  [ End    Set      ]
Signature verification on the catalog failed with signature status value of NotSigned. Could not install module dependencies needed by the configura
    + CategoryInfo          : SecurityError: (root/Microsoft/...gurationManager:String) [], CimException
    + FullyQualifiedErrorId : CatalalogSignatureVerificationFailed
    + PSComputerName        : localhost

VERBOSE: Operation 'Invoke CimMethod' complete.
VERBOSE: Time taken for configuration job to complete is 0.284 seconds

PS C:\[redacted] |
```

Push

A configuration delivered by using push might be tampered with at its source before it delivered to the node. The Local Configuration Manager performs similar signature validation steps for pushed or published configuration(s). Below is a complete example of signature validation for push.

- Enable signature validation on the node.

  PowerShell

```
[DSCLocalConfigurationManager()]
Configuration EnableSignatureValidation
{
    Settings
    {
        RefreshMode = 'PUSH'
    }
    SignatureValidation validations{
        TrustedStorePath = 'Cert:\LocalMachine\DSCStore'
        SignedItemType =  'Configuration','Module'
    }

}
EnableSignatureValidation
Set-DscLocalConfigurationManager -Path .\EnableSignatureValidation -
Verbose
```

- Create a sample configuration file.

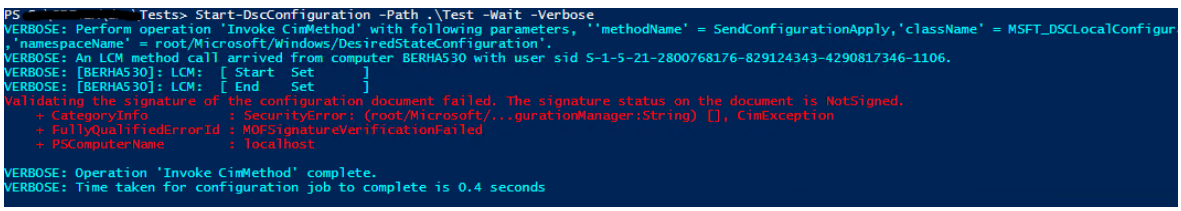
PowerShell

```
# Sample configuration
Configuration Test
{

    File foo
    {
        DestinationPath =  "$env:TEMP\signingTest.txt"
        Contents = "ABC"
    }
}
Test
```

- Try pushing the unsigned configuration file in to the node.

PowerShell

```
Start-DscConfiguration -Path .\Test -Wait -Verbose -Force
```



- Sign the configuration file using code-signing certificate.

```
PS [redacted]s> # Sign Mof

PS [redacted]ts> Set-AuthenticodeSignature -Certificate $cert -FilePath .\test\localhost.mof


    Directory: [redacted]\test


SignerCertificate                         Status                                                Path
-----------------                         ------                                                ----
8789E1439E2464C1F1B6117851ED241D1FD1E8C9  Valid                                                 localhost.mof
```

- Try pushing the signed MOF file.

```
[redacted]Tests> Start-DscConfiguration -Path .\Test -Wait -Verbose -Force
VERBOSE: Perform operation 'Invoke CimMethod' with following parameters, ''methodName' = SendConfigurationApply,'className' = MSFT_DSCLocalConfigur
,'namespaceName' = root/Microsoft/Windows/DesiredStateConfiguration'.
VERBOSE: An LCM method call arrived from computer BERHA530 with user sid S-1-5-21-2800768176-829124343-4290817346-1106.
VERBOSE: [BERHA530]: LCM:  [ Start  Set      ]
VERBOSE: [BERHA530]: LCM:  [ Start  Resource ]  [[File]foo]
VERBOSE: [BERHA530]: LCM:  [ Start  Test     ]  [[File]foo]
VERBOSE: [BERHA530]:                            [[File]foo] The system cannot find the file specified.
VERBOSE: [BERHA530]:                            [[File]foo] The related file/directory is: C:\Users\[redacted]\AppData\Local\Temp\signingTest.txt.
VERBOSE: [BERHA530]: LCM:  [ End    Test     ]  [[File]foo]  in 0.0150 seconds.
VERBOSE: [BERHA530]: LCM:  [ Start  Set      ]  [[File]foo]
VERBOSE: [BERHA530]:                            [[File]foo] The system cannot find the file specified.
VERBOSE: [BERHA530]:                            [[File]foo] The related file/directory is: C:\Users\[redacted]\AppData\Local\Temp\signingTest.txt.
VERBOSE: [BERHA530]: LCM:  [ End    Set      ]  [[File]foo]  in 0.0000 seconds.
VERBOSE: [BERHA530]: LCM:  [ End    Resource ]  [[File]foo]
VERBOSE: [BERHA530]: LCM:  [ End    Set      ]
VERBOSE: [BERHA530]: LCM:  [ End    Set      ]    in  0.2030 seconds.
VERBOSE: Operation 'Invoke CimMethod' complete.
VERBOSE: Time taken for configuration job to complete is 0.243 seconds
```

Activate Windows
Go to Settings to activate

PowerShell Engine Improvements

Article • 09/17/2021

The following improvements to the core PowerShell engine have been implemented in WMF 5.1:

Performance

Performance has improved in some important areas:

- Startup
- Pipelining to cmdlets like `ForEach-Object` and `Where-Object` is approximately 50% faster

Some example improvements (your results may vary depending on your hardware):

Scenario	5.0 Time (ms)	5.1 Time (ms)
`powershell -command "echo 1"`	900	250
First ever PowerShell run: `powershell -command "Unknown-Command"`	30000	13000
Command analysis cache built: `powershell -command "Unknown-Command"`	7000	520
`1..1000000 | % { }`	1400	750

> **Note**
>
> One change related to startup might impact some unsupported scenarios. PowerShell no longer reads the files `$pshome\*.ps1xml` -- these files have been converted to C# to avoid some file and CPU overhead of processing the XML files. The files still exist to support V2 side-by-side, so if you change the file contents, it will not have any effect to V5, only V2. Note that changing the contents of these files was never a supported scenario.

Another visible change is how PowerShell caches the exported commands and other information for modules that are installed on a system. Previously, this cache was stored in the directory `$env:LOCALAPPDATA\Microsoft\Windows\PowerShell\CommandAnalysis`. In WMF 5.1, the cache is a single file

`$env:LOCALAPPDATA\Microsoft\Windows\PowerShell\ModuleAnalysisCache`. See Module Analysis Cache for more details.

Information Stream

Article • 09/17/2021

PowerShell 5.0 adds a new structured **Information** stream to transmit structured data between a script and its host. `Write-Host` has also been updated to emit its output to the **Information** stream where you can now capture or silence it. The new `Write-Information` cmdlet used with **InformationVariable** and **InformationAction** common parameters enables more flexibility and capability.

The following function uses cmdlets that take advantage of the new **Information** stream.

PowerShell

```
function OutputGusher {
  [CmdletBinding()]
  param()
  Write-Host -ForegroundColor Green 'Preparing to give you output!'
  Write-Host '============================'
  Write-Host 'I ' -ForegroundColor White -NoNewline
  Write-Host '<3 ' -ForegroundColor Red -NoNewline
  Write-Host 'Output' -ForegroundColor White
  Write-Host '============================'

  $p = Get-Process -id $pid
  $p

  Write-Information $p -Tag Process
  Write-Information 'Some spammy logging information' -Tag LogLow
  Write-Information 'Some important logging information' -Tag LogHigh

  Write-Host
  Write-Host -ForegroundColor Green 'SCRIPT COMPLETE!!'
}
```

The following examples show the results of running this function.

PowerShell

```
$r = OutputGusher
```

Output

```
Preparing to give you output!
============================
I <3 Output
============================
```

```
SCRIPT COMPLETE!!
```

The `$r` variable has captured the process information in the script variable `$p`.

PowerShell

```
$r.Id
4008
```

Unlike the `Write-Host` cmdlet, using the **InformationVariable** parameter of `Write-Information` allows you to capture the output in a variable. Using the **Tag**, you can create separate channels for message sent to the **Information** stream.

PowerShell

```
$r = OutputGusher -InformationVariable iv
$ivOutput = $iv | Group-Object -AsHash { $_.Tags[0] } -AsString
$ivOutput
```

Output

```
Preparing to give you output!
============================
I <3 Output
============================
SCRIPT COMPLETE!!

Name                 Value
----                 -----
LogLow               {Some spammy logging information}
LogHigh              {Some important logging information}
Process              {System.Diagnostics.Process (powershell)}
PSHOST               {Preparing to give you output!,
============================, I , <3 ...}
```

When you send a message to the **Information** stream with a tag, that message is not displayed in the host application but can be retrieved using the tag name. For example:

PowerShell

```
$iv | where Tags -eq 'LogHigh'
```

Output

```
Some important logging information
```

Improvements to Just Enough Administration (JEA)

Article • 09/17/2021

Just Enough Administration is a new feature in WMF 5.0 that enables role-based administration through PowerShell remoting. It extends the existing constrained endpoint infrastructure by allowing non-administrators to run specific commands, scripts, and executables as an administrator. This enables you to reduce the number of full administrators in your environment and improve security.

Constrained file copy to/from JEA endpoints

You can now remotely copy files to/from a JEA endpoint and be assured that the connecting user can't copy just *any* file on your system. This is possible by configuring your PSSC file to mount a user drive for connecting users. The user drive is a new PSDrive that is unique to each connecting user and persists across sessions. When `Copy-Item` is used to copy files to or from a JEA session, it is constrained to only allow access to the user drive. Attempts to copy files to any other PSDrive will fail.

To set up the user drive in your JEA session configuration file, use the following new fields:

PowerShell

```
MountUserDrive = $true
UserDriveMaximumSize = 10485760    # 10 MB
```

The folder backing the user drive is created at `$env:LOCALAPPDATA\Microsoft\Windows\PowerShell\DriveRoots\`. For each user connecting to the endpoint, a folder is created with the name `$env:USERDOMAIN_$env:USERNAME`.

To utilize the user drive and copy files to/from a JEA endpoint configured to expose the User drive, use the `-ToSession` and `-FromSession` parameters on `Copy-Item`.

PowerShell

```
# Connect to the JEA endpoint
$jeasession = New-PSSession -ComputerName 'srv01' -ConfigurationName
'UserDemo'

# Copy a file in the local folder to the remote machine.
```

```powershell
# Note: you cannot specify the file name or subfolder on the remote machine.
# You must exactly type "User:"
Copy-Item -Path .\SampleFile.txt -Destination User: -ToSession $jeasession

# Copy the file back from the remote machine to your local machine
Copy-Item -Path User:\SampleFile.txt -Destination . -FromSession $jeasession
```

You can then write custom functions to process the data stored in the user drive and make those available to users in your Role Capability file.

Support for Group Managed Service Accounts

In some cases, a task a user needs to perform in a JEA session may need to access resources beyond the local machine. When a JEA session is configured to use a virtual account, any attempt to reach such resources will appear to come from the local machine's identity, not the virtual account or connected user. In TP5, we have enabled support for running JEA under the context of a Group Managed Service Account, making it much easier to access network resources by using a domain identity.

To configure a JEA session to run under a gMSA account, use the following new key in your PSSC file:

PowerShell

```powershell
# Provide the name of your gMSA account here (don't include a trailing $)
# The local machine must be privileged to use this gMSA in Active Directory
GroupManagedServiceAccount = 'myGMSAforJEA'

# You cannot configure a JEA endpoint to use both a gMSA and virtual account
# You can leave the RunAsVirtualAccount field commented out or explicitly
set it to false
RunAsVirtualAccount = $false
```

> **Note**
>
> Group Managed Service Accounts do not afford the isolation or limited scope of virtual accounts. Every connecting user will share the same gMSA identity, which may have permissions across your entire enterprise. Be very careful when selecting to use a gMSA, and always prefer virtual accounts which are limited to the local machine when possible.

Conditional access policies

JEA is great at limiting what someone can do when they've connected to a system to manage it, but what if you also want to limit *when* someone can use JEA? We have added configuration options into the session configuration files (.pssc) to let you specify security groups to which a user must belong in order to establish a JEA session. This is especially helpful if you have a Just In Time (JIT) system in your environment, and want to make your users elevate their privileges before accessing a highly-privileged JEA endpoint.

The new *RequiredGroups* field in the PSSC file allows you to specify the logic to determine if a user can connect to JEA. It consists of specifying a hashtable (optionally nested) that uses the 'And' and 'Or' keys to construct your rules. Here are some examples of how to use this field:

PowerShell

```
# Example 1: Connecting users must belong to a security group called
"elevated-jea"
RequiredGroups = @{ And = 'elevated-jea' }

# Example 2: Connecting users must have signed on with 2 factor
authentication or a smart card
# The 2 factor authentication group name is "2FA-logon" and the smart card
group name is "smartcard-logon"
RequiredGroups = @{ Or = '2FA-logon', 'smartcard-logon' }

# Example 3: Connecting users must elevate into "elevated-jea" with their
JIT system and have logged on with 2FA or a smart card
RequiredGroups = @{ And = 'elevated-jea', @{ Or = '2FA-logon', 'smartcard-
logon' }}
```

Fixed: Virtual accounts are now supported on Windows Server 2008 R2

In WMF 5.1, you are now able to use virtual accounts on Windows Server 2008 R2, enabling consistent configurations and feature parity across Windows Server 2008 R2 - 2016. Virtual accounts remain unsupported when using JEA on Windows 7.

Improvements to Package Management in WMF 5.1

Article • 09/17/2021

The following are the fixes made in the WMF 5.1:

Version Alias

Scenario: If you have version 1.0 and 2.0 of a package, P1, installed on your system, and you want to uninstall version 1.0, you would run `Uninstall-Package -Name P1 -Version 1.0` and expect version 1.0 to be uninstalled after running the cmdlet. However the result is that version 2.0 gets uninstalled.

This occurs because the `-Version` parameter is an alias of the `-MinimumVersion` parameter. When PackageManagement is looking for a qualified package with the minimum version of 1.0, it returns the latest version. This behavior is expected in normal cases because finding the latest version is usually the desired result. However, it should not apply to the `Uninstall-Package` case.

Solution:removed `-Version` alias entirely in PackageManagement (a.k.a. OneGet) and PowerShellGet.

Multiple prompts for bootstrapping the NuGet provider

Scenario: When you run `Find-Module` or `Install-Module` or other PackageManagement cmdlets on your computer for the first time, PackageManagement tries to bootstrap the NuGet provider. It does this because the PowerShellGet provider also uses the NuGet provider to download PowerShell modules. PackageManagement then prompts the user for permission to install the NuGet provider. After the user selects "yes" for the bootstrapping, the latest version of the NuGet provider will be installed.

However, in some cases, when you have an old version of NuGet provider installed on your computer, the older version of NuGet sometimes gets loaded first into the PowerShell session (that's the race condition in PackageManagement). However PowerShellGet requires the later version of the NuGet provider to work, so PowerShellGet asks PackageManagement to bootstrap the NuGet provider again. This results in multiple prompts for bootstrapping the NuGet provider.

Solution: In WMF5.1, PackageManagement loads the latest version of the NuGet provider to avoid multiple prompts for bootstrapping the NuGet provider.

You could also work around this issue by manually deleting the old version of the NuGet provider (NuGet-Anycpu.exe) if exists from
$env:ProgramFiles\PackageManagement\ProviderAssemblies
$env:LOCALAPPDATA\PackageManagement\ProviderAssemblies

Support for PackageManagement on computers with Intranet access only

Scenario: For the enterprise scenario, people are working under an environment where there is no Internet access but Intranet only. PackageManagement did not support this case in WMF 5.0.

Scenario: In WMF 5.0, PackageManagement did not support computers that have only Intranet (but not Internet) access.

Solution: In WMF 5.1, you can follow these steps to allow Intranet computers to use PackageManagement:

1. Download the NuGet provider using another computer that has an Internet connection by using `Install-PackageProvider -Name NuGet`.

2. Find the NuGet provider under either `$env:ProgramFiles\PackageManagement\ProviderAssemblies\nuget` or `$env:LOCALAPPDATA\PackageManagement\ProviderAssemblies\nuget`.

3. Copy the binaries to a folder or network share location that the Intranet computer can access, and then install the NuGet provider with `Install-PackageProvider -Name NuGet -Source <Path to folder>`.

Event logging improvements

When you install packages, you are changing the state of the computer. In WMF 5.1, PackageManagement now logs events to the Windows event log for `Install-Package`, `Uninstall-Package`, and `Save-Package` activities. The Event log is the same as for PowerShell, that is, `Microsoft-Windows-PowerShell, Operational`.

Support for basic authentication

In WMF 5.1, PackageManagement supports finding and installing packages from a repository that requires basic authentication. You can supply your credentials to the `Find-Package` and `Install-Package` cmdlets. For example:

PowerShell

```
Find-Package -Source <SourceWithCredential> -Credential (Get-Credential)
```

Support for using PackageManagement behind a proxy

In WMF 5.1, PackageManagement now takes new proxy parameters `-ProxyCredential` and `-Proxy`. Using these parameters, you can specify the proxy URL and credentials to PackageManagement cmdlets. By default, system proxy settings are used. For example:

PowerShell

```
Find-Package -Source https://www.nuget.org/api/v2/ -Proxy
http://www.myproxyserver.com -ProxyCredential (Get-Credential)
```

Software Inventory Logging (SIL)

Article • 09/17/2021

> **Important**
>
> When installing WMF 5.x on a Windows Server 2012 R2 Server that is already running SIL, it is necessary to run the Start-SilLogging cmdlet once after the WMF install, as the installation process will errantly stop the Software Inventory Logging feature.

Software Inventory Logging helps reduce the operational costs of getting accurate information about the Microsoft software installed locally on a server, but especially across many servers in an IT environment (assuming the software is installed and running across the IT environment). Provided one is set up, you can forward this data to an aggregation server, and collect the log data in one place by using a uniform, automatic process.

While you can also log software inventory data by querying each computer directly, Software Inventory Logging, by employing a forwarding (over the network) architecture initiated by each server, can overcome server discovery challenges that are typical for many software inventory and asset management scenarios. Software Inventory Logging uses SSL to secure data that is forwarded over HTTPS to an aggregation server. Storing the data in one place makes the data easier to analyze, manipulate, and share when necessary.

None of this data is sent to Microsoft as part of the feature functionality. Software Inventory Logging data and functionality is meant for the sole use of the server software's licensed owner and administrators.

For more information and documentation about Software Inventory Logging cmdlets, see Manage Software Inventory Logging in Windows Server 2012 R2.

Product Compatibility Status

Article • 09/17/2021

Compatible

Systems that are running the following server applications **can run** Windows Management Framework 5.1:

- Microsoft SharePoint Server 2013
- Skype for Business Server 2015
- Microsoft Lync Server 2013
- System Center 2012 Configuration Manager

> **Note**
>
> Skype for Business Server 2015 compatibility with WMF 5.1 has been tested only with Windows Server 2012 R2.

Not Tested

Systems that are running the following server applications **have not tested** against Windows Management Framework 5.1:

- Microsoft SharePoint Server 2010
- System Center 2012 Virtual Machine Manager

Incompatible

Systems that are running the following server applications **should not run** Windows Management Framework 5.1:

- Microsoft Exchange Server 2013
- Microsoft Exchange Server 2010 SP3
- Microsoft Lync Server 2010
- System Center 2012 R2 Service Management Automation

Known Issues in WMF 5.0

Article • 09/17/2021

PowerShell Shortcuts are broken when used for the first time

Resolution: Perform one of the following actions:

1. Right click on the PowerShell shortcut. Select "Windows PowerShell" to launch in a non-elevated mode.
2. Right click on the PowerShell shortcut. Right click on "Windows PowerShell" and select "Run As Administrator" to launch in an elevated mode.

Once you have performed either of the above actions, the PowerShell shortcuts will work. These actions need to be performed only once.

PowerShell Modules and DSC Resources report errors about ExecutionPolicy on Windows 7

On Windows 7, using PowerShell modules and DSC resources may result in errors reported about ExecutionPolicy.

Resolution: Set the ExecutionPolicy to **RemoteSigned** by running the following command in an elevated PowerShell session (Run as Administrator):

```PowerShell
Set-ExecutionPolicy RemoteSigned
```

Connecting to an old remote Exchange endpoint causes a crash

The old Exchange endpoint redirects to a new endpoint. There is a bug in the redirection logic that results in a crash.

Resolution: Connect directly to the new endpoint.

Software Inventory Logging feature is erroneously stopped after WMF 5.0 installation on Windows Server 2012 R2

When installing WMF 5.0 on a Windows Server 2012 R2 that is already running SIL, the Software Inventory Logging feature is erroneously stopped after installation.

Resolution: Run the `Start-SilLogging` cmdlet once after the WMF installation, as the installation process will errantly stop the Software Inventory Logging feature.

`Get-ChildItem` does not work if -LiteralPath and -Recurse are used together

If a directory name contains an invalid wildcard character, then `Get-ChildItem` will not produce expected results when both -LiteralPath and -Recurse are used together.

Resolution: Not ideal, but current workaround is to implement recursion in the script rather than rely on the cmdlet.

Sysprep fails after WMF 5.0 installation

There are two workarounds for this issue depending on the version of Windows Server you are running.

Resolution:

- For systems running **Windows Server 2008 R2**

    1. Open PowerShell as an administrator

    2. Run the following command

    ```
    PowerShell

    Set-SilLogging -TargetUri https://BlankTarget -
    CertificateThumbprint 0123456789
    ```

    3. Run the command and ignore the error, as they are expected.

    ```
    PowerShell

    Publish-SilData
    ```

4. Delete the files in \Windows\System32\Logfiles\SIL\ directory

```PowerShell
Remove-Item -Recurse $env:SystemRoot\System32\Logfiles\SIL\
```

5. Install all available important Windows Updates, and begin Sysyprep operation normally.

- For systems running **Windows Server 2012**

1. After installing WMF 5.0 on the server to be Sysprep'd, login as administrator.
2. Copy Generize.xml from directory `\Windows\System32\Sysprep\ActionFiles\` to a location outside of the Windows directory, `C:\` for example.
3. Open your Generalize.xml copy with notepad.
4. Find and remove the following text, one instance of each needs to be deleted (they will be near the end of the document).

```XML
<sysprepOrder order="0x3200"></sysprepOrder>
<sysprepOrder order="0x3300"></sysprepOrder>
```

5. Save the edited copy of Generalize.xml and close the file.
6. Open a command prompt as administrator
7. Run the following command to take ownership of the Generalize.xml file in system32 folder:

```PowerShell
Takeown /f C:\Windows\System32\Sysprep\ActionFiles\Generalize.xml
```

8. Run the following command to set appropriate permission on the file:

```PowerShell
Cacls C:\Windows\System32\ Sysprep\ActionFiles\Generalize.xml /G
`<AdministratorUserName>`:F
```

   - Answer Yes at the prompt for confirmation.

- Note that `<AdministratorUserName>` should be replaced by the username who is administrator on the machine. For example, "Administrator".

9. Copy the file you edited and saved over to the Sysprep directory using the following command:

```
PowerShell

xcopy C:\Generalize.xml
C:\Windows\System32\Sysprep\ActionFiles\Generalize.xml
```

   - Answer Yes to overwrite (note that if there is no prompt to overwrite, double check the path entered).
   - Assumes your edited copy of Generalize.xml was copied to C:\ .

10. Generalize.xml is now updated with the workaround. Please run Sysprep with the generalize option enabled.

Known Issues in WMF 5.1

Article • 09/17/2021

Starting PowerShell shortcut as Administrator

Upon installing WMF, if you try to start PowerShell as administrator from the shortcut, you may get an "Unspecified error" message. Reopen the shortcut as non-administrator and the shortcut now works even as administrator.

Pester

In this release, there are two issues you should be aware of when using Pester on Nano Server:

- Running tests against Pester itself can result in some failures because of differences between FULL CLR and CORE CLR. In particular, the **Validate** method is not available on the **XmlDocument** type. Six tests which attempt to validate the schema of the NUnit output logs are known to fail.
- One code coverage test fails because the **WindowsFeature** DSC Resource does not exist in Nano Server. However, these failures are generally benign and can safely be ignored.

Operation Validation

- `Update-Help` fails for Microsoft.PowerShell.Operation.Validation module due to non-working help URI

DSC after uninstall WMF

- Uninstalling WMF does not delete DSC MOF documents from the configuration folder. DSC won't work properly if the MOF documents contain newer properties which are not available on the older systems. In this case, run the following script from elevated PowerShell console to clean up the DSC states.

  PowerShell

  ```
  $PreviousDSCStates = @("$env:windir\system32\configuration\*.mof",
    "$env:windir\system32\configuration\*.mof.checksum",
    "$env:windir\system32\configuration\PartialConfiguration\*.mof",
  ```

```
"$env:windir\system32\configuration\PartialConfiguration\*.mof.checksum
"
)
$PreviousDSCStates | Remove-Item -ErrorAction SilentlyContinue -Verbose
```

JEA Virtual Accounts

JEA endpoints and session configurations configured to use virtual accounts in WMF 5.0 will not be configured to use a virtual account after upgrading to WMF 5.1. This means that commands run in JEA sessions will run under the connecting user's identity instead of a temporary administrator account, potentially preventing the user from running commands which require elevated privileges. To restore the virtual accounts, you need to unregister and re-register any session configurations that use virtual accounts.

PowerShell

```
# Find the JEA endpoint by its name
$jea = Get-PSSessionConfiguration -Name MyJeaEndpoint

# Copy the cached PSSC file so it can be re-registered
$pssc = Copy-Item $jea.ConfigFilePath $env:temp -PassThru

# Unregister the current PSSC
Unregister-PSSessionConfiguration -Name $jea.Name

# Re-register the PSSC
Register-PSSessionConfiguration -Name $jea.Name -Path $pssc.FullName -Force

# Ensure the access policies remain the same
Set-PSSessionConfiguration -Name $newjea.Name -SecurityDescriptorSddl
$jea.SecurityDescriptorSddl
```

Desired State Configuration (DSC) Known Issues and Limitations

Article • 09/17/2021

Breaking Change: Certificates used to encrypt/decrypt passwords in DSC configurations may not work after installing WMF 5.0 RTM

In WMF 4.0 and WMF 5.0 Preview releases, DSC would not allow passwords in the configuration to be of length more than 121 characters. DSC was forcing to use short passwords even if lengthy and strong password was desired. This breaking change allows passwords to be of arbitrary length in the DSC configuration.

Resolution: Re-create the certificate with Data Encipherment or Key Encipherment Key usage, and Document Encryption Enhanced Key usage (1.3.6.1.4.1.311.80.1). For more information, see Protect-CmsMessage.

DSC cmdlets may fail after installing WMF 5.0 RTM

`Start-DscConfiguration` and other DSC cmdlets may fail after installing WMF 5.0 RTM with the following error:

Output

```
LCM failed to retrieve the property PendingJobStep from the object of class
dscInternalCache .
+ CategoryInfo : ObjectNotFound: (root/Microsoft/...gurationManager:String)
[], CimException
+ FullyQualifiedErrorId : MI RESULT 6
+ PSComputerName : localhost
```

Resolution: Delete DSCEngineCache.mof by running the following command in an elevated PowerShell session (Run as Administrator):

PowerShell

```
Remove-Item -Path $env:SystemRoot\system32\Configuration\DSCEngineCache.mof
```

DSC cmdlets may not work if WMF 5.0 RTM is installed on top of WMF 5.0 Production Preview

Resolution: Run the following command in an elevated PowerShell session (run as administrator):

```
PowerShell

mofcomp $env:windir\system32\wbem\DscCoreConfProv.mof
```

LCM can go into an unstable state while using Get-DscConfiguration in DebugMode

If LCM is in DebugMode, pressing CTRL+C to stop the processing of `Get-DscConfiguration` can cause LCM to go into an unstable state such that majority of DSC cmdlets won't work.

Resolution: Don't press CTRL+C while debugging `Get-DscConfiguration` cmdlet.

Stop-DscConfiguration may not respond in DebugMode

If LCM is in DebugMode, `Stop-DscConfiguration` may not respond while trying to stop an operation started by `Get-DscConfiguration`

Resolution: Finish the debugging of the operation started by `Get-DscConfiguration` as outlined in Debugging DSC resources.

No Verbose Error Messages are shown in DebugMode

If LCM is in **DebugMode**, no verbose error messages are displayed from DSC Resources.

Resolution: Disable **DebugMode** to see verbose messages from the resource

Invoke-DscResource operations cannot be retrieved by Get-DscConfigurationStatus cmdlet

After using `Invoke-DscResource` cmdlet to directly invoke any resource's methods, the records of such operation cannot be retrieved through `Get-DscConfigurationStatus`.

Resolution: None.

Get-DscConfigurationStatus returns pull cycle operations as type Consistency

When a node is set to PULL refresh mode, for each pull operation performed, `Get-DscConfigurationStatus` cmdlet reports the operation type as **Consistency** instead of *Initial*

Resolution: None.

Invoke-DscResource cmdlet does not return message in the order they were produced

The `Invoke-DscResource` cmdlet does not return verbose, warning, and error messages in the order they were produced by LCM or the DSC resource.

Resolution: None.

DSC Resources cannot be debugged easily when used with Invoke-DscResource

When LCM is running in debug mode, `Invoke-DscResource` cmdlet does not give information about runspace to connect to for debugging. For more information, see Debugging DSC resources.

Resolution: Discover and attach to the runspace using cmdlets `Get-PSHostProcessInfo`, `Enter-PSHostProcess` , `Get-Runspace` and `Debug-Runspace` to debug the DSC resource.

```
PowerShell
```

```
# Find all the processes hosting PowerShell
Get-PSHostProcessInfo

ProcessName    ProcessId AppDomainName
-----------    --------- -------------
powershell          3932 DefaultAppDomain
powershell_ise      2304 DefaultAppDomain
WmiPrvSE            3396 DscPsPluginWkr_AppDomain

# Enter the process that is hosting DSC engine (WMI process with
DscPsPluginWkr_Appdomain)
Enter-PSHostProcess -Id 3396 -AppDomainName DscPsPluginWkr_AppDomain

# Find all the available rusnspaces in that process
Get-Runspace

Id Name       ComputerName Type  State  Availability
-- ----       ------------ ----  -----  ------------
 2 Runspace2  localhost    Local Opened InBreakpoint
 5 RemoteHost localhost    Local Opened Busy

# Debug the runspace that is in **InBreakpoint** availability state
Debug-Runspace -Id 2
```

Various Partial Configuration documents for same node cannot have identical resource names

For several partial configurations that are deployed onto a single node, identical names of resources cause run time error.

Resolution: Use different names for even same resources in different partial configurations.

Start-DscConfiguration –UseExisting does not work with -Credential

When using `Start-DscConfiguration` with **UseExisting** parameter, the **Credential** parameter is ignored. DSC uses default process identity to proceed the operation. This causes error when a different credential is needed to proceed on remote node.

Resolution: Use CIM session for remote DSC operations:

PowerShell

```
$session = New-CimSession -ComputerName $node -Credential $credential
Start-DscConfiguration -UseExisting -CimSession $session
```

IPv6 Addresses as Node Names in DSC configurations

IPv6 addresses as node names in DSC configuration scripts are not supported in this release.

Resolution: None.

Debugging of `Class-Based` DSC Resources

Debugging of class-based DSC Resources is not supported in this release.

Resolution: None.

Variables and functions defined in $script scope in DSC Class-Based Resource are not preserved across multiple calls to a DSC Resource

Multiple consecutive calls to `Start-DSCConfiguration` fails if the configuration is using any class-based resource which has variables or functions defined in `$script` scope.

Resolution: Define all variables and functions in DSC Resource class itself. No `$script` scope variables/functions.

DSC Resource Debugging when a resource is using PSDscRunAsCredential

DSC Resource debugging when a resource is using the **PSDscRunAsCredential** property in the configuration is not supported in this release.

Resolution: None.

PsDscRunAsCredential is not supported for DSC Composite Resources

Resolution: Use Credential property if available. Example ServiceSet and WindowsFeatureSet

Get-DscResource -Syntax does not reflect PsDscRunAsCredential correctly

The **Syntax** parameter does not reflect **PsDscRunAsCredential** correctly when resource marks it as mandatory or does not support it.

Resolution: None. However, authoring configuration in ISE reflects correct metadata about **PsDscRunAsCredential** property when using IntelliSense.

WindowsOptionalFeature is not available in Windows 7

The **WindowsOptionalFeature** DSC resource is not available in Windows 7. This resource requires the DISM module, and DISM cmdlets that are available starting in Windows 8 and newer releases of the Windows operating system.

For Class-based DSC resources, Import-DscResource -ModuleVersion may not work as expected

If the compilation node has multiple versions of a class-based DSC resource module, `Import-DscResource -ModuleVersion` does not pick the specified version and results in following compilation error.

Output

```
ImportClassResourcesFromModule : Exception calling
"ImportClassResourcesFromModule" with "3" argument(s):
 "Keyword 'MyTestResource' already defined in the configuration."
At
C:\Windows\system32\WindowsPowerShell\v1.0\Modules\PSDesiredStateConfigurati
on\PSDesiredStateConfiguration.psm1:2035 char:35
+ ... rcesFound = ImportClassResourcesFromModule -Module $mod -Resources $r
...
+                 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
    + CategoryInfo          : NotSpecified: (:)
[ImportClassResourcesFromModule], MethodInvocationException
    + FullyQualifiedErrorId :
PSInvalidOperationException,ImportClassResourcesFromModule
```

Resolution: Import the required version by defining the **ModuleSpecification** object to the **ModuleName** parameter with **RequiredVersion** key specified as follows:

```PowerShell
Import-DscResource -ModuleName
@{ModuleName='MyModuleName';RequiredVersion='1.2'}
```

Some DSC resources like registry resource may start to take a long time to process the request.

Resolution 1: Create a schedule task that cleans up the following folder periodically.

```PowerShell
$env:windir\system32\config\systemprofile\AppData\Local\Microsoft\Windows\PowerShell\CommandAnalysis
```

Resolution 2: Change the DSC configuration to clean up the *CommandAnalysis* folder at the end of the configuration.

```PowerShell
Configuration $configName
{

   # User Data
    Registry SetRegisteredOwner
    {
        Ensure = 'Present'
        Force = $True
        Key = $Node.RegisteredKey
        ValueName = $Node.RegisteredOwnerValue
        ValueType = 'String'
        ValueData = $Node.RegisteredOwnerData
    }
    #
    # Script to delete the config
    #
    script DeleteCommandAnalysisCache
    {
        DependsOn = "[Registry]SetRegisteredOwner"
        getscript = "@{}"
        testscript = 'Remove-Item -Path
$env:windir\system32\config\systemprofile\AppData\Local\Microsoft\Windows\PowerShell\CommandAnalysis -Force -Recurse -ErrorAction SilentlyContinue -
```

```
ErrorVariable ev | out-null;$true'
        setscript = '$true'
    }
}
```

Starting Windows PowerShell

Article • 05/04/2023

Windows PowerShell is a scripting engine `.DLL` that's embedded into multiple hosts. The most common hosts you'll start are the interactive command-line `powershell.exe` and the Interactive Scripting Environment `powershell_ise.exe`.

To start Windows PowerShell on Windows Server 2012 R2, Windows 8.1, Windows Server 2012, and Windows 8, see Common Management Tasks and Navigation in Windows.

PowerShell has renamed binary

PowerShell version 6 and higher uses .NET Core. Supported versions are available on Windows, macOS, and Linux.

Beginning in PowerShell 6, the PowerShell binary was renamed `pwsh.exe` for Windows and `pwsh` for macOS and Linux. You can start PowerShell preview versions using `pwsh-preview`. For more information, see About pwsh.

To find cmdlet reference and installation documentation for PowerShell 7, use the following links:

Document	Link
Cmdlet reference	PowerShell Module Browser
Windows installation	Installing PowerShell on Windows
macOS installation	Installing PowerShell on macOS
Linux installation	Installing PowerShell on Linux

To view content for other PowerShell versions, see How to use the PowerShell documentation.

How to Start Windows PowerShell on Earlier Versions of Windows

This section explains how to start Windows PowerShell and Windows PowerShell Integrated Scripting Environment (ISE) on Windows 7, Windows Server 2008 R2, and Windows Server 2008. It also explains how to enable the optional feature for Windows

PowerShell ISE in Windows PowerShell 2.0 on Windows Server 2008 R2 and Windows Server 2008.

Use any of the following methods to start the installed version of Windows PowerShell 3.0, or Windows PowerShell 4.0, where applicable.

From the Start Menu

- Click **Start**, type **PowerShell**, and then click **Windows PowerShell**.
- From the **Start** menu, click **Start**, click **All Programs**, click **Accessories**, click the **Windows PowerShell** folder, and then click **Windows PowerShell**.

At the Command Prompt

In Windows Command shell, Windows PowerShell, or Windows PowerShell ISE, to start Windows PowerShell, type: `PowerShell`.

You can also use the parameters of the `powershell.exe` program to customize the session. For more information, see PowerShell.exe Command-Line Help.

With Administrative privileges (Run as administrator)

Click **Start**, type **PowerShell**, right-click **Windows PowerShell**, and then click **Run as administrator**.

How to Start Windows PowerShell ISE on Earlier Releases of Windows

Use any of the following methods to start Windows PowerShell ISE.

From the Start Menu

- Click **Start**, type **ISE**, and then click **Windows PowerShell ISE**.
- From the **Start** menu, click **Start**, click **All Programs**, click **Accessories**, click the **Windows PowerShell** folder, and then click **Windows PowerShell ISE**.

At the Command Prompt

In Windows Command shell, Windows PowerShell, or Windows PowerShell ISE, to start Windows PowerShell, type: `PowerShell_ISE`. In Windows PowerShell, you can use the

alias `ise`.

With Administrative privileges (Run as administrator)

Click **Start**, type **ISE**, right-click **Windows PowerShell ISE**, and then click **Run as administrator**.

How to Enable Windows PowerShell ISE on Earlier Releases of Windows

In Windows PowerShell 4.0 and Windows PowerShell 3.0, Windows PowerShell ISE is enabled by default on all versions of Windows. If it isn't already enabled, Windows Management Framework 4.0 or Windows Management Framework 3.0 enables it.

In Windows PowerShell 2.0, Windows PowerShell ISE is enabled by default on Windows 7. However, on Windows Server 2008 R2 and Windows Server 2008, it's an optional feature.

To enable Windows PowerShell ISE in Windows PowerShell 2.0 on Windows Server 2008 R2 or Windows Server 2008, use the following procedure.

To enable Windows PowerShell Integrated Scripting Environment (ISE)

1. Start Server Manager.
2. Click **Features** and then click **Add Features**.
3. In Select Features, click Windows PowerShell Integrated Scripting Environment (ISE).

Starting the 32-Bit Version of Windows PowerShell

When you install Windows PowerShell on a 64-bit computer, **Windows PowerShell (x86)**, a 32-bit version of Windows PowerShell is installed in addition to the 64-bit version. When you run Windows PowerShell, the 64-bit version runs by default.

However, you might occasionally need to run **Windows PowerShell (x86)**, such as when you're using a module that requires the 32-bit version or when you're connecting remotely to a 32-bit computer.

To start a 32-bit version of Windows PowerShell, use any of the following procedures.

In Windows Server 2012 R2

- On the **Start** screen, type **Windows PowerShell (x86)**. Click the **Windows PowerShell x86** tile.
- In **Server Manager**, from the **Tools** menu, select **Windows PowerShell (x86)**.
- On the desktop, move the cursor to the upper right corner, click **Search**, type **PowerShell x86** and then click **Windows PowerShell (x86)**.
- Via command line, enter:
  `%SystemRoot%\SysWOW64\WindowsPowerShell\v1.0\powershell.exe`

In Windows 8.1

- On the **Start** screen, type **Windows PowerShell (x86)**. Click the **Windows PowerShell x86** tile.
- If you're running Remote Server Administration Tools for Windows 8.1, you can also open Windows PowerShell x86 from the **Server ManagerTools** menu. Select **Windows PowerShell (x86)**.
- On the desktop, move the cursor to the upper right corner, click **Search**, type **PowerShell x86** and then click **Windows PowerShell (x86)**.
- Via command line, enter:
  `%SystemRoot%\SysWOW64\WindowsPowerShell\v1.0\powershell.exe`

Using the Windows PowerShell 2.0 Engine

Article • 10/07/2021

Windows PowerShell is designed to be backward compatible with previous versions. Cmdlets, providers, snap-ins, modules, and scripts written for Windows PowerShell 2.0 run unchanged in newer versions Windows PowerShell. However, Microsoft .NET Framework 4 changed the runtime activation policy. Windows PowerShell host programs written for Windows PowerShell 2.0 and compiled with Common Language Runtime (CLR) 2.0 cannot run without modification in new versions Windows PowerShell that are compiled with CLR 4.0 (or higher).

The Windows PowerShell 2.0 Engine is intended to be used only when an existing script or host program cannot run because it is incompatible with Windows PowerShell 5.1. Examples of this include older versions of Exchange or SQL Server modules. Such cases are expected to be rare.

Many programs that require the Windows PowerShell 2.0 Engine start it automatically. These instructions are included for the rare situations in which you need to start the engine manually.

Deprecation and security concerns

Windows PowerShell 2.0 was deprecated in August, 2017. For more information, see the announcement on the PowerShell blog.

Windows PowerShell 2.0 is missing a significant amount of the hardening and security features added in versions 3, 4, and 5. We highly, highly recommend that users not use it if they can help it. For more information, see A Comparison of Shell and Scripting Language Security and PowerShell ♥ the Blue Team.

Installing and Enabling Required Programs

Before starting the Windows PowerShell 2.0 Engine, enable the Windows PowerShell 2.0 Engine and Microsoft .NET Framework 3.5 with Service Pack 1. For instructions, see Installing Windows PowerShell.

Systems on which Windows Management Framework 3.0 or higher is installed have all of the required components. No further configuration is necessary. For information about installing Windows Management Framework, see Install and configure WMF.

How to start the Windows PowerShell 2.0 Engine

When you start Windows PowerShell the newest version starts by default. To start Windows PowerShell with the Windows PowerShell 2.0 Engine, use the Version parameter of `PowerShell.exe`. You can run the command at any command prompt, including Windows PowerShell and Cmd.exe.

```
PowerShell.exe -Version 2
```

How to start a remote session with the Windows PowerShell 2.0 Engine

To run the Windows PowerShell 2.0 Engine in a remote session, create a session configuration (also known as an *endpoint*) on the remote computer that loads the Windows PowerShell 2.0 Engine. The session configuration is saved on the remote computer and can be used by any authorized user to create sessions that use the Windows PowerShell 2.0 Engine.

This is an advanced task that is typically performed by a system administrator.

The following procedure uses the **PSVersion** parameter of the Register-PSSessionConfiguration cmdlet to create a session configuration that uses the Windows PowerShell 2.0 Engine. You can also use the **PowerShellVersion** parameter of the New-PSSessionConfigurationFile cmdlet to create a session configuration file for a session that loads the Windows PowerShell 2.0 Engine and you can use the **PSVersion** parameter of the Set-PSSessionConfiguration parameter to change a session configuration to use the Windows PowerShell 2.0 Engine.

For more information about session configuration files, see about_Session_Configuration_Files. For information about session configurations, including setup and security, see about_Session_Configurations.

To start a remote Windows PowerShell 2.0 session

1. To create a session configuration that requires the Windows PowerShell 2.0 Engine, use the **PSVersion** parameter of the `Register-PSSessionConfiguration` cmdlet with

a value of `2.0`. Run this command on the computer at the "server side" or receiving end of the connection.

The following sample command creates the PS2 session configuration on the Server01 computer. To run this command, start Windows PowerShell with the **Run as administrator** option.

```
PowerShell

Register-PSSessionConfiguration -Name PS2 -PSVersion 2.0
```

2. To create a session on the Server01 computer that uses the PS2 session configuration, use the **ConfigurationName** parameter of cmdlets that create a remote session, such as the `New-PSSession cmdlet.

   When a session that uses the session configuration starts, the Windows PowerShell 2.0 Engine is automatically loaded into the session.

   The following command starts a session on the Server01 computer that uses the PS2 session configuration. The command saves the session in the `$s` variable.

```
PowerShell

$s = New-PSSession -ComputerName Server01 -ConfigurationName PS2
```

How to start a background job with the Windows PowerShell 2.0 Engine

To start a background job with the Windows PowerShell 2.0 Engine, use the **PSVersion** parameter of the Start-Job cmdlet.

The following command starts a background job with the Windows PowerShell 2.0 Engine

```
PowerShell

Start-Job {Get-Process} -PSVersion 2.0
```

For more information about background jobs, see about_Jobs.

PowerShell Desired State Configuration (DSC) Overview

Article • 02/02/2023

DSC is a management platform in PowerShell that enables you to manage your IT and development infrastructure with configuration as code.

There are three versions of DSC available:

- DSC 1.1 is the legacy version of DSC that originally shipped in Windows PowerShell 5.1.
- DSC 2.0 is the version of DSC that shipped in PowerShell 7.

  With the release of PowerShell 7.2, the **PSDesiredStateConfiguration** module is no longer included in the PowerShell package. Separating DSC into its own module allows us to invest and develop DSC independent of PowerShell and reduces the size of the PowerShell package. Users of DSC will enjoy the benefit of upgrading DSC without the need to upgrade PowerShell, accelerating time to deployment of new DSC features. Users that want to continue using DSC v2 can download **PSDesiredStateConfiguration** 2.0.5 from the PowerShell Gallery.
- DSC 3.0 is the new version of DSC. This version is a preview release that is still being developed. Users working with non-Windows environments can expect cross-platform features in DSC 3.0. DSC 3.0 is the version that is supported by the machine configuration feature of Azure Automanage.

The documentation for DSC has been moved to a new location so that we can manage the DSC version-specific information separate from the versions of PowerShell.

See the new documentation in Desired State Configuration 2.0.

The PowerShell Gallery

Article • 04/13/2023

The PowerShell Gallery is the central repository for PowerShell content. In it, you can find PowerShell scripts, modules containing PowerShell cmdlets and Desired State Configuration (DSC) resources. Some of these packages are authored by Microsoft, and others are authored by the PowerShell community.

The **PowerShellGet** module contains cmdlets for discovering, installing, updating, and publishing PowerShell packages from the PowerShell Gallery. These packages can contain artifacts such as Modules, DSC Resources, Role Capabilities, and Scripts. Make sure you have the latest version of **PowerShellGet** installed.

The documentation for **PowerShellGet** and the PowerShell Gallery has been moved to a new location so that we can manage the version-specific information separate from the versions of PowerShell.

See the new documentation in PowerShellGet and the PowerShell Gallery.

Community Update

A list of resources and a summary of new articles and community contributions.

What's new in Docs?

WHAT'S NEW

2023 Updates

2022 Updates

2021 Updates

2020 Updates

Contributor Hall of Fame

Learning resources

TRAINING

PowerShell 101

Deep Dives

PowerShell Learn modules

VIDEO

Microsoft Virtual Academy videos

Jason Helmick's - The Show

The PSConfEU Channel

The PowerShell.org Channel

Community resources

OVERVIEW

Community support

DOWNLOAD

Digital art

REFERENCE

PowerShell 7 usage stats

Top contributors to PowerShell

Getting support from the community

Article • 11/17/2022

The PowerShell Community is a vibrant and active group of users. This article can help you get connected with other member of the community.

The PowerShell community can file issues, bugs, or feature requests in our GitHub repository. If you have questions, you may find help from other members of the community in one of these public forums:

- User Groups
- PowerShell Tech Community
- DSC Community
- PowerShell.org
- StackOverFlow
- r/PowerShell subreddit
- PowerShell Virtual User Group - join via:
  - Slack
  - Discord

For information about our support policy, see the PowerShell Support Lifecycle.

Community Contributor Hall of Fame

Article • 06/01/2023

The PowerShell Community is a vibrant and collaborative group. We greatly appreciate all the help and support we get from the community. You can be a contributor too. To learn how, read our Contributor's Guide.

These GitHub users are the All-Time Top Community Contributors.

Pull Requests merged

Pull Requests help us fix those issues and make the documentation better for everyone.

PRs Merged	2015	2016	2017	2018	2019	2020	2021	2022	2023	Grand Total
Community	3	194	446	464	318	161	100	122	52	1860
matt9ucci			157	80	30	1	6			274
nschonni				14	138	10				162
kiazhi		25	79	12						116
alexandair		57	7	26	2	1				93
doctordns		5	32	20	7	9	5		1	79
sethvs			1	43		20	1	10		75
ehmiiz								22	7	29
yecril71pl						21	3	3		27
Dan1el42		20								20
NReilingh		2		13	3					18
it-praktyk				16	1					17
skycommand			1	3	3	6		1	2	16
vors		15	1							16
kvprasoon		2	1	7	2	2	2			16
markekraus			11	5						16

PRs Merged	2015	2016	2017	2018	2019	2020	2021	2022	2023	Grand Total
purdo17				13						13
k-takai				5	1	7				13
PlagueHO		10			1					11
bergmeister			1	3	3	1	1	1	1	11
exchange12rocks			7	3			1			11

GitHub issues opened

GitHub issues help us identify errors and gaps in our documentation.

Issues Opened	2015	2016	2017	2018	2019	2020	2021	2022	2023	Grand Total
Community	3	54	95	212	564	560	366	226	108	2188
mklement0			19	60	56	61	28	8	10	242
iSazonov			1	4	10	8	4	3		30
ehmiiz								20	7	27
jszabo98				2	15	6	1		1	25
juvtib						15	7			22
doctordns			5	3	5	7	1			21
vexx32				3	11			3		17
peetrike				1		4	2	6	2	15
KirkMunro				7	7	1				15
alexandair		9	4	2						15
clamb123							14			14
trollyanov							11	1		12
rkeithhill			1	2	2	2	3	1	1	12
iRon7						2	2	2	6	12
JustinGrote				1	3	6	1	1		12

Issues Opened	2015	2016	2017	2018	2019	2020	2021	2022	2023	Grand Total
CarloToso									10	10
UberKluger						1	7	2		10
vors	1	6	2	1						10
LaurentDardenne			3	2				5		10
kilasuit					3	2	1	4		10

What's new in PowerShell Docs for 2023

Article • 06/01/2023

This article lists notable changes made to docs each month and celebrates the contributions from the community.

Help us make the documentation better for you. Read the Contributor's Guide to learn how to get started.

2023-May

New content

- New cmdlet in 7.4 - Get-SecureRandom
- Using Windows Defender Application Control

Updated content

- How to use the PowerShell documentation
  - Added descriptions for various navigation elements on the site
  - Added information about how to use the new **Download PDF** feature
- Exploring the Windows PowerShell ISE
  - Added screenshots for the ISE user interface elements
- Update documentation for Add-Member
  - Corrected some parameter values
  - Improved the description and added examples for the **SecondValue** parameter

Quality Project contributions

- @robderickson contributed 1 PR to update 10 files in the MicrosoftDocs/windows-docs-powershell repository

Top Community Contributors

GitHub stats

- 38 PRs merged (7 from Community)
- 24 issues opened (18 from Community)
- 20 issues closed (17 Community issues closed)

The following people contributed to PowerShell docs this month by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
rwp0	1	
pronichkin	1	
Ooggle	1	
mavaddat	1	
IanKemp	1	
mcdonaldjc	1	
Brizio	1	
dotnvo	1	
r0bfr	1	
mklement0		3
aksarben		2
crisman		2

2023-April

New content

- Handling errors in Crescendo
- Transforming arguments in Crescendo

Updated content

- Updated release notes for PowerShell 7.4-preview.3
- Migrated the PowerShell Gallery and PowerShellGet docs to new location to enable version selectors for PowerShellGet

PowerShell Summit 2023 - Hack-a-Doc event

- We hosted a Hack-a-Doc event on April 27th. Special thanks to the following 19 people. They contributed 62 PRs to update 204 files in the MicrosoftDocs/windows-powershell-docs repository.

GitHub Id	name	Count of PRs	Count of file
RobBiddle	Robert Biddle	28	48

GitHub Id	name	Count of PRs	Count of file
pbossman	Phil Bossman	1	27
ThomasNieto	Thomas Nieto	1	24
kevinCefalu	Kevin Cefalu	1	24
robderickson	Rob Derickson	4	17
Snozzberries	Michael Soule	13	16
Spoonsk	Joseph Gast	1	12
thedavecarroll	Dave Carroll	1	11
raynbowbrite	Vanda Paladino	2	7
majst32	Melissa Januszko	1	6
XXLMandalorian013	Drew McClellan	1	4
ThePoShWolf	Anthony Howell	1	1
mdowst	Matthew Dowst	1	1
thepowerstring		1	1
KevinMarquette	Kevin Marquette	1	1
53883		1	1
zockan	Michael Svegmar	1	1
lanwench	Paula Kingsley	1	1
stevenjudd	Steven Judd	1	1
Grand Total		62	204

Top Community Contributors

GitHub stats

- 23 PRs merged (2 from Community)
- 16 issues opened (14 from Community)
- 17 issues closed (15 Community issues closed)

The following people contributed to PowerShell docs this month by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
NLZ	1	
Jonathan-Quilter	1	

2023-March

New content

- Create a class-based DSC Resource for Machine Configuration
- Using PSReadLine key handlers

Updated content

- Release notes for PowerShell 7.4-preview.2

Quality project updates from the community

- One of our top contributors @ehmiiz blogged about contributing to Docs
  - How to Learn Git, Markdown and PowerShell by Contributing to the PowerShell-Docs Repository

Top Community Contributors

GitHub stats

- 60 PRs merged (13 from Community)
- 44 issues opened (31 from Community)
- 50 issues closed (36 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
skycommand	2	
martincostello	1	
iRon7	1	4
chrullrich	1	
FlintyLemming	1	

GitHub Id	PRs merged	Issues opened
ehmiiz	1	
vvavrychuk	1	
bb-froggy	1	
BenjamimCS	1	
kirillkrylov	1	
bergmeister	1	
lizy14	1	
CarloToso		5
MartinGC94		2
rgl		2

2023-February

New Content

- Preventing script injection attacks (Thanks @PaulHigin)

Content updates

- Major update to about_PowerShell_Config
- Update to about_Logging_Non-Windows for macOS instructions
- Major update to Class-based DSC Resources and other related articles for DSC v2

Quality project updates from the community

- Added alias information to 4 cmdlet articles (Thanks @ehmiiz!)

Top Community Contributors

GitHub stats

- 35 PRs merged (8 from Community)
- 20 issues opened (14 from Community)
- 17 issues closed (10 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
joshua-russell	4	1
1NF053C	1	
doctordns	1	
Hrxn	1	
KyleMit	1	
VertigoRay	1	
ehmiiz	1	
ArmaanMcleod		2
mklement0		2

2023-January

New Content

- What's new in PowerShell 7.4 (preview)
- about_Data_Files

Content updates

- Updated docs for 7.4-preview.1 release
- Major update to about_Language_Modes
- Major update to about_Logging_Non-Windows

Quality project updates from the community

- Added alias information to 40 cmdlet articles (Thanks @ehmiiz !)
- Added alias information to 52 cmdlet articles (Thanks @szabolevo !)

Top Community Contributors

GitHub stats

- 71 PRs merged (21 from Community)
- 53 issues opened (33 from Community)

- 62 issues closed (40 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
ehmiiz	5	5
szabolevo	5	7
anderjef	2	
turbedi	1	
desk7	1	
cobrabr	1	
ZYinMD	1	
tompazourek	1	
kenyon	1	
cjvandyk	1	
JTBrinkmann	1	
mklement0		4
CarloToso		3
KyleMit		2
iRon7		2

What's new in PowerShell Docs for 2022

Article • 06/28/2023

This article lists notable changes made to docs each month and celebrates the contributions from the community.

Help us make the documentation better for you. Read the Contributor's Guide to learn how to get started.

2022-December

New Content

- about_PSItem
- Configuring a light colored theme
- What's new in Crescendo 1.1
- Export-CrescendoCommand
- PowerShell 7.4 (preview) cmdlet reference - a direct copy of the 7.3 content in preparation for the preview release of PowerShell 7.4

More Quality project updates

- Added alias information to 83 cmdlet articles (Thanks @ehmiiz!)
- Added alias information to 8 cmdlet articles (Thanks @szabolevo!)

GitHub stats

- 51 PRs merged (14 from Community)
- 50 issues opened (28 from Community)
- 46 issues closed (23 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
ehmiiz	8	7
changeworld	3	
szabolevo	1	
amkhrjee	1	

GitHub Id	PRs merged	Issues opened
xtqqczze	1	3
ALiwoto	1	2
mklement0		3

2022-November

New Content

- Contributing quality improvements
  - See examples under Quality project updates
- Product terminology and branding guidelines
- Labelling in GitHub

Content updates

- Updated release notes for the PowerShell 7.3 GA release
- Updated about_Telemetry
- Improved the description of delay-binding in about_Script_Blocks
- Added a best practice recommendation to about_Functions_Advanced_Parameters

Quality project updates

- Added alias information to 129 cmdlet articles (Thanks @ehmiiz!)
- Added links to PRs in the PowerShell 7.3 release notes (Thanks @skycommand!)
- Converted hyperlinks to link references in 5 articles (Thanks @chadmando!)

GitHub stats

- 52 PRs merged (12 from Community)
- 41 issues opened (27 from Community)
- 42 issues closed (28 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
ehmiiz	9	8
chadmando	1	
baardhermansen	1	

GitHub Id	PRs merged	Issues opened
skycommand	1	
mklement0		3
peetrike		2

2022-October

New Content

- Create a class-based DSC Resource
- Hacktoberfest and other hack-a-thon events

Content updates

- Hacktoberfest 2022 cleanup efforts
  - Thank you to @ehmiiz, @TSanzo-BLE, and @chadmando for their Hacktoberfest PRs! Their 11 PRs touched 114 articles.
- Published PowerShell SDK .NET API content for PowerShell 7.2 and 7.3-preview
  - The first updates since PowerShell 7.1 released in November 2020
  - Removed the unsupported versions 6.0 and 7.1
- Added a list of aliases not available on Linux and macOS to PowerShell differences on non-Windows platforms

GitHub stats

- 65 PRs merged (21 from Community)
- 42 issues opened (28 from Community)
- 34 issues closed (23 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
ehmiiz	5	5
TSanzo-BLE	4	
yecril71pl	2	
chadmando	2	
GigaScratch	1	1

GitHub Id	PRs merged	Issues opened
rbleattler	1	
spjeff	1	
adamdriscoll	1	
manuelcarriernunes	1	
michelangelobottura	1	
dmpe	1	
KamilPacanek	1	
SetTrend		2

2022-September

No new content this month.

Content updates

- PSScriptAnalyzer 1.21 update release
- Release notes for 7.3-preview.8

GitHub stats

- 31 PRs merged (8 from Community)
- 18 issues opened (9 from Community)
- 16 issues closed (8 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
DonaldDWebster	1	
emerconghaile	1	
floojah	1	
imere	1	
mcdonaldjc	1	
rayden84	1	

GitHub Id	PRs merged	Issues opened
sirsql	1	
tig	1	
b-long		2

2022-August

New content

- New landing page for What's new content
- Shell experience docs
  - Running commands in the shell
- DSC 2.0 docs
  - Conceptual content - 15 new articles
  - PSDscResources module reference - 58 new articles

Content updates

- PowerShell VS Code docs
- Release notes for 7.3-preview.7
- Cleaned up markdown tables in About topics for better accessibility and localization

Other Projects

- Get-WhatsNew cmdlet released - This cmdlet displays release notes for all versions of PowerShell so you can see what's new for a particular version.

GitHub stats

- 57 PRs merged (16 from Community)
- 24 issues opened (12 from Community)
- 26 issues closed (15 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
sethvs	4	

GitHub Id	PRs merged	Issues opened
BEEDELLROKEJULIANLOCKHART	1	
Chemerevsky	1	
ClaudioESSilva	1	
davidhaymond	1	
DavidMetcalfe	1	
dharmatech	1	
kozhemyak	1	
mcawai	1	
NaridaL	1	
Nicicalu	1	
sdarwin	1	
seansaleh	1	

2022-July

New content

- Optimizing your shell experience
- Using tab completion
- Using command predictors
- Getting dynamic help
- Using aliases
- Customizing your shell environment

Content updates

- Updated PowerShell 7.3-preview.6 release notes
- Started reviewing and testing PowerShellGet v3 cmdlet reference (currently in beta) to ensure accuracy and release readiness.
- Refresh of our Community Contributor Guide

Top Community Contributors

GitHub stats

- 50 PRs merged (6 from Community)
- 22 issues opened (14 from Community)
- 29 issues closed (19 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
Alvynskio	1	
bergmeister	1	
BusHero	1	
lewis-yeung	1	
sethvs	1	
tommymaynard	1	

2022-June

New content migrated from GitHub wiki

- Limitations of PowerShell transcripts
- Avoid using Invoke-Expression
- Avoid assigning variables in expressions
- about_Case-Sensitivity
- Updated about_Arrays

New SecretManagement content

- Understanding the security features of SecretManagement and SecretStore
- Using the SecretStore in automation
- Using Azure Key Vault in automation

Content updates

- Updated release notes for 7.3-preview.5 and PSReadLine 2.2.6

Top Community Contributors

GitHub stats

- 44 PRs merged (8 from Community)

- 23 issues opened (14 from Community)
- 23 issues closed (13 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
mcdonaldjc	2	1
radrow	1	
yecril71pl	1	
muhahaaa	1	
windin7cc	1	
fabiod89	1	
NaridaL	1	

2022-May

New content

- Create a Crescendo configuration using the Crescendo cmdlets
- Overview of the SecretManagement and SecretStore modules
- Get started with the SecretStore module
- Understanding the SecretManagement module
- Managing a SecretStore vault

Content updates

- Renamed the `staging` branch to `main`
- Updated the Table of Contents for easier discovery
  - Moved Support Lifecycle to the top level
  - Moved Contributor Guide to the top level
- 7.3-preview.4 release notes
- Bulk formatting cleanup for many docs
  - PowerShell-Docs content - 272 files
  - Secrets management - 17 files
- Updated the PSScriptAnalyzer README and deleted docs that were migrated to Microsoft Learn
- Removed CentOS and Fedora from docs - no longer supported

- Retired 7.1 content - no longer supported
  - Collapse release notes into diff article
  - Delete or move content to archive repo

Top Community Contributors

GitHub stats

- 53 PRs merged (12 from Community)
- 38 issues opened (21 from Community)
- 39 issues closed (26 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
tommymaynard	5	
naveensrinivasan	2	
rikurauhala	1	
joshua6point0	1	
rhorber	1	
Raton-Laveur	1	
StephenRoille	1	
krlinus		2

2022-April

New content

- No new content this month

Content updates

- Rewrote the install instructions for PowerShellGet
- Created separate article for Installing PowerShellGet on older Windows systems

Other projects

- PowerShell + DevOps Summit April 25-28

    - Gave presentation about contributing to Docs
    - Lightning demo about argument completers
    - Interview for the PowerShell Podcast

Top Community Contributors

GitHub stats

- 24 PRs merged (3 from Community)
- 22 issues opened (17 from Community)
- 21 issues closed (15 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
Hrxn	1	
kevinholtkamp	1	
MikeyBronowski	1	
tommymaynard		4

2022-March

New Content

- New PowerShell docs
    - about_Member-Access_Enumeration
    - about_Module_Manifests
    - How to create a command-line predictor
- Utility modules updates
    - New docs for Crescendo release
        - Install Crescendo
        - Choose a command-line tool
        - Decide which features to amplify
        - Create a Crescendo cmdlet
        - Generate and test a Crescendo module
    - Moved PlatyPS article from PowerShell docs to the PlatyPS documentation
        - Moved PlatyPS article

    - Migrated more PSScriptAnalyzer documentation from the source code repository
        - Using PSScriptAnalyzer
        - Rules and recommendations
        - Creating custom rules

Content updates

- Bulk cleanup of related links in About_ topics
- Added issue and PR templates to all docs repos
- Updates for 7.3 preview content
    - New tab completions
    - Support for SSH options on remoting cmdlets
    - New experimental feature `PSAMSIMethodInvocationLogging`

Other projects

- Created a prototype cmdlet `Get-WhatsNew` based on the draft RFC
    - Check out the RFC and provide feedback

New team member

- Welcome Mikey Lombardi to the docs team

Top Community Contributors

GitHub stats

- 49 PRs merged (8 from Community)
- 26 issues opened (14 from Community)
- 33 issues closed (18 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
AspenForester	1	
codaamok	1	
DianaKuzmenko	1	
MikeyBronowski	1	
poshdude	1	

GitHub Id	PRs merged	Issues opened
robcmo	1	
sertdfyguhi	1	
stampycode	1	

2022-February

New Content

- about_Calling_Generic_Methods

Content updates

- Catching up on issues
- Updates for 7.3 preview content

Top Community Contributors

GitHub stats

- 22 PRs merged (3 from Community)
- 24 issues opened (19 from Community)
- 18 issues closed (16 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
sethvs	2	
guilhermgonzaga	1	

2022-January

New Content

- No new content. We're down to one writer for PowerShell. I was out of the office for half of December for vacation then half of January for COVID.

Content updates

- Catching up on issues
- Updates for 7.3 preview content

Top Community Contributors

GitHub stats

- 51 PRs merged (10 from Community)
- 29 issues opened (26 from Community)
- 46 issues closed (39 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
sethvs	3	
UberKluger	1	
MiguelDomingues	1	
reZach	1	
Hertz-Hu	1	
julian-hansen	1	
Hrxn	1	
peteraritchie	1	

What's new in PowerShell Docs for 2021

Article • 02/02/2023

This article lists notable changes made to docs each month and celebrates the contributions from the community.

Help us make the documentation better for you. Read the Contributor's Guide to learn how to get started.

2021-December

New Content

- Added PowerShell 7.3-preview.1 [preview content]
- New DSC 3.0 content
  - PowerShell Desired State Configuration overview
  - Manage configuration using PowerShell DSC
  - DSC Configurations
  - DSC Resources

Content updates

- Moved Desired State Configuration content to new docset and repository
  - DSC is now being developed outside of the PowerShell product.
  - The move allows for better versioning of documentation for DSC.

Top Community Contributors

GitHub stats

- 24 PRs merged (4 from Community)
- 30 issues opened (26 from Community)
- 12 issues closed (7 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
dAu6jARL	1	
shriharshmishra	1	

GitHub Id	PRs merged	Issues opened
a-sync	1	
bogdangrigg	1	

2021-November

New Content

- about_Built-in_Functions

Content updates

- PowerShell 7.2 GA documentation updates
- Update GitHub Issue and PR templates - piloting the new YAML-based forms for issues
- Updated Crescendo reference for Preview 4 release

Top Community Contributors

GitHub stats

- 48 PRs merged (13 from Community)
- 31 issues opened (24 from Community)
- 34 issues closed (28 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
matt9ucci	4	
yecril71pl	3	
tholabrk	1	
lukejjh	1	
Oechiih	1	
bergmeister	1	
Hrxn	1	

GitHub Id	PRs merged	Issues opened
jebeckham	1	

2021-October

New Content

- PSScriptAnalyzer documentation
  - Overview
  - Rules documentation

Content updates

- Lots of general editorial and freshness updates across 450 files
- PowerShell 7.2-rc.1 documentation updates

Top Community Contributors

GitHub stats

- 49 PRs merged (12 from Community)
- 33 issues opened (30 from Community)
- 33 issues closed (32 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
doctordns	4	
diecknet	1	
Kagre	1	
KexyBiscuit	1	
JohnRoos	1	
Zhu-Panda	1	
philanderson888	1	
BlackFalcons	1	

GitHub Id	PRs merged	Issues opened
milaandahiya	1	
mklement0		2

2021-September

New Content

- SDK documentation
  - How to validate an argument using a script
  - ValidateScript Attribute Declaration
- Learning content
  - PowerShell security features

Content updates

- Install documentation - Did a complete rewrite of the setup documentation. There is now a separate article for each supported OS.
  - Install on Windows
  - Install on macOS
  - Install on Linux
    - Alpine
    - CentOS
    - Debian
    - Fedora
    - Raspberry Pi OS
    - Red Hat Enterprise Linux
    - Ubuntu
    - Alternate install methods
    - Community supported Linux
- Supporting documentation
  - Using PowerShell in Docker
  - Arm Processor support
  - Microsoft Update for PowerShell FAQ
  - PowerShell Support Lifecycle
- Reformatted and updated the PSScriptAnalyzer rules documentation. Next month we plan to publish these docs to Microsoft Learn.
  - Rules documentation on GitHub
- Lots of general editorial updates across 4500 files
- PowerShell 7.2-preview.10 documentation updates

Top Community Contributors

GitHub stats

- 68 PRs merged (6 from Community)
- 32 issues opened (29 from Community)
- 49 issues closed (41 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
RaghuRocks3	1	
Zhu-Panda	1	
Jaykul	1	
juvtib	1	
przmv	1	
mklement0		2

2021-August

New content

- about_ANSI_Terminals
- about_PSCustomObject

Content updates

- PowerShell 7.2-preview.9 documentation updates

Top Community Contributors

GitHub stats

- 66 PRs merged (14 from Community)
- 42 issues opened (30 from Community)
- 53 issues closed (38 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
AvrumFeldman	1	
benmccallum	1	
bitdeft		2
BraINstinct0	1	
diddledani	1	
doctordns	1	
gravitional	1	
homotechsual	1	
imba-tjd	1	
juvtib	1	
kozhemyak	1	
omarys	1	
ryandasilva2992	1	
sethvs	1	
sneakernuts	1	

2021-July

New content

- about_Functions_Argument_Completion
- about_Tab_Expansion

Content updates

- about_Functions_Advanced_Parameters - major updates and links to new articles
- PowerShell 7.2-preview.8 documentation updates

Top Community Contributors

GitHub stats

- 51 PRs merged (9 from Community)

- 56 issues opened (50 from Community)
- 59 issues closed (52 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
rkeithhill	2	
juvtib	2	
SetTrend	1	
Rob-S	1	
xtqqczze	1	
akashdabhi03	1	
kurtmckee	1	
clamb123		13
mklement0		2
jerryKahnPerl		2

2021-June

New content

- about_Intrinsic_Members
- about_Booleans

Content updates

- Converted about_remote_faq to new Yaml format and moved to conceptual TOC
- Moved **PSDesiredStateConfiguration** out of 7.2 docs and into PowerShell-Docs-Modules
  - DSC is being removed from PowerShell to become an optional module that is loaded from the PowerShell Gallery
  - Long-term plan is to move all DSC documentation out of PowerShell-Docs into a new repository for DSC content
- Totally rewrote the PowerShell release notes to summarize the current state, making it easier for users to find the information without having to read every release note.

    - Differences between Windows PowerShell 5.1 and PowerShell (core) 7.x
    - PowerShell differences on non-Windows platforms
- PowerShell 7.2-preview.7 documentation updates

Top Community Contributors

GitHub stats

- 43 PRs merged (1 from Community)
- 36 issues opened (32 from Community)
- 49 issues closed (41 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
rkeithhill	1	
frenchiveruti		2
paulaustin-automutatio		2
ringerc		2
trollyanov		2
UberKluger		2

2021-May

New Content

- Migrated two articles from the Windows Server content to the PowerShell docset
    - PowerShell scripting performance considerations
    - PowerShell module authoring considerations
- Added PowerShell Language Specification 3.0
    - The specification document is available from the Microsoft Download Center as a Microsoft Word document.
- Updated content for PowerShell 7.2-Preview6 release
- Moved Samples under the Learn node in the Table of Contents

Top Community Contributors

GitHub stats

- 53 PRs merged (6 from Community)
- 37 issues opened (35 from Community)
- 39 issues closed (36 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
kvprasoon	2	
jErprog	1	
aamnah	1	
BetaLyte	1	
TheNCuber	1	
trollyanov		6
Tarjei-stavanger		3
aungminko93750		3
SetTrend		2
cdichter		2
reuvygroovy		2

2021-April

New Content

- Published new Learn content Write your first PowerShell code
- Updated docs for PowerShell 7.2-preview.5
- Updated metadata on ~3300 articles in the Windows module documentation
  - Preparing for Windows Server 2022 release and fixing updateable help
  - This is still a work in progress

Top Community Contributors

GitHub stats

- 45 PRs merged (5 from Community)
- 42 issues opened (33 from Community)
- 55 issues closed (32 Community issues closed)

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
ealmonte32	1	
hananyajacobson	1	
MarcChasse	1	
Melvin-Abraham	1	
robertkruk	1	
MikeMM70		2

2021-March

New content

- Working on simplify and expanding the Overview content
  - Added What is a PowerShell command?
- Started a new tutorial series - PowerShell Bits
  - Discover PowerShell
- Help content for PowerShell utility modules
  - Microsoft.PowerShell.Crescendo
  - Microsoft.PowerShell.SecretManagement
  - Microsoft.PowerShell.SecretStore
  - PlatyPS
  - PSScriptAnalyzer
- Working with the Windows team to update help for Windows management modules
  - Added content for Windows Server 2019 and Windows Server 2022 (preview)
  - Continuing to work on improving updateable help for these modules
- PowerShell 7.2-preview documentation updates

Top Community Contributors

GitHub stats

- 42 PRs merged (5 from Community)
- 63 issues opened (42 from Community)
- 47 issues closed

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
bl-ue	1	
brianary	1	
Lx	1	
matt9ucci	1	
kfasick	1	
mklement0		10
juvtib		6
BoJackem23		2

2021-February

New content

- PowerShell 7.2-preview documentation updates

Top Community Contributors

GitHub stats

- 40 PRs merged (12 from Community)
- 40 issues opened (30 from Community)
- 35 issues closed

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
bbodenmiller	1	

GitHub Id	PRs merged	Issues opened
brianary	1	
exchange12rocks	1	
IvenBach	1	
jamiepinheiro	1	
jdoubleu	1	
LogicalToolkit	1	
matt9ucci	1	
mihir-ajmera	1	
revolter	1	
secretGeek	1	
springcomp	1	
Ayanmullick		2

2021-January

New content

- PowerShell 7.2-preview documentation updates

Top Community Contributors

GitHub stats

- 44 PRs merged (14 from Community)
- 46 issues opened (38 from Community)
- 35 issues closed

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
AndreyMatrosov	4	
revolter	2	

GitHub Id	PRs merged	Issues opened
cconrad	1	
Hrxn	1	
kilasuit	1	
NN---	1	
snickler	1	
vinian	1	
zeekbrown	1	
brianary		2
mklement0		2
plastikfan		2

What's new in PowerShell Docs for 2020

Article • 02/02/2023

This article lists notable changes made to docs each month and celebrates the contributions from the community.

Help us make the documentation better for you. Read the Contributor's Guide to learn how to get started.

2020-December

- Updated contributor guide
  - documented the `&preserve_view=true` query parameter for hyperlinks
  - documented cross-reference syntax for hyperlinks
  - added information about localization

- GitHub stats
  - 44 PRs merged (11 from Community)
  - 50 issues opened (43 from Community)
  - 50 issues closed

Top Community Contributors

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
doctordns	3	2
chadbaldwin	1	
dawedawe	1	
dumpvn	1	
kvprasoon	1	
lbearl	1	
petershen0307	1	
skycommand	1	

GitHub Id	PRs merged	Issues opened
springcomp	1	
Cwilson-dataselfcom		5
bobbybatatina		2

2020-November

- PowerShell 7.1 GA Release
  - What's New in PowerShell 7.1
  - Converted 7.1 docs to release status
  - Added 7.2 (preview) docs
  - Retired v6 docs to archive repository

- Blog posts
  - You've got Help!
  - Updating help for the PSReadLine module

- Documentation maintenance
  - Updated 137 articles to remove MSDN and TechNet references
  - Updated 171 articles to indicate Windows-only compatibility
  - Updated 38 articles to address build warnings and suggestions
  - Added include to 24 DSC articles
  - Major rewrite of the PowerShell Jobs articles
    - about_Jobs
    - about_Remote_Jobs
    - about_Thread_Jobs

- GitHub stats
  - 50 PRs merged (8 from Community)
  - 55 issues opened (45 from Community)
  - 51 issues closed

Top Community Contributors

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
AlanFlorance	1	

GitHub Id	PRs merged	Issues opened
gilbertbw	1	
ianwalkeruk	1	
JeremyTBradshaw	1	
matt9ucci	1	
Rob-S	1	
ShaydeNofziger	1	
skycommand	1	
juvtib		8
iRon7		2
l-ip		2
stephenrgentry		2
Vixb1122		2

2020-October

- New articles
  - about_Character_Encoding
  - about_Output_Streams
  - Using Visual Studio Code to debug compiled cmdlets (thanks @fsackur)
  - Add Credential support to PowerShell functions (thanks @joshduffney)

- Documentation maintenance
  - Updates for 7.1-rc content
  - Updated all article descriptions to improve SEO

- GitHub stats
  - 61 PRs merged (7 from Community)
  - 49 issues opened (42 from Community)
  - 61 issues closed

Top Community Contributors

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
doctordns	1	
escape208	1	
nickdevore	1	
fsackur	1	
Duffney	1	
skycommand	1	
yecril71pl	1	
mklement0		3
Abdullah0820		2

2020-September

- Documentation maintenance
  - Updates for 7.1-preview content
- Community presentation
  - How to contribute to Docs for RTPUG - https://www.youtube.com/watch?v=0_DEB61YOMc
- GitHub stats
  - 41 PRs merged (9 from Community)
  - 52 issues opened (47 from Community)
  - 51 issues closed

Top Community Contributors

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
doctordns	1	

GitHub Id	PRs merged	Issues opened
fatherjack	1	
goforgold	1	
jonathanweinberg	1	
kvprasoon	1	
skycommand	1	
springcomp	1	
themichaelbender	1	
toddryan	1	
mklement0		13
setpeetrike		2

2020-August

- New PowerShell documentation
  - About_Calculated_Properties
  - Writing Progress across multiple threads with Foreach Parallel
- Documentation maintenance
  - Updates for 7.1-preview content
- GitHub stats
  - 69 PRs merged (26 from Community)
  - 68 issues opened (49 from Community)
  - 58 issues closed

Top Community Contributors

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened
sethvs	10	2
yecril71pl	10	

GitHub Id	PRs merged	Issues opened
mklement0	1	7
springcomp	1	2
SquirrelAssassin		2
thorstenbutz		2
aetos382	1	
crumdev	1	
joshSi	1	
kmoad	1	

2020-July

- New PowerShell documentation
  - Resurrected old ETS docs - 7 articles added
  - Added article about creating updateable help using PlatyPS
- Documentation maintenance
  - Updates for 7.1-preview content
  - Updated page header - simplified menu choices and added a download button
  - Fixed several `Update-Help` issues
    - Help for PSDesiredStateConfiguration and ThreadJob modules now downloads
    - Published updateable help for PowerShell 7.1 preview
    - Updateable help for PowerShell 5.1 now includes About topics
- GitHub stats
  - 99 PRs merged (29 from Community)
  - 51 issues opened (44 from Community)
  - 71 issues closed

Top Community Contributors

The following people have contributed to PowerShell docs by submitting pull requests or filing issues. Thank you!

GitHub Id	PRs merged	Issues opened

GitHub Id	PRs merged	Issues opened
yecril71pl	10	3
sethvs	10	
springcomp	3	2
txtor	2	1
baardhermansen	1	
skycommand	1	
srjennings	1	
xtqqczze	1	
mklement0		3
Allexxann		2
sharpninja		2
XuHeng1021		2

2020-June

- New PowerShell documentation
  - Published new PowerShell 101 content contributed by Mike F. Robbins
  - Added two recent blog posts from Rob Holt to the **Scripting and development** docs
    - Choosing the right PowerShell NuGet package for your .NET project
    - Resolving PowerShell module assembly dependency conflicts

- Documentation maintenance
  - Archived older content to https://aka.ms/PSLegacyDocs
    - PowerShell Web Access SDK content
    - PowerShell Workflows SDK content
  - Updates for 7.1-preview content

- GitHub stats
  - 83 PRs merged (15 from Community)
  - 68 issues opened (52 from Community)
  - 74 issues closed

Top Community Contributors

The following people have contributed to PowerShell docs by submitting pull requests or filling issues. Thank you!

GitHub Id	PRs merged	Issues opened
doctordns	3	
gabrielmccoll	2	
adrianhale	1	
aisbergde	1	
beatcracker	1	
bergmeister	1	
DarioArzaba	1	
gforceg	1	
jpomfret	1	
Karl-WE	1	
signalwarrant	1	
skycommand	1	
tkhadimullin	1	
johnkberry		2
juvtib		2
mklement0		2
Sagatboy33		4

2020-May

- New PowerShell documentation
  - Created a new Deep dives section containing content from community contributor Kevin Marquette
    - Everything you want to know about arrays
    - Everything you want to know about hashtables
    - Everything you want to know about PSCustomObject

        - Everything you want to know about string substitution
        - Everything you want to know about if/then/else
        - Everything you want to know about switch
        - Everything you want to know about exceptions
        - Everything you want to know about $null
        - Everything you want to know about ShouldProcess
        - How to create a Standard Library binary module
    - Published the PowerShell 7.0 .NET API reference
    - `Update-Help -Force` for PowerShell 5.1 now downloads updated content for the core PowerShell modules

- Documentation maintenance
    - Major reorganization of the Table of Contents
        - New content under **Learning PowerShell**
        - Windows PowerShell 5.1 content collected in one location
    - Archived older content to https://aka.ms/PSLegacyDocs
        - PowerShell Web Access
        - PowerShell Workflows Guide
    - Updates for 7.1-preview content

- GitHub stats
    - 81 PRs merged (21 from Community)
    - 61 issues opened (53 from Community)
    - 64 issues closed

Top Community Contributors

The following people have contributed to PowerShell docs by submitting pull requests or filling issues. Thank you!

GitHub Id	PRs merged	Issues opened
nschonni	10	
xtqqczze	2	1
kilasuit	1	1
davidseibel	1	
doctordns	1	
jhoffmann271	1	
KevinMarquette	1	

GitHub Id	PRs merged	Issues opened
klitztuch	1	
markojorge	1	
perjahn	1	
schuelermine	1	
jsilverm		7
mklement0		5
cam1170		2
JustinGrote		2
peetrike		2

2020-April

- New documents
  - PowerShell documentation
    - Using Experimental Features
    - about_PSModulePath
  - Wiki articles
    - The case for and against Invoke-Expression
    - Variables can be assigned values as part of an expression (with limitations)

- Documentation maintenance
  - Now publishing updates to Microsoft Learn on a daily schedule
    - Monday-Friday 3pm Redmond Time (UTC-8)
  - Restructured the Community content
  - Many editorial cleanups
  - Updated Contributor Guide
    - Clarified some formatting rules
    - New information about table formatting

- GitHub stats
  - 74 PRs merged (8 from Community)
  - 79 issues opened (71 from Community)
  - 102 issues closed

Top Community Contributors

The following people have contributed to PowerShell docs by submitting pull requests or filling issues. Thank you!

GitHub Id	PRs merged	Issues opened
ScSurber	1	1
alexandair	1	
bmkaiser	1	
hyoshioka0128	1	
jpomfret	1	
raydixon	1	
signalwarrant	1	
mklement0		8
reinierk		3
scabon		2
Abdullah0820		2
awooga		2
Damag3d		2
Fiasco123		2
Jasonthurston		2

2020-March

- New documents
  - The PowerShell Docs community pages
    - Community resources page
    - What's new in PowerShell Docs page (this page)
    - PowerShell Infographic added to the Digital Art page
    - PowerShell-Doc contributor guide
  - New PowerShell content
    - Migrating from Windows PowerShell 5.1 to PowerShell 7
    - PowerShell 7 module compatibility list
    - Using PowerShell in Docker
  - New Wiki content

    - PowerShell prevents exceptions for non existent keys for types that implement IDictionary TKey, TValue
    - PowerShell's treatment of namespaces is case insensitive but case preserving

- Documentation maintenance
    - Massive cleanup of broken links
    - Cleanup of old and duplicate issues

- GitHub stats
    - 100 PRs merged (14 from Community)
    - 68 issues opened (56 from Community)
    - 109 issues closed

Top Community Contributors

The following people have contributed to PowerShell docs by submitting pull requests or filling issues. Thank you!

- k-takai - 7 PRs
- mklement0 - 5 issues
- juvtib - 4 issues
- iSazonov - 3 issue
- doctordns - 2 issues
- mdorantesm - 2 issues
- qt3m45su0najc7 - 2 issues

2020-February

- New documents
    - about_Parameter_Sets
    - Release history of modules and cmdlets
- PowerShell 7 documentation updates
- Updates to address issues
- Ran PlatyPS to verify parameter info for all cmdlets and versions
- GitHub stats
    - 52 PRs merged (9 from Community)
    - 49 issues opened (42 from Community)
    - 55 issues closed

Top Community Contributors

The following people have contributed to PowerShell docs by submitting pull requests or filling issues. Thank you!

- Maamue - 2 PRs
- doctordns - 2 PRs
- mklement0 - 4 issues
- he852100 - 3 issues
- VectorBCO - 2 issues
- metablaster - 2 issues

2020-January

- New documents
  - about_Windows_PowerShell_Compatibility
- PowerShell 7 documentation updates
- Updates to address issues
- GitHub stats
  - 58 PRs merged (7 from Community)
  - 57 issues opened (43 from Community)
  - 70 issues closed

Top Community Contributors

The following people have contributed to PowerShell docs by submitting pull requests or filling issues. Thank you!

- Makovec - 3 PRs
- mklement0 - 9 issues
- mvadu - 2 issues
- razos - 2 issues
- VLoub - 2 issues
- doctordns - 2 issues

PowerShell Digital Art

Article • 06/28/2023

The legends are true! The powerful shell that ensures safe passage to the cloud. But how?

Please enjoy the digital artwork linked below. Demonstrate to your peers that *you have been entrusted with the Scrolls of Monad!*

PowerShell Infographics

- PowerShell Infographic

Comic

- PowerShell Hero Comic (High resolution)
- PowerShell Hero Comic (Print resolution)
- PowerShell Hero Comic (Web resolution)

Wallpaper

- PowerShell Hero Comic Wallpaper (4k resolution)
- PowerShell Hero Pink Wallpaper (4k resolution)
- PowerShell Hero White Wallpaper (4k resolution)

Poster

- PowerShell Hero Poster

PowerShell Hero

- PowerShell Hero Image

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Using Visual Studio Code for PowerShell Development

Article • 11/07/2022

Visual Studio Code (VS Code) is a cross-platform script editor by Microsoft. Together with the PowerShell extension, it provides a rich and interactive script editing experience, making it easier to write reliable PowerShell scripts. Visual Studio Code with the PowerShell extension is the recommended editor for writing PowerShell scripts.

It supports the following PowerShell versions:

- PowerShell 7.2 and higher (Windows, macOS, and Linux)
- Windows PowerShell 5.1 (Windows-only) with .NET Framework 4.8

> **Note**
>
> Visual Studio Code isn't the same as **Visual Studio**.

Getting started

Before you begin, make sure PowerShell exists on your system. For modern workloads on Windows, macOS, and Linux, see the following links:

- Installing PowerShell on Linux
- Installing PowerShell on macOS
- Installing PowerShell on Windows

For traditional Windows PowerShell workloads, see Installing Windows PowerShell.

> **Important**
>
> The **Windows PowerShell ISE** is still available for Windows. However, it's no longer in active feature development. The ISE only works with PowerShell 5.1 and older. As a component of Windows, it continues to be officially supported for security and high-priority servicing fixes. we've no plans to remove the ISE from Windows.

Install VS Code and the PowerShell Extension

1. Install Visual Studio Code. For more information, see the overview Setting up Visual Studio Code.

   There are installation instructions for each platform:

   - Running Visual Studio Code on Windows
   - Running Visual Studio Code on macOS
   - Running Visual Studio Code on Linux

2. Install the PowerShell Extension.
   a. Launch the VS Code app by typing `code` in a console or `code-insiders` if you installed Visual Studio Code Insiders.
   b. Launch **Quick Open** on Windows or Linux by pressing `Ctrl`+`P`. On macOS, press `Cmd`+`P`.
   c. In Quick Open, type `ext install powershell` and press **Enter**.
   d. The **Extensions** view opens on the Side Bar. Select the PowerShell extension from Microsoft.
   e. Click the **Install** button on the PowerShell extension from Microsoft.
   f. After the install, if you see the **Install** button turn into **Reload**, Click on **Reload**.
   g. After VS Code has reloaded, you're ready for editing.

For example, to create a new file, click **File** > **New**. To save it, click **File** > **Save** and then provide a filename, such as `HelloWorld.ps1`. To close the file, click the `X` next to the filename. To exit VS Code, **File** > **Exit**.

Installing the PowerShell Extension on Restricted Systems

Some systems are set up to require validation of all code signatures. You may receive the following error:

```
Language server startup failed.
```

This problem can occur when PowerShell's execution policy is set by Windows Group Policy. To manually approve PowerShell Editor Services and the PowerShell extension for VS Code, open a PowerShell prompt and run the following command:

PowerShell

```
Import-Module $HOME\.vscode\extensions\ms-
vscode.powershell*\modules\PowerShellEditorServices\PowerShellEditorServices
.psd1
```

You're prompted with **Do you want to run software from this untrusted publisher?** Type `A` to run the file. Then, open VS Code and verify that the PowerShell extension is functioning properly. If you still have problems getting started, let us know in a GitHub issue.

Choosing a version of PowerShell to use with the extension

With PowerShell installing side-by-side with Windows PowerShell, it's now possible to use a specific version of PowerShell with the PowerShell extension. This feature looks at a few well-known paths on different operating systems to discover installations of PowerShell.

Use the following steps to choose the version:

1. Open the **Command Palette** on Windows or Linux with `Ctrl`+`Shift`+`P`. On macOS, use `Cmd`+`Shift`+`P`.
2. Search for **Session**.
3. Click on **PowerShell: Show Session Menu**.
4. Choose the version of PowerShell you want to use from the list.

If you installed PowerShell to a non-typical location, it might not show up initially in the Session Menu. You can extend the session menu by adding your own custom paths as described below.

The PowerShell session menu can also be accessed from the `{}` icon in the bottom right corner of status bar. Hovering on or selecting this icon displays a shortcut to the session menu and a small pin icon. If you select the pin icon, the version number is added to the status bar. The version number is a shortcut to the session menu requiring fewer clicks.

> **Note**
>
> Pinning the version number replicates the behavior of the extension in versions of VS Code before 1.65. The 1.65 release of VS Code changed the APIs the PowerShell extension uses and standardized the status bar for language extensions.

Configuration settings for Visual Studio Code

First, if you're not familiar with how to change settings in VS Code, we recommend reading Visual Studio Code's settings documentation.

After reading the documentation, you can add configuration settings in `settings.json`.

JSON

```
{
    "editor.renderWhitespace": "all",
    "editor.renderControlCharacters": true,
    "files.trimTrailingWhitespace": true,
    "files.encoding": "utf8bom",
    "files.autoGuessEncoding": true
}
```

If you don't want these settings to affect all files types, VS Code also allows per-language configurations. Create a language-specific setting by putting settings in a `[<language-name>]` field. For example:

JSON

```
{
    "[powershell]": {
        "files.encoding": "utf8bom",
        "files.autoGuessEncoding": true
    }
}
```

> **Tip**
>
> For more information about file encoding in VS Code, see **Understanding file encoding**. Also, check out **How to replicate the ISE experience in VS Code** for other tips on how to configure VS Code for PowerShell editing.

Adding your own PowerShell paths to the session menu

You can add other PowerShell executable paths to the session menu through the Visual Studio Code setting: `powershell.powerShellAdditionalExePaths`.

You can do this using the GUI:

1. From the **Command Palette** search for and select **Open User Settings**. Or use the keyboard shortcut on Windows or Linux `Ctrl`+`,`. On macOS, use `Cmd`+`,`.
2. In the **Settings** editor, search for **PowerShell Additional Exe Paths**.
3. Click **Add Item**.
4. For the **Key** (under **Item**), provide your choice of name for this additional PowerShell installation.

5. For the **Value** (under **Value**), provide the absolute path to the executable itself.

You can add as many additional paths as you like. The added items show up in the session menu with the given key as the name.

Alternatively you can add key-value pairs to the object `powershell.powerShellAdditionalExePaths` in your `settings.json`:

JSON

```
{
    "powershell.powerShellAdditionalExePaths": {
        "Downloaded PowerShell":
"C:/Users/username/Downloads/PowerShell/pwsh.exe",
        "Built PowerShell":
"C:/Users/username/src/PowerShell/src/powershell-win-
core/bin/Debug/net6.0/win7-x64/publish/pwsh.exe"
    },
}
```

> ⓘ **Note**
>
> Prior to version 2022.5.0 of the extension, this setting was a list of objects with the required keys `exePath` and `versionName`. A breaking change was introduced to support configuration via GUI. If you had previously configured this setting, please convert it the new format. The value given for `versionName` is now the **Key**, and the value given for `exePath` is now the **Value**. You can do this more easily by resetting the value and using the Settings interface.

To set the default PowerShell version, set the value `powershell.powerShellDefaultVersion` to the text displayed in the session menu (the text used for the key):

JSON

```
{
    "powershell.powerShellAdditionalExePaths": {
        "Downloaded PowerShell":
"C:/Users/username/Downloads/PowerShell/pwsh.exe",
    },
    "powershell.powerShellDefaultVersion": "Downloaded PowerShell",
}
```

After you've configured this setting, restart VS Code or to reload the current VS Code window from the **Command Palette**, type `Developer: Reload Window`.

If you open the session menu, you now see your additional PowerShell installations.

> **Tip**
>
> If you build PowerShell from source, this is a great way to test out your local build of PowerShell.

Debugging with Visual Studio Code

No-workspace debugging

In VS Code version 1.9 (or higher), you can debug PowerShell scripts without opening the folder that contains the PowerShell script.

1. Open the PowerShell script file with **File** > **Open File...**
2. Set a breakpoint - select a line then press `F9`
3. Press `F5` to start debugging

You should see the Debug actions pane appear that allows you to break into the debugger, step, resume, and stop debugging.

Workspace debugging

Workspace debugging refers to debugging in the context of a folder that you've opened from the **File** menu using **Open Folder...**. The folder you open is typically your PowerShell project folder or the root of your Git repository. Workspace debugging allows you to define multiple debug configurations other than just debugging the currently open file.

Follow these steps to create a debug configuration file:

1. Open the **Debug** view on Windows or Linux by pressing `Ctrl`+`Shift`+`D`. On macOS, press `Cmd`+`Shift`+`D`.

2. Click the **create a launch.json file** link.

3. From the **Select Environment** prompt, choose **PowerShell**.

4. Choose the type of debugging you'd like to use:

    - **Launch Current File** - Launch and debug the file in the currently active editor window

- **Launch Script** - Launch and debug the specified file or command
- **Interactive Session** - Debug commands executed from the Integrated Console
- **Attach** - Attach the debugger to a running PowerShell Host Process

VS Code creates a directory and a file `.vscode\launch.json` in the root of your workspace folder to store the debug configuration. If your files are in a Git repository, you typically want to commit the `launch.json` file. The contents of the `launch.json` file are:

JSON

```
{
  "version": "0.2.0",
  "configurations": [
      {
          "type": "PowerShell",
          "request": "launch",
          "name": "PowerShell Launch (current file)",
          "script": "${file}",
          "args": [],
          "cwd": "${file}"
      },
      {
          "type": "PowerShell",
          "request": "attach",
          "name": "PowerShell Attach to Host Process",
          "processId": "${command.PickPSHostProcess}",
          "runspaceId": 1
      },
      {
          "type": "PowerShell",
          "request": "launch",
          "name": "PowerShell Interactive Session",
          "cwd": "${workspaceRoot}"
      }
  ]
}
```

This file represents the common debug scenarios. When you open this file in the editor, you see an **Add Configuration...** button. You can click this button to add more PowerShell debug configurations. One useful configuration to add is **PowerShell: Launch Script**. With this configuration, you can specify a file containing optional arguments that are used whenever you press F5 no matter which file is active in the editor.

After the debug configuration is established, you can select the configuration you want to use during a debug session. Select a configuration from the debug configuration

drop-down in the **Debug** view's toolbar.

Troubleshooting the PowerShell extension

If you experience any issues using VS Code for PowerShell script development, see the troubleshooting guide on GitHub.

Useful resources

There are a few videos and blog posts that may be helpful to get you started using the PowerShell extension for VS Code:

Videos

- Using Visual Studio Code as Your Default PowerShell Editor
- Visual Studio Code: deep dive into debugging your PowerShell scripts

Blog posts

- PowerShell Extension
- Write and debug PowerShell scripts in Visual Studio Code
- Debugging Visual Studio Code Guidance
- Debugging PowerShell in Visual Studio Code
- Get started with PowerShell development in Visual Studio Code
- Visual Studio Code editing features for PowerShell development - Part 1
- Visual Studio Code editing features for PowerShell development - Part 2
- Debugging PowerShell script in Visual Studio Code - Part 1
- Debugging PowerShell script in Visual Studio Code - Part 2

PowerShell extension project source code

The PowerShell extension's source code can be found on GitHub.

If you're interested in contributing, Pull Requests are greatly appreciated. Follow along with the developer documentation on GitHub to get started.

How to replicate the ISE experience in Visual Studio Code

Article • 07/10/2023

While the PowerShell extension for VS Code doesn't seek complete feature parity with the PowerShell ISE, there are features in place to make the VS Code experience more natural for users of the ISE.

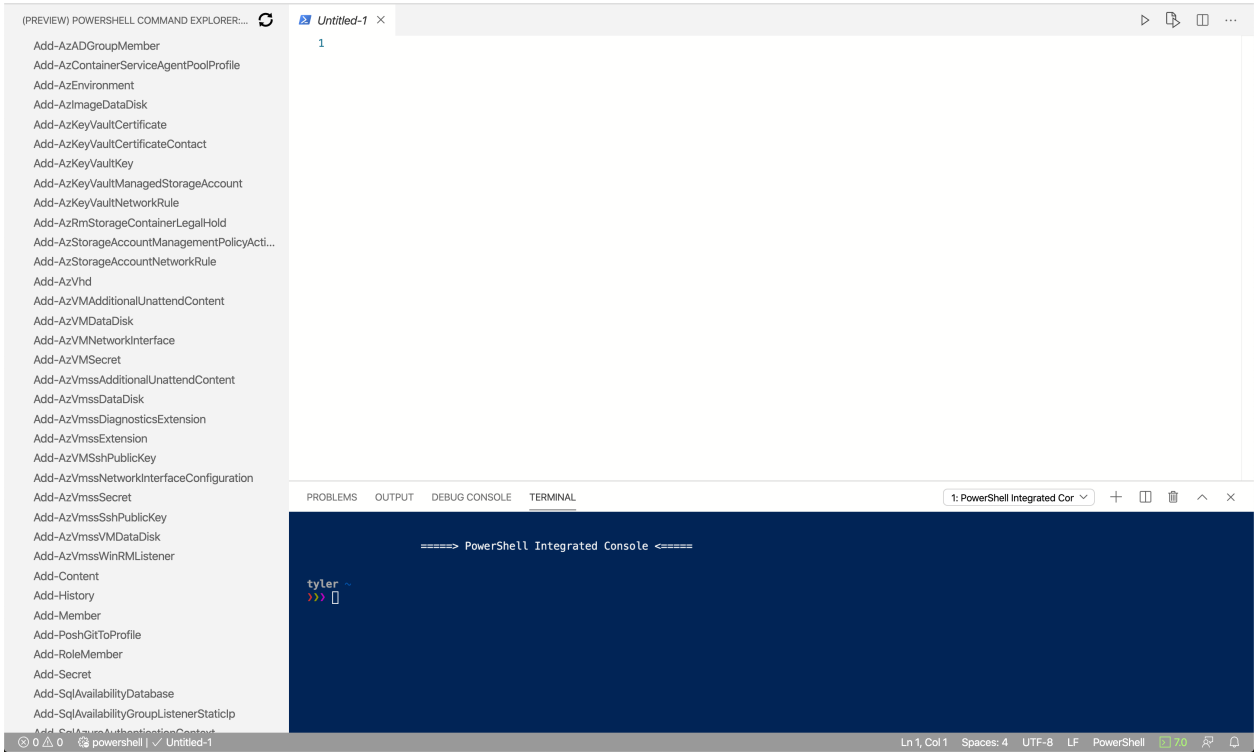
This document tries to list settings you can configure in VS Code to make the user experience a bit more familiar compared to the ISE.

ISE Mode

> **Note**
>
> This feature is available in the PowerShell Preview extension since version 2019.12.0 and in the PowerShell extension since version 2020.3.0.

The easiest way to replicate the ISE experience in Visual Studio Code is by turning on "ISE Mode". To do this, open the command palette (`F1` OR `Ctrl`+`Shift`+`P` OR `Cmd`+`Shift`+`P` on macOS) and type in "ISE Mode". Select "PowerShell: Enable ISE Mode" from the list.

This command automatically applies the settings described below The result looks like this:



ISE Mode configuration settings

ISE Mode makes the following changes to VS Code settings.

- Key bindings

Function	ISE Binding	VS Code Binding
Interrupt and break debugger	`Ctrl`+`B`	`F6`
Execute current line/highlighted text	`F8`	`F8`
List available snippets	`Ctrl`+`J`	`Ctrl`+`Alt`+`J`

> **Note**
>
> You can **configure your own key bindings** in VS Code as well.

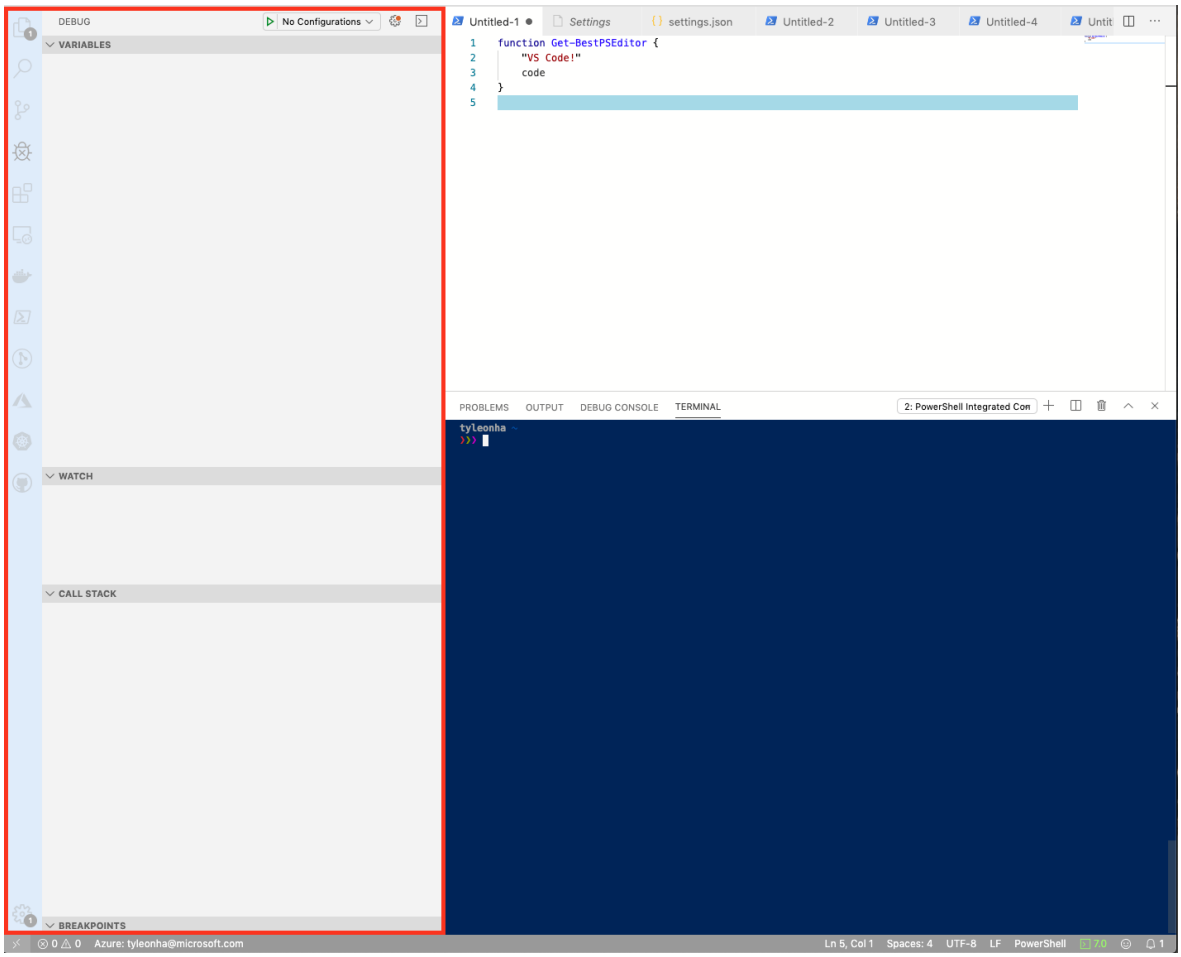
- Simplified ISE-like UI

  If you're looking to simplify the Visual Studio Code UI to look more closely to the UI of the ISE, apply these two settings:

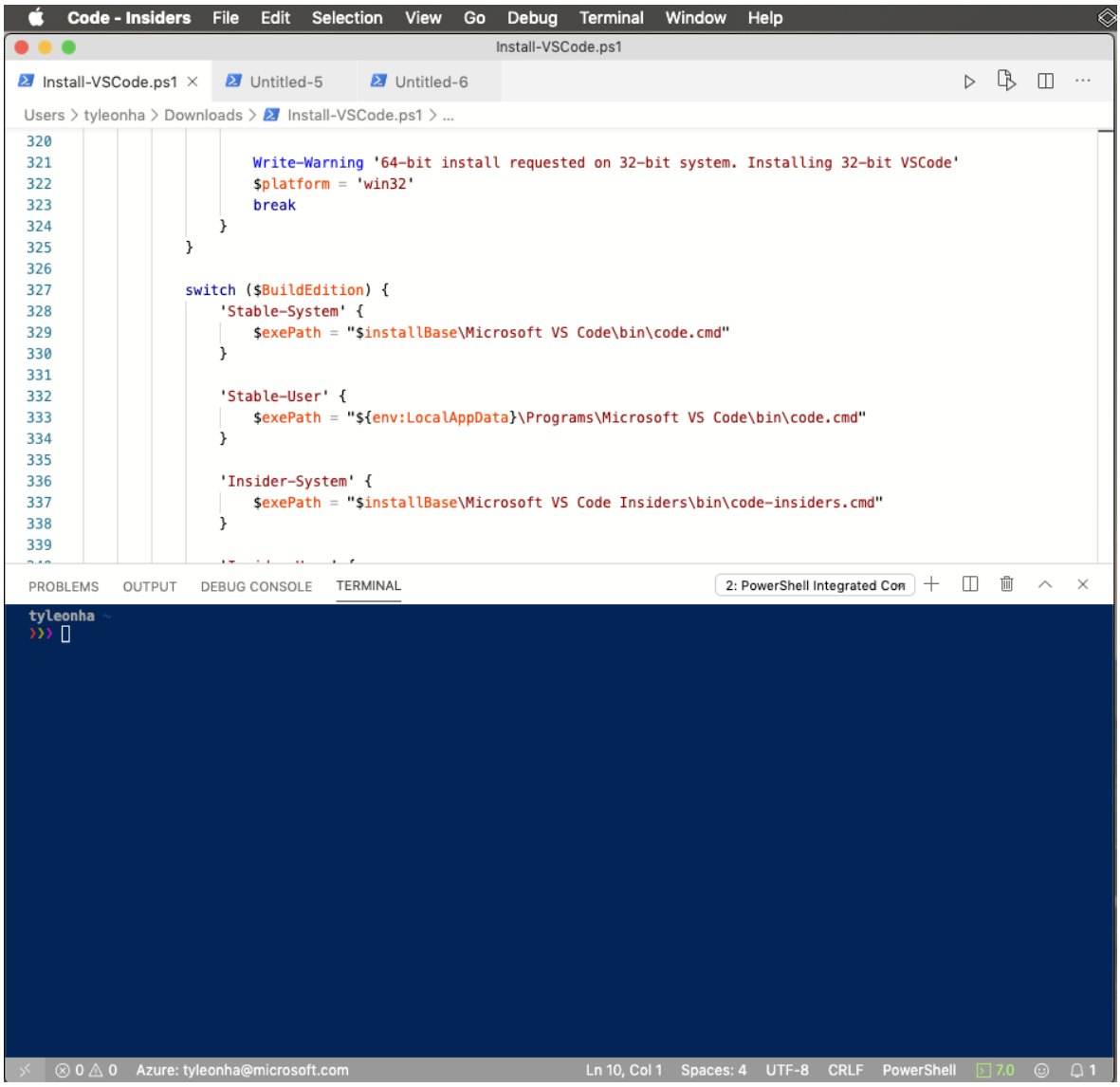
```JSON
"workbench.activityBar.visible": false,
```

```
  "debug.openDebug": "neverOpen",
```

These settings hide the "Activity Bar" and the "Debug Side Bar" sections shown inside the red box below:



The end result looks like this:



- Tab completion

  To enable more ISE-like tab completion, add this setting:

  JSON

  ```
  "editor.tabCompletion": "on",
  ```

- No focus on console when executing

  To keep the focus in the editor when you execute with F8:

  JSON

  ```
  "powershell.integratedConsole.focusConsoleOnExecute": false
  ```

  The default is `true` for accessibility purposes.

- Don't start integrated console on startup

To stop the integrated console on startup, set:

```JSON
"powershell.integratedConsole.showOnStartup": false
```

> **Note**
>
> The background PowerShell process still starts to provide IntelliSense, script analysis, symbol navigation, etc., but the console won't be shown.

- Assume files are PowerShell by default

  To make new/untitled files, register as PowerShell by default:

  ```JSON
  "files.defaultLanguage": "powershell",
  ```

- Color scheme

  There are a number of ISE themes available for VS Code to make the editor look much more like the ISE.

  In the Command Palette type `theme` to get `Preferences: Color Theme` and press `Enter`. In the drop-down list, select `PowerShell ISE`.

  You can set this theme in the settings with:

  ```JSON
  "workbench.colorTheme": "PowerShell ISE",
  ```

- PowerShell Command Explorer

  Thanks to the work of @corbob, the PowerShell extension has the beginnings of its own command explorer.

  In the Command Palette, enter `PowerShell Command Explorer` and press `Enter`.

- Open in the ISE

  If you want to open a file in the Windows PowerShell ISE anyway, open the Command Palette, search for "open in ise", then select **PowerShell: Open Current**

File in PowerShell ISE.

Other resources

- 4sysops has a great article on configuring VS Code to be more like the ISE.
- Mike F Robbins has a great post on setting up VS Code.

VS Code Tips

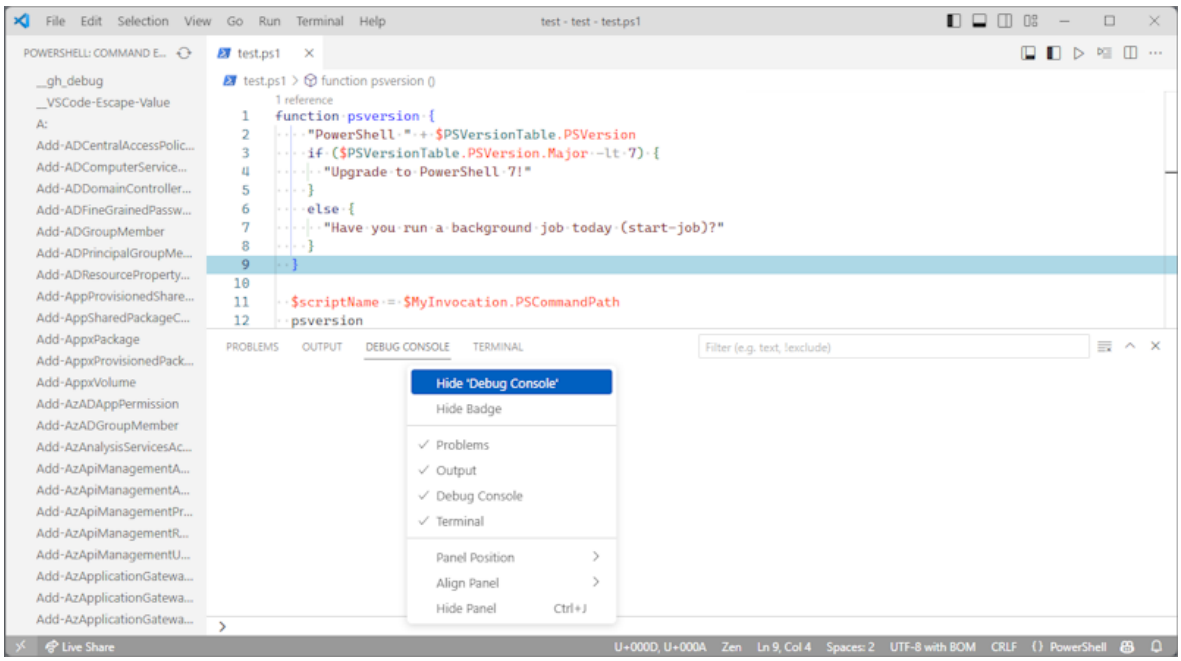
- Command Palette

  The Command Palette is handy way of executing commands in VS Code. Open the command palette using `F1` OR `Ctrl`+`Shift`+`P` OR `Cmd`+`Shift`+`P` on macOS.

  For more information, see the VS Code documentation.

- Hide the Debug Console panel

  The PowerShell extension uses the built-in debugging interface of VS Code to allow for debugging of PowerShell scripts and modules. However, the extension does not use the Debug Console panel. To hide the Debug Console, right-click on **Debug Console** and select **Hide 'Debug Console'**.



For more information about debugging PowerShell with Visual Studio Code, see Using VS Code.

More settings

If you know of more ways to make VS Code feel more familiar for ISE users, contribute to this doc. If there's a compatibility configuration you're looking for, but you can't find any way to enable it, open an issue and ask away!

We're always happy to accept PRs and contributions as well!

Using Visual Studio Code for remote editing and debugging

Article • 11/17/2022

For those of you that are familiar with the ISE, you may recall that you could run `psedit file.ps1` from the integrated console to open files - local or remote - right in the ISE.

This feature is also available in the PowerShell extension for VSCode. This guide shows you how to do it.

Prerequisites

This guide assumes that you have:

- A remote resource (ex: a VM, a container) that you have access to
- PowerShell running on it and the host machine
- VSCode and the PowerShell extension for VSCode

This feature works on PowerShell and Windows PowerShell.

This feature also works when connecting to a remote machine via WinRM, PowerShell Direct, or SSH. If you want to use SSH, but are using Windows, check out the Win32 version of SSH !

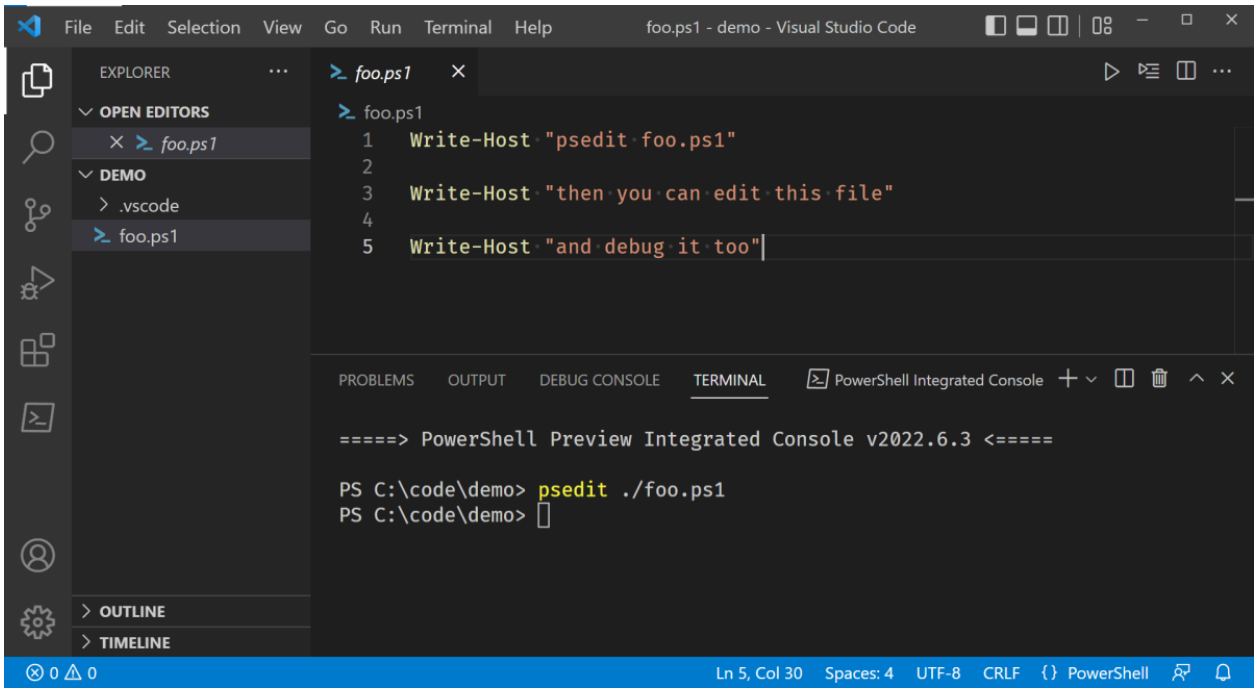
> **ⓘ Important**
>
> The `Open-EditorFile` and `psedit` commands only work in the **PowerShell Integrated Console** created by the PowerShell extension for VSCode.

Usage examples

These examples show remote editing and debugging from a MacBook Pro to an Ubuntu VM running in Azure. The process is identical on Windows.

Local file editing with Open-EditorFile

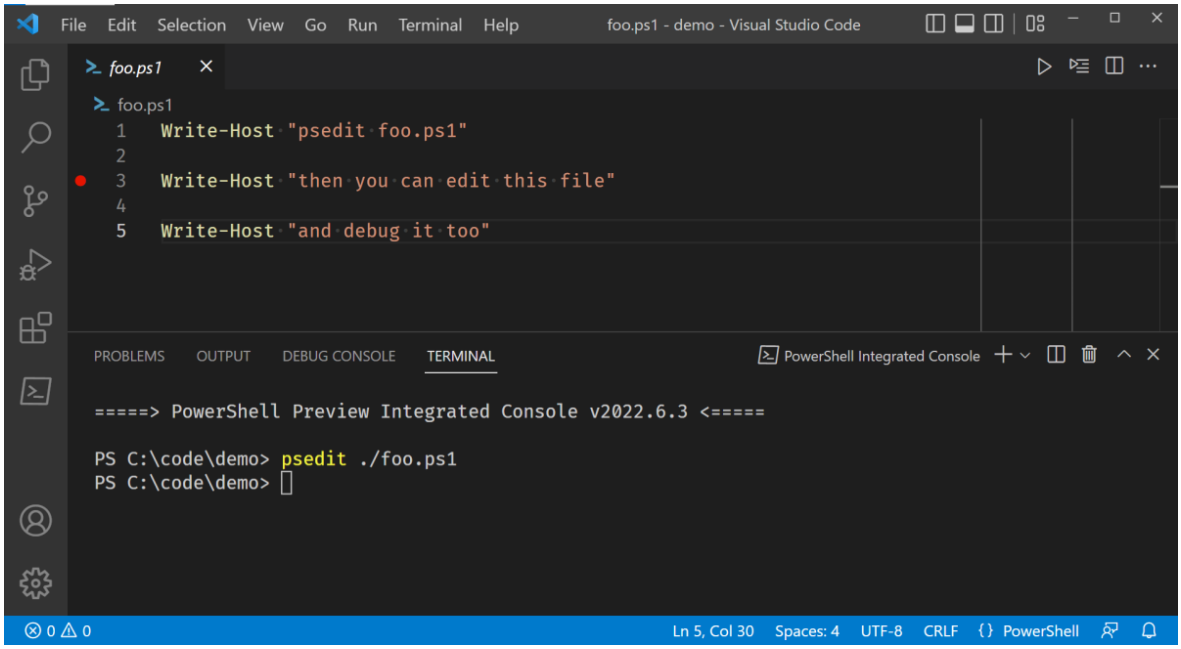
With the PowerShell extension for VSCode started and the PowerShell Integrated Console opened, we can type `Open-EditorFile foo.ps1` or `psedit foo.ps1` to open the local foo.ps1 file right in the editor.



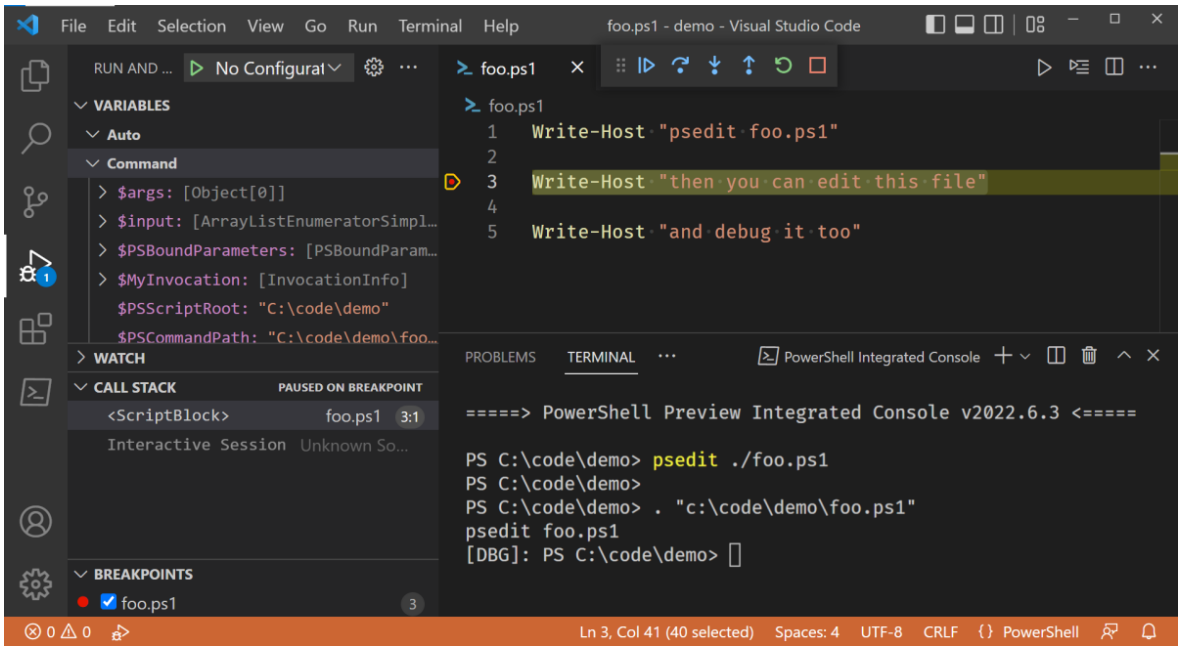
> **Note**
>
> The file `foo.ps1` must already exist.

From there, we can:

- Add breakpoints to the gutter



- Hit F5 to debug the PowerShell script.



While debugging, you can interact with the debug console, check out the variables in the scope on the left, and all the other standard debugging tools.

Remote file editing with Open-EditorFile

Now let's get into remote file editing and debugging. The steps are nearly the same, there's just one thing we need to do first - enter our PowerShell session to the remote server.

There's a cmdlet for to do so. It's called `Enter-PSSession`.

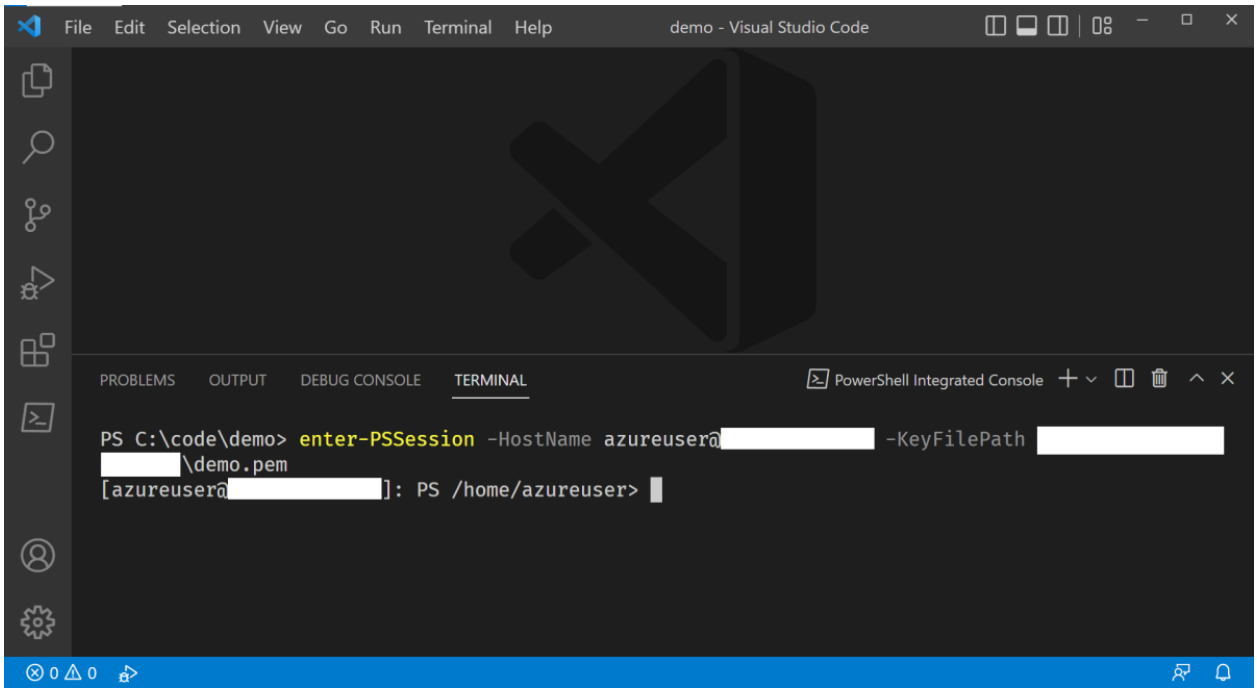
In short:

- `Enter-PSSession -ComputerName foo` starts a session via WinRM
- `Enter-PSSession -ContainerId foo` and `Enter-PSSession -VmId foo` start a session via PowerShell Direct
- `Enter-PSSession -HostName foo` starts a session via SSH

For more information, see the documentation for Enter-PSSession.

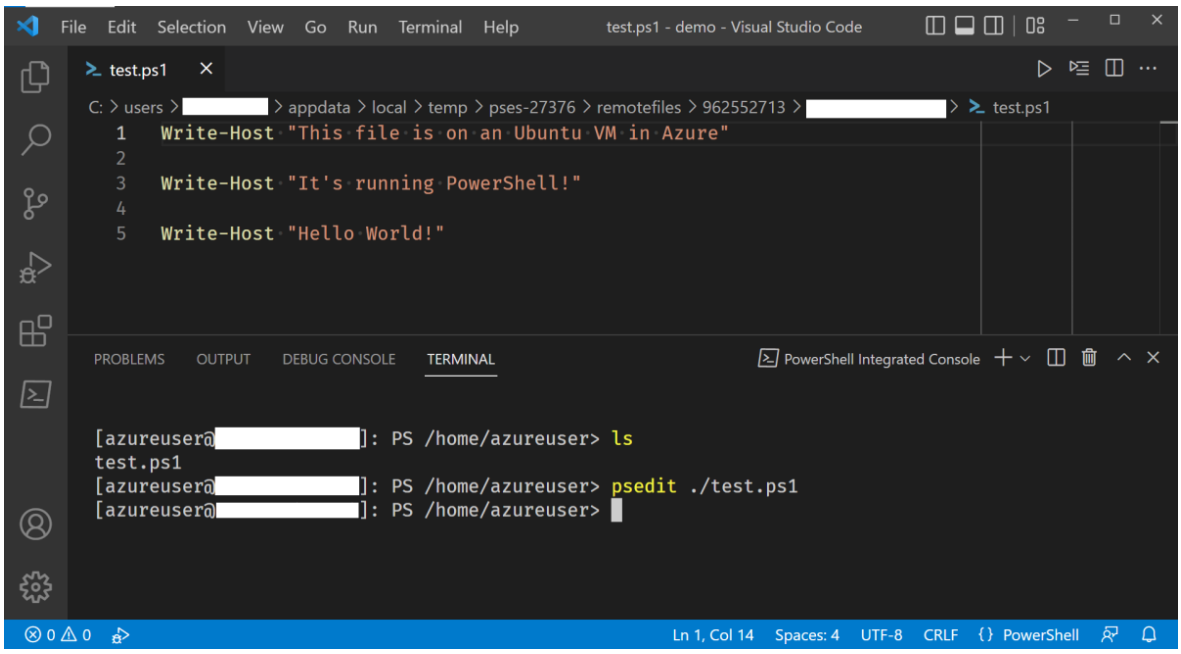
Since we're remoting to an Ubuntu VM in Azure, we're using SSH.

First, in the Integrated Console, run `Enter-PSSession`. You're connected to the remote session when `[<hostname>]` shows up to the left of your prompt.

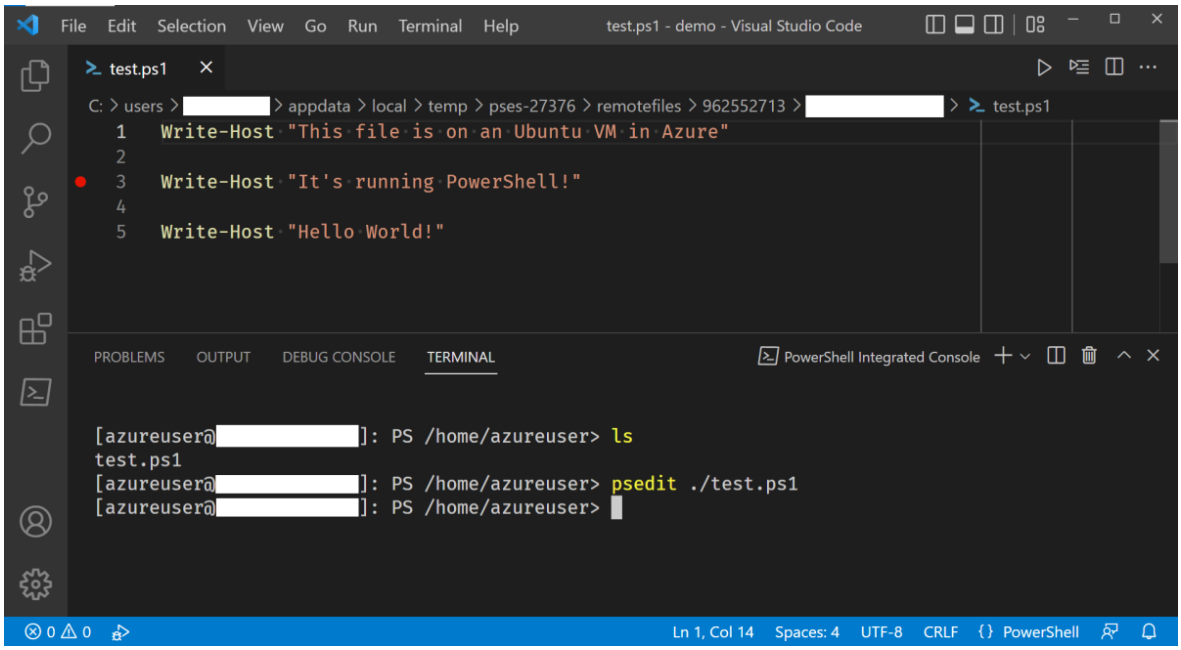


Now, we can do the same steps as if we're editing a local script.

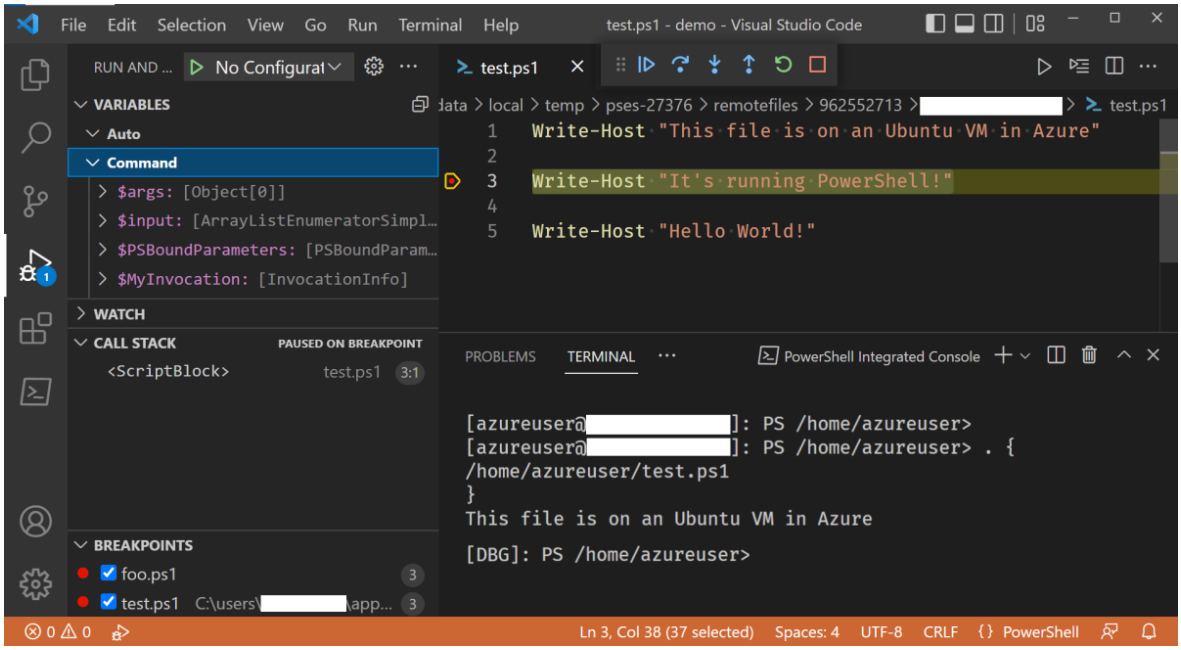
1. Run `Open-EditorFile test.ps1` or `psedit test.ps1` to open the remote `test.ps1` file



2. Edit the file/set breakpoints



3. Start debugging (F5) the remote file



If you have any problems, you can open issues in the GitHub repo.

Understanding file encoding in VS Code and PowerShell

Article • 12/16/2022

When using VS Code to create and edit PowerShell scripts, it's important that your files are saved using the correct character encoding format.

What is file encoding and why is it important?

VS Code manages the interface between a human entering strings of characters into a buffer and reading/writing blocks of bytes to the filesystem. When VS Code saves a file, it uses a text encoding to decide what bytes each character becomes. For more information, see about_Character_Encoding.

Similarly, when PowerShell runs a script it must convert the bytes in a file to characters to reconstruct the file into a PowerShell program. Since VS Code writes the file and PowerShell reads the file, they need to use the same encoding system. This process of parsing a PowerShell script goes: *bytes* -> *characters* -> *tokens* -> *abstract syntax tree* -> *execution*.

Both VS Code and PowerShell are installed with a sensible default encoding configuration. However, the default encoding used by PowerShell has changed with the release of PowerShell 6. To ensure you have no problems using PowerShell or the PowerShell extension in VS Code, you need to configure your VS Code and PowerShell settings properly.

Common causes of encoding issues

Encoding problems occur when the encoding of VS Code or your script file doesn't match the expected encoding of PowerShell. There is no way for PowerShell to automatically determine the file encoding.

You're more likely to have encoding problems when you're using characters not in the 7-bit ASCII character set. For example:

- Extended non-letter characters like em-dash (`–`), non-breaking space ( ) or left double quotation mark (`"`)
- Accented latin characters (`É`, `ü`)
- Non-latin characters like Cyrillic (`Д`, `Ц`)

- CJK characters (`本`, `화`, `が`)

Common reasons for encoding issues are:

- The encodings of VS Code and PowerShell haven't been changed from their defaults. For PowerShell 5.1 and below, the default encoding is different from VS Code's.
- Another editor has opened and overwritten the file in a new encoding. This often happens with the ISE.
- The file is checked into source control in an encoding that's different from what VS Code or PowerShell expects. This can happen when collaborators use editors with different encoding configurations.

How to tell when you have encoding issues

Often encoding errors present themselves as parse errors in scripts. If you find strange character sequences in your script, this can be the problem. In the example below, an en-dash (`–`) appears as the characters `â€"`:

Output

```
Send-MailMessage : A positional parameter cannot be found that accepts
argument 'Testing FuseMail SMTP...'.
At C:\Users\<User>\<OneDrive>\Development\PowerShell\Scripts\Send-
EmailUsingSmtpRelay.ps1:6 char:1
+ Send-MailMessage â&euro;"From $from â&euro;"To $recipient1 â&euro;"Subject
$subject  ...
+ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
    + CategoryInfo          : InvalidArgument: (:) [Send-MailMessage],
ParameterBindingException
    + FullyQualifiedErrorId :
PositionalParameterNotFound,Microsoft.PowerShell.Commands.SendMailMessage
```

This problem occurs because VS Code encodes the character `–` in UTF-8 as the bytes `0xE2 0x80 0x93`. When these bytes are decoded as Windows-1252, they're interpreted as the characters `â€"`.

Some strange character sequences that you might see include:

- `â€"` instead of `–`
- `â€"` instead of `—`
- `Ã„2` instead of `Ä`
- `Â` instead of ` ` (a non-breaking space)
- `Ã©` instead of `é`

This handy reference lists the common patterns that indicate a UTF-8/Windows-1252 encoding problem.

How the PowerShell extension in VS Code interacts with encodings

The PowerShell extension interacts with scripts in a number of ways:

1. When scripts are edited in VS Code, the contents are sent by VS Code to the extension. The Language Server Protocol mandates that this content is transferred in UTF-8. Therefore, it isn't possible for the extension to get the wrong encoding.
2. When scripts are executed directly in the Integrated Console, they're read from the file by PowerShell directly. If PowerShell's encoding differs from VS Code's, something can go wrong here.
3. When a script that's open in VS Code references another script that isn't open in VS Code, the extension falls back to loading that script's content from the file system. The PowerShell extension defaults to UTF-8 encoding, but uses byte-order mark, or BOM, detection to select the correct encoding.

The problem occurs when assuming the encoding of BOM-less formats (like UTF-8 with no BOM and Windows-1252). The PowerShell extension defaults to UTF-8. The extension can't change VS Code's encoding settings. For more information, see issue #824.

Choosing the right encoding

Different systems and applications can use different encodings:

- In .NET Standard, on the web, and in the Linux world, UTF-8 is now the dominant encoding.
- Many .NET Framework applications use UTF-16. For historical reasons, this is sometimes called "Unicode", a term that now refers to a broad standard that includes both UTF-8 and UTF-16.
- On Windows, many native applications that predate Unicode continue to use Windows-1252 by default.

Unicode encodings also have the concept of a byte-order mark (BOM). BOMs occur at the beginning of text to tell a decoder which encoding the text is using. For multi-byte encodings, the BOM also indicates endianness of the encoding. BOMs are designed to

be bytes that rarely occur in non-Unicode text, allowing a reasonable guess that text is Unicode when a BOM is present.

BOMs are optional and their adoption isn't as popular in the Linux world because a dependable convention of UTF-8 is used everywhere. Most Linux applications presume that text input is encoded in UTF-8. While many Linux applications will recognize and correctly handle a BOM, a number don't, leading to artifacts in text manipulated with those applications.

Therefore:

- If you work primarily with Windows applications and Windows PowerShell, you should prefer an encoding like UTF-8 with BOM or UTF-16.
- If you work across platforms, you should prefer UTF-8 with BOM.
- If you work mainly in Linux-associated contexts, you should prefer UTF-8 without BOM.
- Windows-1252 and latin-1 are essentially legacy encodings that you should avoid if possible. However, some older Windows applications may depend on them.
- It's also worth noting that script signing is encoding-dependent, meaning a change of encoding on a signed script will require resigning.

Configuring VS Code

VS Code's default encoding is UTF-8 without BOM.

To set VS Code's encoding, go to the VS Code settings (`Ctrl`+`,`) and set the `"files.encoding"` setting:

JSON

```
"files.encoding": "utf8bom"
```

Some possible values are:

- `utf8`: [UTF-8] without BOM
- `utf8bom`: [UTF-8] with BOM
- `utf16le`: Little endian [UTF-16]
- `utf16be`: Big endian [UTF-16]
- `windows1252`: [Windows-1252]

You should get a dropdown for this in the GUI view, or completions for it in the JSON view.

You can also add the following to autodetect encoding when possible:

JSON

```
"files.autoGuessEncoding": true
```

If you don't want these settings to affect all files types, VS Code also allows per-language configurations. Create a language-specific setting by putting settings in a `[<language-name>]` field. For example:

JSON

```
"[powershell]": {
    "files.encoding": "utf8bom",
    "files.autoGuessEncoding": true
}
```

You may also want to consider installing the Gremlins tracker for Visual Studio Code. This extension reveals certain Unicode characters that easily corrupted because they're invisible or look like other normal characters.

Configuring PowerShell

PowerShell's default encoding varies depending on version:

- In PowerShell 6+, the default encoding is UTF-8 without BOM on all platforms.
- In Windows PowerShell, the default encoding is usually Windows-1252, an extension of latin-1, also known as ISO 8859-1.

In PowerShell 5+ you can find your default encoding with this:

PowerShell

```
[psobject].Assembly.GetTypes() | Where-Object { $_.Name -eq 'ClrFacade'} |
  ForEach-Object {
    $_.GetMethod('GetDefaultEncoding',
[System.Reflection.BindingFlags]'nonpublic,static').Invoke($null, @())
  }
```

The following script can be used to determine what encoding your PowerShell session infers for a script without a BOM.

PowerShell

```
$badBytes = [byte[]]@(0xC3, 0x80)
$utf8Str = [System.Text.Encoding]::UTF8.GetString($badBytes)
$bytes = [System.Text.Encoding]::ASCII.GetBytes('Write-Output "') +
[byte[]]@(0xC3, 0x80) + [byte[]]@(0x22)
$path = Join-Path ([System.IO.Path]::GetTempPath()) 'encodingtest.ps1'

try
{
    [System.IO.File]::WriteAllBytes($path, $bytes)

    switch (& $path)
    {
        $utf8Str
        {
            return 'UTF-8'
            break
        }

        default
        {
            return 'Windows-1252'
            break
        }
    }
}
finally
{
    Remove-Item $path
}
```

It's possible to configure PowerShell to use a given encoding more generally using profile settings. See the following articles:

- @mklement0's answer about PowerShell encoding on StackOverflow.
- @rkeithhill's blog post about dealing with BOM-less UTF-8 input in PowerShell.

It's not possible to force PowerShell to use a specific input encoding. PowerShell 5.1 and below, running on Windows with the locale set to en-US, defaults to Windows-1252 encoding when there's no BOM. Other locale settings may use a different encoding. To ensure interoperability, it's best to save scripts in a Unicode format with a BOM.

> **Important**
>
> Any other tools you have that touch PowerShell scripts may be affected by your encoding choices or re-encode your scripts to another encoding.

Existing scripts

Scripts already on the file system may need to be re-encoded to your new chosen encoding. In the bottom bar of VS Code, you'll see the label UTF-8. Click it to open the action bar and select **Save with encoding**. You can now pick a new encoding for that file. See VS Code's encoding for full instructions.

If you need to re-encode multiple files, you can use the following script:

PowerShell

```
Get-ChildItem *.ps1 -Recurse | ForEach-Object {
    $content = Get-Content -Path $_
    Set-Content -Path $_.Fullname -Value $content -Encoding UTF8 -PassThru -
Force
}
```

The PowerShell Integrated Scripting Environment (ISE)

If you also edit scripts using the PowerShell ISE, you need to synchronize your encoding settings there.

The ISE should honor a BOM, but it's also possible to use reflection to set the encoding. Note that this wouldn't be persisted between startups.

Source control software

Some source control tools, such as git, ignore encodings; git just tracks the bytes. Others, like Azure DevOps or Mercurial, may not. Even some git-based tools rely on decoding text.

When this is the case, make sure you:

- Configure the text encoding in your source control to match your VS Code configuration.
- Ensure all your files are checked into source control in the relevant encoding.
- Be wary of changes to the encoding received through source control. A key sign of this is a diff indicating changes but where nothing seems to have changed (because bytes have but characters have not).

Collaborators' environments

On top of configuring source control, ensure that your collaborators on any files you share don't have settings that override your encoding by re-encoding PowerShell files.

Other programs

Any other program that reads or writes a PowerShell script may re-encode it.

Some examples are:

- Using the clipboard to copy and paste a script. This is common in scenarios like:
  - Copying a script into a VM
  - Copying a script out of an email or webpage
  - Copying a script into or out of a Microsoft Word or PowerPoint document
- Other text editors, such as:
  - Notepad
  - vim
  - Any other PowerShell script editor
- Text editing utilities, like:
  - `Get-Content`/`Set-Content`/`Out-File`
  - PowerShell redirection operators like `>` and `>>`
  - `sed`/`awk`
- File transfer programs, like:
  - A web browser, when downloading scripts
  - A file share

Some of these tools deal in bytes rather than text, but others offer encoding configurations. In those cases where you need to configure an encoding, you need to make it the same as your editor encoding to prevent problems.

Other resources on encoding in PowerShell

There are a few other nice posts on encoding and configuring encoding in PowerShell that are worth a read:

- about_Character_Encoding
- @mklement0's summary of PowerShell encoding on StackOverflow
- Previous issues opened on VS Code-PowerShell for encoding problems:
  - #1308
  - #1628
  - #1680
  - #1744
  - #1751
- The classic *Joel on Software* write up about Unicode
- Encoding in .NET Standard

Using Visual Studio Code to debug compiled cmdlets

Article • 02/08/2023

This guide shows you how to interactively debug C# source code for a compiled PowerShell module using Visual Studio Code (VS Code) and the C# extension.

Some familiarity with the Visual Studio Code debugger is assumed.

- For a general introduction to the VS Code debugger, see Debugging in Visual Studio Code.
- For examples of debugging PowerShell script files and modules, see Using Visual Studio Code for remote editing and debugging.

This guide assumes you have read and followed the instructions in the Writing Portable Modules guide.

Creating a build task

Build your project automatically before launching a debugging session. Rebuilding ensures that you debug the latest version of your code.

Configure a build task:

1. In the **Command Palette**, run the **Configure Default Build Task** command.

   Run Configure Default Build Task

2. In the **Select a task to configure** dialog, choose **Create tasks.json file from template**.

3. In the **Select a Task Template** dialog, choose **.NET Core**.

A new `tasks.json` file is created if one doesn't exist yet.

To test your build task:

1. In the **Command Palette**, run the **Run Build Task** command.

2. In the **Select the build task to run** dialog, choose **build**.

Information about DLL files being locked

By default, a successful build doesn't show output in the terminal pane. If you see output that contains the text **Project file doesn't exist**, you should edit the `tasks.json` file. Include the explicit path to the C# project expressed as `"${workspaceFolder}/myModule"`. In this example, `myModule` is the name of the project folder. This entry must go after the `build` entry in the `args` list as follows:

JSON

```
    {
        "label": "build",
        "command": "dotnet",
        "type": "shell",
        "args": [
            "build",
            "${workspaceFolder}/myModule",
            // Ask dotnet build to generate full paths for file names.
            "/property:GenerateFullPaths=true",
            // Do not generate summary otherwise it leads to duplicate
errors in Problems panel
            "/consoleloggerparameters:NoSummary",
        ],
        "group": "build",
        "presentation": {
            "reveal": "silent"
        },
        "problemMatcher": "$msCompile"
    }
```

When debugging, your module DLL is imported into the PowerShell session in the VS Code terminal. The DLL becomes locked. The following message is displayed when you run the build task without closing the terminal session:

Output

```
Could not copy "obj\Debug\netstandard2.0\myModule.dll" to
"bin\Debug\netstandard2.0\myModule.dll"`.
```

Terminal sessions must be closed before you rebuild.

Setting up the debugger

To debug the PowerShell cmdlet, you need to set up a custom launch configuration. This configuration is used to:

- Build your source code
- Start PowerShell with your module loaded

- Leave PowerShell open in the terminal pane

When you invoke your cmdlet in the terminal session, the debugger stops at any breakpoints set in your source code.

Configuring launch.json for PowerShell

1. Install the C# for Visual Studio Code extension
2. In the Debug pane, add a debug configuration
3. In the `Select environment` dialog, choose `.NET Core`
4. The `launch.json` file is opened in the editor. With your cursor inside the `configurations` array, you see the `configuration` picker. If you don't see this list, select **Add Configuration**.
5. To create a default debug configuration, select **Launch .NET Core Console App**:

   Launch .NET Core Console App
6. Edit the `name`, `program`, `args`, and `console` fields as follows:

   JSON

```
{
    "name": "PowerShell cmdlets: pwsh",
    "type": "coreclr",
    "request": "launch",
    "preLaunchTask": "build",
    "program": "pwsh",
    "args": [
        "-NoExit",
        "-NoProfile",
        "-Command",
        "Import-Module
${workspaceFolder}/myModule/bin/Debug/netstandard2.0/myModule.dll",
    ],
    "cwd": "${workspaceFolder}",
    "stopAtEntry": false,
    "console": "integratedTerminal"
}
```

The `program` field is used to launch `pwsh` so that the cmdlet being debugged can be run. The `-NoExit` argument prevents the PowerShell session from exiting as soon as the module is imported. The path in the `Import-Module` argument is the default build output path when you've followed the Writing Portable Modules guide. If you've created a

module manifest (`.psd1` file), you should use the path to that instead. The `/` path separator works on Windows, Linux, and macOS. You must use the integrated terminal to run the PowerShell commands you want to debug.

> ⓘ **Note**
>
> If the debugger doesn't stop at any breakpoints, look in the Visual Studio Code Debug Console for a line that says:
>
> ```
> Loaded '/path/to/myModule.dll'. Skipped loading symbols. Module is
> optimized and the debugger option 'Just My Code' is enabled.
> ```
>
> If you see this, add `"justMyCode": false` to your launch config (at the same level as `"console": "integratedTerminal"`.

Configuring launch.json for Windows PowerShell

This launch configuration works for testing your cmdlets in Windows PowerShell (`powershell.exe`). Create a second launch configuration with the following changes:

1. `name` should be `PowerShell cmdlets: powershell`
2. `type` should be `clr`
3. `program` should be `powershell`

   It should look like this:

   JSON

   ```
   {
        "name": "PowerShell cmdlets: powershell",
        "type": "clr",
        "request": "launch",
        "preLaunchTask": "build",
        "program": "powershell",
        "args": [
            "-NoExit",
            "-NoProfile",
            "-Command",
            "Import-Module
   ${workspaceFolder}/myModule/bin/Debug/netstandard2.0/myModule.dll",
        ],
        "cwd": "${workspaceFolder}",
   ```

```
        "stopAtEntry": false,
        "console": "integratedTerminal"
    }
```

Launching a debugging session

Now everything is ready to begin debugging.

- Place a breakpoint in the source code for the cmdlet you want to debug:

  A breakpoint shows as a red dot in the gutter

- Ensure that the relevant **PowerShell cmdlets** configuration is selected in the configuration drop-down menu in the **Debug** view:

  Select the launch configuration

- Press `F5` or click on the **Start Debugging** button

- Switch to the terminal pane and invoke your cmdlet:

  Invoke the cmdlet

- Execution stops at the breakpoint:

  Executions halts at breakpoint

You can step through the source code, inspect variables, and inspect the call stack.

To end debugging, click **Stop** in the debug toolbar or press `Shift`+`F5`. The shell used for debugging exits and releases the lock on the compiled DLL file.

PowerShell scripting performance considerations

Article • 06/23/2023

PowerShell scripts that leverage .NET directly and avoid the pipeline tend to be faster than idiomatic PowerShell. Idiomatic PowerShell uses cmdlets and PowerShell functions, often leveraging the pipeline, and resorting to .NET only when necessary.

> **Note**
>
> Many of the techniques described here aren't idiomatic PowerShell and may reduce the readability of a PowerShell script. Script authors are advised to use idiomatic PowerShell unless performance dictates otherwise.

Suppressing output

There are many ways to avoid writing objects to the pipeline.

- Assigning to `$null`
- Casting to `[void]`
- File redirection to `$null`
- Pipe to `Out-Null`

The speeds of assigning to `$null`, casting to `[void]`, and file redirection to `$null` are almost identical. However, calling `Out-Null` in a large loop can be significantly slower, especially in PowerShell 5.1.

PowerShell

```
$tests = @{
    'Assign to $null' = {
        $arrayList = [System.Collections.ArrayList]::new()
        foreach ($i in 0..$args[0]) {
            $null = $arraylist.Add($i)
        }
    }
    'Cast to [void]' = {
        $arrayList = [System.Collections.ArrayList]::new()
        foreach ($i in 0..$args[0]) {
            [void]$arraylist.Add($i)
        }
    }
```

```
    'Redirect to $null' = {
        $arrayList = [System.Collections.ArrayList]::new()
        foreach ($i in 0..$args[0]) {
            $arraylist.Add($i) > $null
        }
    }
    'Pipe to Out-Null' = {
        $arrayList = [System.Collections.ArrayList]::new()
        foreach ($i in 0..$args[0]) {
            $arraylist.Add($i) | Out-Null
        }
    }
}

10kb, 50kb, 100kb | ForEach-Object {
    $groupResult = foreach ($test in $tests.GetEnumerator()) {
        $ms = (Measure-Command { & $test.Value $_ }).TotalMilliseconds

        [pscustomobject]@{
            Iterations        = $_
            Test              = $test.Key
            TotalMilliseconds = [math]::Round($ms, 2)
        }

        [GC]::Collect()
        [GC]::WaitForPendingFinalizers()
    }

    $groupResult = $groupResult | Sort-Object TotalMilliseconds
    $groupResult | Select-Object *, @{
        Name       = 'RelativeSpeed'
        Expression = {
            $relativeSpeed = $_.TotalMilliseconds /
$groupResult[0].TotalMilliseconds
            [math]::Round($relativeSpeed, 2).ToString() + 'x'
        }
    }
}
```

These tests were run on a Windows 11 machine in PowerShell 7.3.4. The results are shown below:

Output

```
Iterations Test              TotalMilliseconds RelativeSpeed
---------- ----              ----------------- -------------
     10240 Assign to $null               36.74 1x
     10240 Redirect to $null             55.84 1.52x
     10240 Cast to [void]                62.96 1.71x
     10240 Pipe to Out-Null              81.65 2.22x
     51200 Assign to $null              193.92 1x
     51200 Cast to [void]               200.77 1.04x
     51200 Redirect to $null            219.69 1.13x
```

```
 51200 Pipe to Out-Null              329.62 1.7x
102400 Redirect to $null             386.08 1x
102400 Assign to $null               392.13 1.02x
102400 Cast to [void]                405.24 1.05x
102400 Pipe to Out-Null              572.94 1.48x
```

The times and relative speeds can vary depending on the hardware, the version of PowerShell, and the current workload on the system.

Array addition

Generating a list of items is often done using an array with the addition operator:

PowerShell

```powershell
$results = @()
$results += Do-Something
$results += Do-SomethingElse
$results
```

Array addition is inefficient because arrays have a fixed size. Each addition to the array creates a new array big enough to hold all elements of both the left and right operands. The elements of both operands are copied into the new array. For small collections, this overhead may not matter. Performance can suffer for large collections.

There are a couple of alternatives. If you don't actually require an array, instead consider using a typed generic list (**List<T>**):

PowerShell

```powershell
$results = [System.Collections.Generic.List[object]]::new()
$results.AddRange((Do-Something))
$results.AddRange((Do-SomethingElse))
$results
```

The performance impact of using array addition grows exponentially with the size of the collection and the number additions. This code compares explicitly assigning values to an array with using array addition and using the `Add()` method on a **List<T>**. It defines explicit assignment as the baseline for performance.

PowerShell

```powershell
$tests = @{
    'PowerShell Explicit Assignment' = {
        param($count)
```

```
        $result = foreach($i in 1..$count) {
            $i
        }
    }
    '.Add(..) to List<T>' = {
        param($count)

        $result = [Collections.Generic.List[int]]::new()
        foreach($i in 1..$count) {
            $result.Add($i)
        }
    }
    '+= Operator to Array' = {
        param($count)

        $result = @()
        foreach($i in 1..$count) {
            $result += $i
        }
    }
}

5kb, 10kb, 100kb | ForEach-Object {
    $groupResult = foreach($test in $tests.GetEnumerator()) {
        $ms = (Measure-Command { & $test.Value -Count $_
}).TotalMilliseconds

        [pscustomobject]@{
            CollectionSize    = $_
            Test              = $test.Key
            TotalMilliseconds = [math]::Round($ms, 2)
        }

        [GC]::Collect()
        [GC]::WaitForPendingFinalizers()
    }

    $groupResult = $groupResult | Sort-Object TotalMilliseconds
    $groupResult | Select-Object *, @{
        Name       = 'RelativeSpeed'
        Expression = {
            $relativeSpeed = $_.TotalMilliseconds /
$groupResult[0].TotalMilliseconds
            [math]::Round($relativeSpeed, 2).ToString() + 'x'
        }
    }
}
```

These tests were run on a Windows 11 machine in PowerShell 7.3.4.

Output

```
CollectionSize Test                            TotalMilliseconds
RelativeSpeed
-------------- ----                            ----------------
-
          5120 PowerShell Explicit Assignment            26.65 1x
          5120 .Add(..) to List<T>                      110.98 4.16x
          5120 += Operator to Array                     402.91 15.12x
         10240 PowerShell Explicit Assignment             0.49 1x
         10240 .Add(..) to List<T>                      137.67 280.96x
         10240 += Operator to Array                    1678.13 3424.76x
        102400 PowerShell Explicit Assignment            11.18 1x
        102400 .Add(..) to List<T>                     1384.03 123.8x
        102400 += Operator to Array                  201991.06 18067.18x
```

When you're working with large collections, array addition is dramatically slower than adding to a **List<T>**.

When using a **List<T>**, you need to create the list with a specific type, like **String** or **Int**. When you add objects of a different type to the list, they are cast to the specified type. If they can't be cast to the specified type, the method raises an exception.

PowerShell

```
$intList = [System.Collections.Generic.List[int]]::new()
$intList.Add(1)
$intList.Add('2')
$intList.Add(3.0)
$intList.Add('Four')
$intList
```

Output

```
MethodException:
Line |
   5 |  $intList.Add('Four')
     |  ~~~~~~~~~~~~~~~~~~~~
     | Cannot convert argument "item", with value: "Four", for "Add" to type
     "System.Int32": "Cannot convert value "Four" to type "System.Int32".
     Error: "The input string 'Four' was not in a correct format.""

1
2
3
```

When you need the list to be a collection of different types of objects, create it with **Object** as the list type. You can enumerate the collection inspect the types of the objects in it.

PowerShell

```
$objectList = [System.Collections.Generic.List[object]]::new()
$objectList.Add(1)
$objectList.Add('2')
$objectList.Add(3.0)
$objectList.GetEnumerator().ForEach({ "$_ is $($_.GetType())" })
```

Output

```
1 is int
2 is string
3 is double
```

If you do require an array, you can call the `ToArray()` method on the list or you can let PowerShell create the array for you:

PowerShell

```
$results = @(
    Do-Something
    Do-SomethingElse
)
```

In this example, PowerShell creates an **ArrayList** to hold the results written to the pipeline inside the array expression. Just before assigning to `$results`, PowerShell converts the **ArrayList** to an **object[]**.

String addition

Strings are immutable. Each addition to the string actually creates a new string big enough to hold the contents of both the left and right operands, then copies the elements of both operands into the new string. For small strings, this overhead may not matter. For large strings, this can affect performance and memory consumption.

There are at least two alternatives:

- The `-join` operator concatenates strings
- The .NET **StringBuilder** class provides a mutable string

The following example compares the performance of these three methods of building a string.

PowerShell

```
$tests = @{
    'StringBuilder' = {
        $sb = [System.Text.StringBuilder]::new()
        foreach ($i in 0..$args[0]) {
            $sb = $sb.AppendLine("Iteration $i")
        }
        $sb.ToString()
    }
    'Join operator' = {
        $string = @(
            foreach ($i in 0..$args[0]) {
                "Iteration $i"
            }
        ) -join "`n"
        $string
    }
    'Addition Assignment +=' = {
        $string = ''
        foreach ($i in 0..$args[0]) {
            $string += "Iteration $i`n"
        }
        $string
    }
}

10kb, 50kb, 100kb | ForEach-Object {
    $groupResult = foreach ($test in $tests.GetEnumerator()) {
        $ms = (Measure-Command { & $test.Value $_ }).TotalMilliseconds

        [pscustomobject]@{
            Iterations        = $_
            Test              = $test.Key
            TotalMilliseconds = [math]::Round($ms, 2)
        }

        [GC]::Collect()
        [GC]::WaitForPendingFinalizers()
    }

    $groupResult = $groupResult | Sort-Object TotalMilliseconds
    $groupResult | Select-Object *, @{
        Name       = 'RelativeSpeed'
        Expression = {
            $relativeSpeed = $_.TotalMilliseconds /
$groupResult[0].TotalMilliseconds
            [math]::Round($relativeSpeed, 2).ToString() + 'x'
        }
    }
}
```

These tests were run on a Windows 10 machine in PowerShell 7.3.4. The output shows that the `-join` operator is the fastest, followed by the **StringBuilder** class.

Output

```
Iterations Test                    TotalMilliseconds RelativeSpeed
---------- ----                    ----------------- -------------
     10240 Join operator                        7.08 1x
     10240 StringBuilder                       54.10 7.64x
     10240 Addition Assignment +=             724.16 102.28x
     51200 Join operator                       41.76 1x
     51200 StringBuilder                      318.06 7.62x
     51200 Addition Assignment +=           17693.06 423.68x
    102400 Join operator                      106.98 1x
    102400 StringBuilder                      543.84 5.08x
    102400 Addition Assignment +=           90693.13 847.76x
```

The times and relative speeds can vary depending on the hardware, the version of PowerShell, and the current workload on the system.

Processing large files

The idiomatic way to process a file in PowerShell might look something like:

PowerShell

```powershell
Get-Content $path | Where-Object { $_.Length -gt 10 }
```

This can be an order of magnitude slower than using .NET APIs directly:

PowerShell

```powershell
try
{
    $stream = [System.IO.StreamReader]::new($path)
    while ($line = $stream.ReadLine())
    {
        if ($line.Length -gt 10)
        {
            $line
        }
    }
}
finally
{
    $stream.Dispose()
}
```

Looking up entries by property in large collections

It's common to need to use a shared property to identify the same record in different collections, like using a name to retrieve an ID from one list and an email from another. Iterating over the first list to find the matching record in the second collection is slow. In particular, the repeated filtering of the second collection has a large overhead.

Given two collections, one with an **ID** and **Name**, the other with **Name** and **Email**:

PowerShell

```
$Employees = 1..10000 | ForEach-Object {
    [PSCustomObject]@{
        Id   = $_
        Name = "Name$_"
    }
}

$Accounts = 2500..7500 | ForEach-Object {
    [PSCustomObject]@{
        Name = "Name$_"
        Email = "Name$_@fabrikam.com"
    }
}
```

The usual way to reconcile these collections to return a list of objects with the **ID**, **Name**, and **Email** properties might look like this:

PowerShell

```
$Results = $Employees | ForEach-Object -Process {
    $Employee = $_

    $Account = $Accounts | Where-Object -FilterScript {
        $_.Name -eq $Employee.Name
    }

    [pscustomobject]@{
        Id    = $Employee.Id
        Name  = $Employee.Name
        Email = $Account.Email
    }
}
```

However, that implementation has to filter all 5000 items in the `$Accounts` collection once for every item in the `$Employee` collection. That can take minutes, even for this single-value lookup.

Instead, you can make a hash table that uses the shared **Name** property as a key and the matching account as the value.

PowerShell

```
$LookupHash = @{}
foreach ($Account in $Accounts) {
    $LookupHash[$Account.Name] = $Account
}
```

Looking up keys in a hash table is much faster than filtering a collection by property values. Instead of checking every item in the collection, PowerShell can check if the key is defined and use its value.

PowerShell

```
$Results = $Employees | ForEach-Object -Process {
    $Email = $LookupHash[$_.Name].Email
    [pscustomobject]@{
        Id    = $_.Id
        Name  = $_.Name
        Email = $Email
    }
}
```

This is much faster. While the looping filter took minutes to complete, the hash lookup takes less than a second.

Avoid Write-Host

It's generally considered poor practice to write output directly to the console, but when it makes sense, many scripts use `Write-Host`.

If you must write many messages to the console, `Write-Host` can be an order of magnitude slower than `[Console]::WriteLine()` for specific hosts like `pwsh.exe`, `powershell.exe`, or `powershell_ise.exe`. However, `[Console]::WriteLine()` isn't guaranteed to work in all hosts. Also, output written using `[Console]::WriteLine()` doesn't get written to transcripts started by `Start-Transcript`.

Instead of using `Write-Host`, consider using Write-Output.

JIT compilation

PowerShell compiles the script code to bytecode that's interpreted. Beginning in PowerShell 3, for code that's repeatedly executed in a loop, PowerShell can improve performance by Just-in-time (JIT) compiling the code into native code.

Loops that have fewer than 300 instructions are eligible for JIT-compilation. Loops larger than that are too costly to compile. When the loop has executed 16 times, the script is JIT-compiled in the background. When the JIT-compilation completes, execution is transferred to the compiled code.

Avoid repeated calls to a function

Calling a function can be an expensive operation. If you calling a function in a long running tight loop, consider moving the loop inside the function.

Consider the following examples:

PowerShell

```
$ranGen = New-Object System.Random
$RepeatCount = 10000

'Basic for-loop = {0}ms' -f (Measure-Command -Expression {
    for ($i = 0; $i -lt $RepeatCount; $i++) {
        $Null = $ranGen.Next()
    }
}).TotalMilliseconds

'Wrapped in a function = {0}ms' -f (Measure-Command -Expression {
    function Get-RandNum_Core {
        param ($ranGen)
        $ranGen.Next()
    }

    for ($i = 0; $i -lt $RepeatCount; $i++) {
        $Null = Get-RandNum_Core $ranGen
    }
}).TotalMilliseconds

'For-loop in a function = {0}ms' -f (Measure-Command -Expression {
    function Get-RandNum_All {
        param ($ranGen)
        for ($i = 0; $i -lt $RepeatCount; $i++) {
            $Null = $ranGen.Next()
        }
    }

    Get-RandNum_All $ranGen
}).TotalMilliseconds
```

The **Basic for-loop** example is the base line for performance. The second example wraps the random number generator in a function that's called in a tight loop. The third example moves the loop inside the function. The function is only called once but the

code still generates 10000 random numbers. Notice the difference in execution times for each example.

Output

```
Basic for-loop = 47.8668ms
Wrapped in a function = 820.1396ms
For-loop in a function = 23.3193ms
```

Avoid wrapping cmdlet pipelines

Most cmdlets are implemented for the pipeline, which is a sequential syntax and process. For example:

PowerShell

```
cmdlet1 | cmdlet2 | cmdlet3
```

Initializing a new pipeline can be expensive, therefore you should avoid wrapping a cmdlet pipeline into another existing pipeline.

Consider the following example. The `Input.csv` file contains 2100 lines. The `Export-Csv` command is wrapped inside the `ForEach-Object` pipeline. The `Export-Csv` cmdlet is invoked for every iteration of the `ForEach-Object` loop.

PowerShell

```
'Wrapped = {0:N2} ms' -f (Measure-Command -Expression {
    Import-Csv .\Input.csv | ForEach-Object -Begin { $Id = 1 } -Process {
        [PSCustomObject]@{
            Id = $Id
            Name = $_.opened_by
        } | Export-Csv .\Output1.csv -Append
    }
}).TotalMilliseconds

Wrapped = 15,968.78 ms
```

For the next example, the `Export-Csv` command was moved outside of the `ForEach-Object` pipeline. In this case, `Export-Csv` is invoked only once, but still processes all objects passed out of `ForEach-Object`.

PowerShell

```
'Unwrapped = {0:N2} ms' -f (Measure-Command -Expression {
      Import-Csv .\Input.csv | ForEach-Object -Begin { $Id = 2 } -Process {
          [PSCustomObject]@{
              Id = $Id
              Name = $_.opened_by
          }
      } | Export-Csv .\Output2.csv
  }).TotalMilliseconds

Unwrapped = 42.92 ms
```

The unwrapped example is 372 times faster. Also, notice that the first implementation requires the **Append** parameter, which isn't required for the later implementation.

PowerShell module authoring considerations

Article • 11/17/2022

This document includes some guidelines related to how a module is authored for best performance.

Module Manifest Authoring

A module manifest that doesn't use the following guidelines can have a noticeable impact on general PowerShell performance even if the module isn't used in a session.

Command auto-discovery analyzes each module to determine which commands the module exports and this analysis can be expensive. The results of module analysis are cached per user, but the cache isn't available on first run, which is a typical scenario with containers. During module analysis, if the exported commands can be fully determined from the manifest, more expensive analysis of the module can be avoided.

Guidelines

- In the module manifest, don't use wildcards in the `AliasesToExport`, `CmdletsToExport`, and `FunctionsToExport` entries.
- If the module doesn't export commands of a particular type, specify this explicitly in the manifest by specifying `@()`. A missing or `$null` entry is equivalent to specifying the wildcard `*`.

The following should be avoided where possible:

PowerShell

```
@{
    FunctionsToExport = '*'

    # Also avoid omitting an entry, it's equivalent to using a wildcard
    # CmdletsToExport = '*'
    # AliasesToExport = '*'
}
```

Instead, use:

PowerShell

```
@{
    FunctionsToExport = 'Format-Hex', 'Format-Octal'
    CmdletsToExport = @()  # Specify an empty array, not $null
    AliasesToExport = @()  # Also ensure all three entries are present
}
```

Avoid CDXML

When deciding how to implement your module, there are three primary choices:

- Binary (usually C#)
- Script (PowerShell)
- CDXML (an XML file wrapping CIM)

If the speed of loading your module is important, CDXML is roughly an order of magnitude slower than a binary module.

A binary module loads the fastest because it's compiled ahead of time and can use NGen to JIT compile once per machine.

A script module typically loads a bit more slowly than a binary module because PowerShell must parse the script before compiling and executing it.

A CDXML module is typically much slower than a script module because it must first parse an XML file which then generates quite a bit of PowerShell script that's then parsed and compiled.

Preventing script injection attacks

Article • 02/10/2023

PowerShell scripts, like other programming languages, can be vulnerable to injection attacks. An injection attack occurs when a user provides input to a vulnerable function that includes extra commands. The vulnerable function runs the extra commands, which can be a serious security vulnerability. For example, a malicious user could abuse the vulnerable function to run arbitrary code on a remote computer, possibly compromising that computer and gaining access to other machines on the network.

Once you are aware of the issue, there are several ways to protect against injection attacks.

Example of vulnerable code

PowerShell code injection vulnerabilities involve user input that contains script code. The user input is added to vulnerable script where it's parsed and run by PowerShell.

PowerShell

```powershell
function Get-ProcessById
{
    param ($ProcId)

    Invoke-Expression -Command "Get-Process -Id $ProcId"
}
```

The `Get-ProcessById` function looks up a local process by its Id value. It takes a `$ProcId` parameter argument of any type. The `$ProcId` is then converted to a string and inserted into another script that's parsed and run using the `Invoke-Expression` cmdlet. This function works fine when a valid process Id integer is passed in.

PowerShell

```powershell
Get-ProcessById $pid
```

```
 NPM(K)    PM(M)      WS(M)     CPU(s)      Id  SI ProcessName
 ------    -----      -----     ------      --  -- -----------
     97    50.09     132.72       1.20   12528   3 pwsh
```

However, the `$ProcId` parameter doesn't specify a type. It accepts any arbitrary string value that can include other commands.

PowerShell

```
Get-ProcessById "$pid; Write-Host 'pwnd!'"
```

In this example, the function correctly retrieved the process identified by `$pid`, but also ran the injected script `Write-Host 'pwnd!'`.

Output

```
 NPM(K)    PM(M)      WS(M)     CPU(s)      Id  SI ProcessName
 ------    -----      -----     ------      --  -- -----------
     92    45.66     122.52       1.06   21736   3 pwsh
pwnd!
```

Ways to guard against injection attacks

The are several ways to guard against an injection attack.

Use typed input

You can specify a type for the `$ProcId` argument.

PowerShell

```
function Get-ProcessById
{
    param ([int] $ProcId)

    Invoke-Expression -Command "Get-Process -Id $ProcId"
}
Get-ProcessById "$pid; Write-Host 'pwnd!'"
```

Output

```
Get-ProcessById:
Line |
   7 |  Get-ProcessById "$pid; Write-Host 'pwnd!'"
     |                  ~~~~~~~~~~~~~~~~~~~~~~~~~~
     | Cannot process argument transformation on parameter 'ProcId'. Cannot
convert value
"8064; Write-Host 'pwnd!'" to type "System.Int32". Error: "The input string
'8064; Write-Host 'pwnd!'
was not in a correct format."
```

Here, the `$ProcId` input parameter is restricted to an integer type, so an error occurs when a string is passed in that can't be converted to an integer.

Don't use `Invoke-Expression`

Instead of using `Invoke-Expression`, directly call `Get-Process`, and let PowerShell's parameter binder validate the input.

PowerShell

```
function Get-ProcessById
{
    param ($ProcId)

    Get-Process -Id $ProcId
}
Get-ProcessById "$pid; Write-Host 'pwnd!'"
```

Output

```
Get-Process:
Line |
   5 |      Get-Process -Id $ProcId
     |                      ~~~~~~~
     | Cannot bind parameter 'Id'. Cannot convert value "8064; Write-Host
'pwnd!'" to type
"System.Int32". Error: "The input string '8064; Write-Host 'pwnd!' was not
in a correct
format."
```

As a best practice, you should avoid using `Invoke-Expression`, especially when handling user input. `Invoke-Expression` is dangerous because it parses and runs whatever string content you provide, making it vulnerable to injection attacks. It's better to rely on PowerShell parameter binding.

Wrap strings in single quotes

However, there are times when using `Invoke-Expression` is unavoidable and you also need to handle user string input. You can safely handle user input using single quotes around each string input variable. The single quote ensures that PowerShell's parser treats the user input as a single string literal.

PowerShell

```powershell
function Get-ProcessById
{
    param ($ProcId)

    Invoke-Expression -Command "Get-Process -Id '$ProcId'"
}

Get-ProcessById "$pid; Write-Host 'pwnd!'"
```

Output

```
Get-Process: Cannot bind parameter 'Id'. Cannot convert value "8064; Write-
Host " to type
"System.Int32". Error: "The input string '8064; Write-Host' was not in a
correct format."
```

However, this version of the function isn't yet completely safe from injection attacks. A malicious user can still use single quotes in their input to inject code.

PowerShell

```powershell
Get-ProcessById "$pid'; Write-Host 'pwnd!';'"
```

This example uses single quotes in the user input to force the function to run three separate statements, one of which is arbitrary code injected by the user.

Output

```
 NPM(K)    PM(M)      WS(M)     CPU(s)      Id  SI ProcessName
 ------    -----      -----     ------      --  -- -----------
     97    46.08     183.10       1.08    2524   3 pwsh
pwnd!
```

Use the `EscapeSingleQuotedStringContent()` method

To protect against the user inserting their own single quote characters to exploit the function you must use the `EscapeSingleQuotedStringContent()` API. This is a static public method of the PowerShell **System.Management.Automation.Language.CodeGeneration** class. This method makes the user input safe by escaping any single quotes included in the user input.

PowerShell

```powershell
function Get-ProcessById
{
    param ($ProcId)

    $ProcIdClean = [System.Management.Automation.Language.CodeGeneration]::
        EscapeSingleQuotedStringContent("$ProcId")
    Invoke-Expression -Command "Get-Process -Id '$ProcIdClean'"
}
Get-ProcessById "$pid'; Write-Host 'pwnd!';'"
```

Output

```
Get-Process: Cannot bind parameter 'Id'. Cannot convert value "8064'; Write-
Host 'pwnd!';'" to type
"System.Int32". Error: "The input string '8064'; Write-Host 'pwnd!';'' was
not in a correct format."
```

For more information, see EscapeSingleQuotedStringContent().

Detecting vulnerable code with Injection Hunter

Injection Hunter is a module written by Lee Holmes that contains PowerShell Script Analyzer rules for detecting code injection vulnerabilities. Use one of the following commands to install the module from the PowerShell Gallery:

PowerShell

```powershell
# Use PowerShellGet v2.x
Install-Module InjectionHunter

# Use PowerShellGet v3.x
Install-PSResource InjectionHunter
```

You can use this to automate security analysis during builds, continuous integration processes, deployments, and other scenarios.

PowerShell

```powershell
$RulePath = (Get-Module -list InjectionHunter).Path
Invoke-ScriptAnalyzer -CustomRulePath $RulePath -Path .\Invoke-Dangerous.ps1
```

Output

```
RuleName                            Severity     ScriptName Line  Message
--------                            --------     ---------- ----  -------
InjectionRisk.InvokeExpression      Warning      Invoke-Dan 3     Possible
script injection risk via the
                                                 gerous.ps1       Invoke-
Expression cmdlet. Untrusted input can cause
                                                                  arbitrary
PowerShell expressions to be run.
                                                                  Variables
may be used directly for dynamic parameter
                                                                  arguments,
splatting can be used for dynamic
                                                                  parameter
names, and the invocation operator can be
                                                                  used for
dynamic command names. If content escaping
                                                                  is truly
needed, PowerShell has several valid quote

characters, so  [System.Management.Automation.Languag

e.CodeGeneration]::Escape* should be used.
```

For more information, see PSScriptAnalyzer.

Related links

- Lee Holmes' blog post about Injection Hunter
- Injection Hunter

Portable Modules

Article • 11/17/2022

Windows PowerShell is written for .NET Framework while PowerShell Core is written for .NET Core. Portable modules are modules that work in both Windows PowerShell and PowerShell Core. While .NET Framework and .NET Core are highly compatible, there are differences in the available APIs between the two. There are also differences in the APIs available in Windows PowerShell and PowerShell Core. Modules intended to be used in both environments need to be aware of these differences.

Porting an existing module

Porting a PSSnapIn

PowerShell SnapIns aren't supported in PowerShell Core. However, it's trivial to convert a PSSnapIn to a PowerShell module. Typically, the PSSnapIn registration code is in a single source file of a class that derives from PSSnapIn. Remove this source file from the build; it's no longer needed.

Use New-ModuleManifest to create a new module manifest that replaces the need for the PSSnapIn registration code. Some values from the **PSSnapIn** (such as **Description**) can be reused within the module manifest.

The **RootModule** property in the module manifest should be set to the name of the assembly (`.dll`) implementing the cmdlets.

The .NET Portability Analyzer (aka APIPort)

To port modules written for Windows PowerShell to work with PowerShell Core, start with the .NET Portability Analyzer. Run this tool against your compiled assembly to determine if the .NET APIs used in the module are compatible with .NET Framework, .NET Core, and other .NET runtimes. The tool suggests alternate APIs if they exist. Otherwise, you may need to add runtime checks and restrict capabilities not available in specific runtimes.

Creating a new module

If creating a new module, the recommendation is to use the .NET CLI.

Installing the PowerShell Standard module template

Once the .NET CLI is installed, install a template library to generate a simple PowerShell module. The module will be compatible with Windows PowerShell, PowerShell Core, Windows, Linux, and macOS.

The following example shows how to install the template:

PowerShell

```
dotnet new -i Microsoft.PowerShell.Standard.Module.Template
```

Output

```
  Restoring packages for
C:\Users\Steve\.templateengine\dotnetcli\v2.1.302\scratch\restore.csproj...
  Installing Microsoft.PowerShell.Standard.Module.Template 0.1.3.
  Generating MSBuild file
C:\Users\Steve\.templateengine\dotnetcli\v2.1.302\scratch\obj\restore.csproj
.nuget.g.props.
  Generating MSBuild file
C:\Users\Steve\.templateengine\dotnetcli\v2.1.302\scratch\obj\restore.csproj
.nuget.g.targets.
  Restore completed in 1.66 sec for
C:\Users\Steve\.templateengine\dotnetcli\v2.1.302\scratch\restore.csproj.

Usage: new [options]

Options:
  -h, --help          Displays help for this command.
  -l, --list          Lists templates containing the specified name. If no
name is specified, lists all templates.
  -n, --name          The name for the output being created. If no name is
specified, the name of the current directory is used.
  -o, --output        Location to place the generated output.
  -i, --install       Installs a source or a template pack.
  -u, --uninstall     Uninstalls a source or a template pack.
  --nuget-source      Specifies a NuGet source to use during install.
  --type              Filters templates based on available types. Predefined
values are "project", "item" or "other".
  --force             Forces content to be generated even if it would change
existing files.
  -lang, --language   Filters templates based on language and specifies the
language of the template to create.


Templates                         Short Name         Language          Tags
--------------------------------------------------------------------------
------------------
Console Application               console            [C#], F#, VB
Common/Console
```

```
Class library                   classlib          [C#], F#, VB
Common/Library
PowerShell Standard Module      psmodule          [C#]
Library/PowerShell/Module
...
```

Creating a new module project

After the template is installed, you can create a new PowerShell module project using that template. In this example, the sample module is called 'myModule'.

```
PS> mkdir myModule

    Directory: C:\Users\Steve

Mode LastWriteTime Length Name
---- ------------- ------ ----
d----- 8/3/2018 2:41 PM myModule

PS> cd myModule
PS C:\Users\Steve\myModule> dotnet new psmodule

The template "PowerShell Standard Module" was created successfully.

Processing post-creation actions...
Running 'dotnet restore' on C:\Users\Steve\myModule\myModule.csproj...
  Restoring packages for C:\Users\Steve\myModule\myModule.csproj...
  Installing PowerShellStandard.Library 5.1.0.
  Generating MSBuild file
C:\Users\Steve\myModule\obj\myModule.csproj.nuget.g.props.
  Generating MSBuild file
C:\Users\Steve\myModule\obj\myModule.csproj.nuget.g.targets.
  Restore completed in 1.76 sec for C:\Users\Steve\myModule\myModule.csproj.

Restore succeeded.
```

Building the module

Use standard .NET CLI commands to build the project.

PowerShell

```
dotnet build
```

Output

```
PS C:\Users\Steve\myModule> dotnet build
Microsoft (R) Build Engine version 15.7.179.6572 for .NET Core
Copyright (C) Microsoft Corporation. All rights reserved.

  Restore completed in 76.85 ms for C:\Users\Steve\myModule\myModule.csproj.
  myModule -> C:\Users\Steve\myModule\bin\Debug\netstandard2.0\myModule.dll

Build succeeded.
    0 Warning(s)
    0 Error(s)

Time Elapsed 00:00:05.40
```

Testing the module

After building the module, you can import it and execute the sample cmdlet.

PowerShell

```
Import-Module .\bin\Debug\netstandard2.0\myModule.dll
Test-SampleCmdlet -?
Test-SampleCmdlet -FavoriteNumber 7 -FavoritePet Cat
```

Output

```
NAME
    Test-SampleCmdlet

SYNTAX
    Test-SampleCmdlet [-FavoriteNumber] <int> [[-FavoritePet] {Cat | Dog |
Horse}] [<CommonParameters>]


ALIASES
    None


REMARKS
    None


FavoriteNumber FavoritePet
-------------- -----------
             7 Cat
```

Debugging the module

For a guide on setting up Visual Studio Code to debug the module, see Using Visual Studio Code for debugging compiled cmdlets.

Supporting technologies

The following sections describe in detail some of the technologies used by this template.

.NET Standard Library

.NET Standard is a formal specification of .NET APIs that are available in all .NET implementations. Managed code targeting .NET Standard works with the .NET Framework and .NET Core versions that are compatible with that version of the .NET Standard.

> **Note**
>
> Although an API may exist in .NET Standard, the API implementation in .NET Core may throw a `PlatformNotSupportedException` at runtime, so to verify compatibility with Windows PowerShell and PowerShell Core, the best practice is to run tests for your module within both environments. Also run tests on Linux and macOS if your module is intended to be cross-platform.

Targeting .NET Standard helps ensure that, as the module evolves, incompatible APIs don't accidentally get introduced into the module. Incompatibilities are discovered at compile time instead of runtime.

However, it isn't required to target .NET Standard for a module to work with both Windows PowerShell and PowerShell Core, as long as you use compatible APIs. The Intermediate Language (IL) is compatible between the two runtimes. You can target .NET Framework 4.6.1, which is compatible with .NET Standard 2.0. If you don't use APIs outside of .NET Standard 2.0, then your module works with PowerShell Core 6 without recompilation.

PowerShell Standard Library

The PowerShell Standard library is a formal specification of PowerShell APIs available in all PowerShell versions greater than or equal to the version of that standard.

For example, PowerShell Standard 5.1 is compatible with both Windows PowerShell 5.1 and PowerShell Core 6.0 or newer.

We recommend you compile your module using PowerShell Standard Library. The library ensures the APIs are available and implemented in both Windows PowerShell and PowerShell Core 6. PowerShell Standard is intended to always be forwards-compatible. A module built using PowerShell Standard Library 5.1 will always be compatible with future versions of PowerShell.

Module Manifest

Indicating Compatibility With Windows PowerShell and PowerShell Core

After validating that your module works with both Windows PowerShell and PowerShell Core, the module manifest should explicitly indicate compatibility by using the CompatiblePSEditions property. A value of `Desktop` means that the module is compatible with Windows PowerShell, while a value of `Core` means that the module is compatible with PowerShell Core. Including both `Desktop` and `Core` means that the module is compatible with both Windows PowerShell and PowerShell Core.

> **Note**
>
> `Core` doesn't automatically mean that the module is compatible with Windows, Linux, and macOS. The **CompatiblePSEditions** property was introduced in PowerShell v5. Module manifests that use the **CompatiblePSEditions** property fail to load in versions prior to PowerShell v5.

Indicating OS Compatibility

First, validate that your module works on Linux and macOS. Next, indicate compatibility with those operating systems in the module manifest. This makes it easier for users to find your module for their operating system when published to the PowerShell Gallery.

Within the module manifest, the `PrivateData` property has a `PSData` sub-property. The optional `Tags` property of `PSData` takes an array of values that show up in PowerShell Gallery. The PowerShell Gallery supports the following compatibility values:

Tag	Description

Tag	Description
PSEdition_Core	Compatible with PowerShell Core 6
PSEdition_Desktop	Compatible with Windows PowerShell
Windows	Compatible with Windows
Linux	Compatible with Linux (no specific distro)
macOS	Compatible with macOS

Example:

PowerShell

```
@{
    GUID = "4ae9fd46-338a-459c-8186-07f910774cb8"
    Author = "Microsoft Corporation"
    CompanyName = "Microsoft Corporation"
    Copyright = "(C) Microsoft Corporation. All rights reserved."
    HelpInfoUri = "https://go.microsoft.com/fwlink/?linkid=855962"
    ModuleVersion = "1.2.4"
    PowerShellVersion = "3.0"
    ClrVersion = "4.0"
    RootModule = "PackageManagement.psm1"
    Description = 'PackageManagement (a.k.a. OneGet) is a new way to
discover and install software packages from around the web.
 it's a manager or multiplexer of existing package managers (also called
package providers) that unifies Windows package management with a single
Windows PowerShell interface. With PackageManagement, you can do the
following.
  - Manage a list of software repositories in which packages can be
searched, acquired and installed
  - Discover software packages
  - Seamlessly install, uninstall, and inventory packages from one or more
software repositories'

    CmdletsToExport = @(
        'Find-Package',
        'Get-Package',
        'Get-PackageProvider',
        'Get-PackageSource',
        'Install-Package',
        'Import-PackageProvider'
        'Find-PackageProvider'
        'Install-PackageProvider'
        'Register-PackageSource',
        'Set-PackageSource',
        'Unregister-PackageSource',
        'Uninstall-Package'
        'Save-Package'
    )
```

```
    FormatsToProcess  = @('PackageManagement.format.ps1xml')

    PrivateData = @{
        PSData = @{
            Tags = @('PackageManagement', 'PSEdition_Core',
'PSEdition_Desktop', 'Windows', 'Linux', 'macOS')
            ProjectUri = 'https://oneget.org'
        }
    }
}
```

Dependency on Native Libraries

Modules intended for use across different operating systems or processor architectures may depend on a managed library that itself depends on some native libraries.

Prior to PowerShell 7, one would have to have custom code to load the appropriate native dll so that the managed library can find it correctly.

With PowerShell 7, native binaries to load are searched in sub-folders within the managed library's location following a subset of the .NET RID Catalog notation.

```
managed.dll folder
    |
    |--- 'win-x64' folder
    |       |--- native.dll
    |
    |--- 'win-x86' folder
    |       |--- native.dll
    |
    |--- 'win-arm' folder
    |       |--- native.dll
    |
    |--- 'win-arm64' folder
    |       |--- native.dll
    |
    |--- 'linux-x64' folder
    |       |--- native.so
    |
    |--- 'linux-x86' folder
    |       |--- native.so
    |
    |--- 'linux-arm' folder
    |       |--- native.so
    |
    |--- 'linux-arm64' folder
    |       |--- native.so
```

```
    |
    |--- 'osx-x64' folder
    |       |--- native.dylib
```

How to create a Standard Library binary module

Article • 02/02/2023

I recently had an idea for module that I wanted to implement as a binary module. I have yet to create one using the PowerShell Standard Library so this felt like a good opportunity. I used the Creating a cross-platform binary module guide to create this module without any roadblocks. We're going to walk that same process and I'll add a little extra commentary along the way.

> **Note**
>
> The **original version** of this article appeared on the blog written by **@KevinMarquette**. The PowerShell team thanks Kevin for sharing this content with us. Please check out his blog at **PowerShellExplained.com**.

What's the PowerShell Standard Library?

The PowerShell Standard Library allows us to create cross platform modules that work in both PowerShell and Windows PowerShell 5.1.

Why binary modules?

When you are writing a module in C# you give up easy access to PowerShell cmdlets and functions. But if you are creating a module that doesn't depend on a lot of other PowerShell commands, the performance benefit can be significant. PowerShell was optimized for the administrator, not the computer. By switching to C#, you get to shed the overhead added by PowerShell.

For example, we have a critical process that does a lot of work with JSON and hashtables. We optimized the PowerShell as much as we could but the process still takes 12 minutes to complete. The module already contained a lot of C# style PowerShell. This makes conversion to a binary module clean and simple. By converting to a binary module, we reduced the process time from over 12 minutes to under four minutes.

Hybrid modules

You can mix binary cmdlets with PowerShell advanced functions. Everything you know about script modules applies the same way. The empty `psm1` file is included so you can add other PowerShell functions later.

Almost all of the compiled cmdlets that I have created started out as PowerShell functions first. All of our binary modules are really hybrid modules.

Build scripts

I kept the build script simple here. I generally use a large `Invoke-Build` script as part of my CI/CD pipeline. It does more magic like running Pester tests, running **PSScriptAnalyzer**, managing versioning, and publishing to the PSGallery. Once I started using a build script for my modules, I was able to find lots of things to add to it.

Planning the module

The plan for this module is to create a `src` folder for the C# code and structure the rest like I would for a script module. This includes using a build script to compile everything into an `Output` folder. The folder structure looks like this:

```
MyModule
├───src
├───Output
│   └───MyModule
├───MyModule
│   ├───Data
│   ├───Private
│   └───Public
└───Tests
```

Getting Started

First I need to create the folder and create the git repo. I'm using `$module` as a placeholder for the module name. This should make it easier for you to reuse these examples if needed.

PowerShell

```powershell
$module = 'MyModule'
New-Item -Path $module -Type Directory
```

```
Set-Location $module
git init
```

Then create the root level folders.

PowerShell

```
New-Item -Path 'src' -Type Directory
New-Item -Path 'Output' -Type Directory
New-Item -Path 'Tests' -Type Directory
New-Item -Path $module -Type Directory
```

Binary module setup

This article is focused on the binary module so that's where we'll start. This section pulls examples from the Creating a cross-platform binary module guide. Review that guide if you need more details or have any issues.

First thing we want to do is check the version of the dotnet core SDK that we have installed. I'm using 2.1.4, but you should have 2.0.0 or newer before continuing.

PowerShell

```
PS> dotnet --version
2.1.4
```

I'm working out of the `src` folder for this section.

PowerShell

```
Set-Location 'src'
```

Using the dotnet command, create a new class library.

PowerShell

```
dotnet new classlib --name $module
```

This created the library project in a subfolder but I don't want that extra level of nesting. I'm going to move those files up a level.

PowerShell

```
Move-Item -Path .\$module\* -Destination .\
Remove-Item $module -Recurse
```

Set the .NET core SDK version for the project. I have the 2.1 SDK so I'm going to specify `2.1.0`. Use `2.0.0` if you're using the 2.0 SDK.

PowerShell

```
dotnet new globaljson --sdk-version 2.1.0
```

Add the **PowerShell Standard Library** NuGet package to the project. Make sure you use the most recent version available for the level of compatibility that you need. I would default to the latest version but I don't think this module leverages any features newer than PowerShell 3.0.

PowerShell

```
dotnet add package PowerShellStandard.Library --version 7.0.0-preview.1
```

We should have a src folder that looks like this:

PowerShell

```
PS> Get-ChildItem
    Directory: \MyModule\src

Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
d-----        7/14/2018   9:51 PM                obj
-a----        7/14/2018   9:51 PM             86 Class1.cs
-a----        7/14/2018  10:03 PM            259 MyModule.csproj
-a----        7/14/2018  10:05 PM             45 global.json
```

Now we're ready to add our own code to the project.

Building a binary cmdlet

We need to update the `src\Class1.cs` to contain this starter cmdlet:

C#

```
using System;
using System.Management.Automation;
```

```
namespace MyModule
{
    [Cmdlet( VerbsDiagnostic.Resolve , "MyCmdlet")]
    public class ResolveMyCmdletCommand : PSCmdlet
    {
        [Parameter(Position=0)]
        public Object InputObject { get; set; }

        protected override void EndProcessing()
        {
            this.WriteObject(this.InputObject);
            base.EndProcessing();
        }
    }
}
```

Rename the file to match the class name.

PowerShell

```
Rename-Item .\Class1.cs .\ResolveMyCmdletCommand.cs
```

Then we can build our module.

PowerShell

```
PS> dotnet build

Microsoft (R) Build Engine version 15.5.180.51428 for .NET Core
Copyright (C) Microsoft Corporation. All rights reserved.

Restore completed in 18.19 ms for C:\workspace\MyModule\src\MyModule.csproj.
MyModule -> C:\workspace\MyModule\src\bin\Debug\netstandard2.0\MyModule.dll

Build succeeded.
    0 Warning(s)
    0 Error(s)

Time Elapsed 00:00:02.19
```

We can call `Import-Module` on the new dll to load our new cmdlet.

PowerShell

```
PS> Import-Module .\bin\Debug\netstandard2.0\$module.dll
PS> Get-Command -Module $module

CommandType Name                    Version Source
----------- ----                    ------- ------
Cmdlet      Resolve-MyCmdlet        1.0.0.0 MyModule
```

If the import fails on your system, try updating .NET to 4.7.1 or newer. The Creating a cross-platform binary module guide goes into more details on .NET support and compatibility for older versions of .NET.

Module manifest

It's cool that we can import the dll and have a working module. I like to keep going with it and create a module manifest. We need the manifest if we want to publish to the PSGallery later.

From the root of our project, we can run this command to create the module manifest that we need.

PowerShell

```
$manifestSplat = @{
    Path              = ".\$module\$module.psd1"
    Author            = 'Kevin Marquette'
    NestedModules     = @('bin\MyModule.dll')
    RootModule        = "$module.psm1"
    FunctionsToExport = @('Resolve-MyCmdlet')
}
New-ModuleManifest @manifestSplat
```

I'm also going to create an empty root module for future PowerShell functions.

PowerShell

```
Set-Content -Value '' -Path ".\$module\$module.psm1"
```

This allows me to mix both normal PowerShell functions and binary cmdlets in the same project.

Building the full module

I compile everything together into an output folder. We need to create a build script to do that. I would normally add this to an `Invoke-Build` script, but we can keep it simple for this example. Add this to a `build.ps1` at the root of the project.

PowerShell

```
$module = 'MyModule'
Push-Location $PSScriptRoot
```

```
dotnet build $PSScriptRoot\src -o $PSScriptRoot\output\$module\bin
Copy-Item "$PSScriptRoot\$module\*" "$PSScriptRoot\output\$module" -Recurse
-Force

Import-Module "$PSScriptRoot\Output\$module\$module.psd1"
Invoke-Pester "$PSScriptRoot\Tests"
```

These commands build our DLL and place it into our `output\$module\bin` folder. It then copies the other module files into place.

```
Output
└───MyModule
    ├───MyModule.psd1
    ├───MyModule.psm1
    └───bin
        ├───MyModule.deps.json
        ├───MyModule.dll
        └───MyModule.pdb
```

At this point, we can import our module with the psd1 file.

PowerShell

```
Import-Module ".\Output\$module\$module.psd1"
```

From here, we can drop the `.\Output\$module` folder into our `$env:PSModulePath` directory and it autoloads our command whenever we need it.

Update: dotnet new PSModule

I learned that the `dotnet` tool has a `PSModule` template.

All the steps that I outlined above are still valid, but this template cuts many of them out. It's still a fairly new template that's still getting some polish placed on it. Expect it to keep getting better from here.

This is how you use install and use the PSModule template.

PowerShell

```
dotnet new -i Microsoft.PowerShell.Standard.Module.Template
dotnet new psmodule
dotnet build
```

```
Import-Module "bin\Debug\netstandard2.0\$module.dll"
Get-Module $module
```

This minimally-viable template takes care of adding the .NET SDK, PowerShell Standard Library, and creates an example class in the project. You can build it and run it right away.

Important details

Before we end this article, here are a few other details worth mentioning.

Unloading DLLs

Once a binary module is loaded, you can't really unload it. The DLL file is locked until you unload it. This can be annoying when developing because every time you make a change and want to build it, the file is often locked. The only reliable way to resolve this is to close the PowerShell session that loaded the DLL.

VS Code reload window action

I do most of my PowerShell dev work in VS Code. When I'm working on a binary module (or a module with classes), I've gotten into the habit of reloading VS Code every time I build. `Ctrl`+`Shift`+`P` pops the command window and `Reload Window` is always at the top of my list.

Nested PowerShell sessions

One other option is to have good Pester test coverage. Then you can adjust the build.ps1 script to start a new PowerShell session, perform the build, run the tests, and close the session.

Updating installed modules

This locking can be annoying when trying to update your locally installed module. If any session has it loaded, you have to go hunt it down and close it. This is less of an issue when installing from a PSGallery because module versioning places the new one in a different folder.

You can set up a local PSGallery and publish to that as part of your build. Then do your local install from that PSGallery. This sounds like a lot of work, but this can be as simple

as starting a docker container. I cover a way to do that in my post on Using a NuGet server for a PSRepository.

Final thoughts

I didn't touch on the C# syntax for creating a cmdlet, but there is plenty of documentation on it in the Windows PowerShell SDK. It's definitely something worth experimenting with as a stepping stone into more serious C#.

Choosing the right PowerShell NuGet package for your .NET project

Article • 11/17/2022

Alongside the `pwsh` executable packages published with each PowerShell release, the PowerShell team also maintains several packages available on NuGet. These packages allow targeting PowerShell as an API platform in .NET.

As a .NET application that provides APIs and expects to load .NET libraries implementing its own (binary modules), it's essential that PowerShell be available in the form of a NuGet package.

Currently there are several NuGet packages that provide some representation of the PowerShell API surface area. Which package to use with a particular project hasn't always been made clear. This article sheds some light on a few common scenarios for PowerShell-targeting .NET projects and how to choose the right NuGet package to target for your PowerShell-oriented .NET project.

Hosting vs referencing

Some .NET projects seek to write code to be loaded into a pre-existing PowerShell runtime (such as `pwsh`, `powershell.exe`, the PowerShell Integrated Console or the ISE), while others want to run PowerShell in their own applications.

- **Referencing** is for when a project, usually a module, is intended to be loaded into PowerShell. It must be compiled against the APIs that PowerShell provides in order to interact with it, but the PowerShell implementation is supplied by the PowerShell process loading it in. For referencing, a project can use reference assemblies or the actual runtime assemblies as a compilation target, but must ensure that it does not publish any of these with its build.
- **Hosting** is when a project needs its own implementation of PowerShell, usually because it is a standalone application that needs to run PowerShell. In this case, pure reference assemblies cannot be used. Instead, a concrete PowerShell implementation must be depended upon. Because a concrete PowerShell implementation must be used, a specific version of PowerShell must be chosen for hosting; a single host application cannot multi-target PowerShell versions.

Publishing projects that target PowerShell as a reference

> **Note**
>
> We use the term **publish** in this article to refer to running `dotnet publish`, which places a .NET library into a directory with all of its dependencies, ready for deployment to a particular runtime.

In order to prevent publishing project dependencies that are just being used as compilation reference targets, it is recommended to set the PrivateAssets attribute:

```xml
<PackageReference Include="PowerShellStandard.Library" Version="5.1.0.0"
PrivateAssets="all" />
```

If you forget to do this and use a reference assembly as your target, you may see issues related to using the reference assembly's default implementation instead of the actual implementation. This may take the form of a `NullReferenceException`, since reference assemblies often mock the implementation API by simply returning `null`.

Key kinds of PowerShell-targeting .NET projects

While any .NET library or application can embed PowerShell, there are some common scenarios that use PowerShell APIs:

- **Implementing a PowerShell binary module**

  PowerShell binary modules are .NET libraries loaded by PowerShell that must implement PowerShell APIs like the PSCmdlet or CmdletProvider types in order to expose cmdlets or providers respectively. Because they are loaded in, modules seek to compile against references to PowerShell without publishing it in their build. It's also common for modules to want to support multiple PowerShell versions and platforms, ideally with a minimum of overhead of disk space, complexity, or repeated implementation. See about_Modules for more information about modules.

- **Implementing a PowerShell Host**

  A PowerShell Host provides an interaction layer for the PowerShell runtime. It is a specific form of *hosting*, where a PSHost is implemented as a new user interface to PowerShell. For example, the PowerShell ConsoleHost provides a terminal user interface for PowerShell executables, while the PowerShell Editor Services Host and

the ISE Host both provide an editor-integrated partially graphical user interface around PowerShell. While it's possible to load a host onto an existing PowerShell process, it's much more common for a host implementation to act as a standalone PowerShell implementation that redistributes the PowerShell engine.

- **Calling into PowerShell from another .NET application**

  As with any application, PowerShell can be called as a subprocess to run workloads. However, as a .NET application, it's also possible to invoke PowerShell in-process to get back full .NET objects for use within the calling application. This is a more general form of *hosting*, where the application holds its own PowerShell implementation for internal use. Examples of this might be a service or daemon running PowerShell to manage machine state or a web application that runs PowerShell on request to do something like manage cloud deployments.

- **Unit testing PowerShell modules from .NET**

  While modules and other libraries designed to expose functionality to PowerShell should be primarily tested from PowerShell (we recommend Pester), sometimes it's necessary to unit test APIs written for a PowerShell module from .NET. This situation involves the module code trying to target a number of PowerShell versions, while testing should run it on specific, concrete implementations.

PowerShell NuGet packages at a glance

In this article, we'll cover the following NuGet packages that expose PowerShell APIs:

- PowerShellStandard.Library, a reference assembly that enables building a single assembly that can be loaded by multiple PowerShell runtimes.
- Microsoft.PowerShell.SDK, the way to target and rehost the whole PowerShell SDK
- The System.Management.Automation package, the core PowerShell runtime and engine implementation, that can be useful in minimal hosted implementations and for version-specific targeting scenarios.
- The **Windows PowerShell reference assemblies**, the way to target and effectively rehost Windows PowerShell (PowerShell versions 5.1 and below).

> **Note**
>
> The **PowerShell NuGet** package is not a .NET library package at all, but instead provides the PowerShell dotnet global tool implementation. This should not be used by any projects, since it only provides an executable.

PowerShellStandard.Library

The PowerShell Standard library is a reference assembly that captures the intersection of the APIs of PowerShell versions 7, 6 and 5.1. This provides a compile-time-checked API surface to compile .NET code against, allowing .NET projects to target PowerShell versions 7, 6 and 5.1 without risking calling an API that won't be there.

PowerShell Standard is intended for writing PowerShell modules, or other code only intended to be run after loading it into a PowerShell process. Because it is a reference assembly, PowerShell Standard contains no implementation itself, so provides no functionality for standalone applications.

Using PowerShell Standard with different .NET runtimes

PowerShell Standard targets the .NET Standard 2.0 target runtime, which is a façade runtime designed to provide a common surface area shared by .NET Framework and .NET Core. This allows targeting a single runtime to produce a single assembly that will work with multiple PowerShell versions, but has the following consequences:

- The PowerShell loading the module or library must be running a minimum of .NET 4.6.1; .NET 4.6 and .NET 4.5.2 do not support .NET Standard. Note that a newer Windows PowerShell version does not mean a newer .NET Framework version; Windows PowerShell 5.1 may run on .NET 4.5.2.
- In order to work with a PowerShell running .NET Framework 4.7.1 or below, the .NET 4.6.1 NETStandard.Library implementation is required to provide the netstandard.dll and other shim assemblies in older .NET Framework versions.

PowerShell 6+ provides its own shim assemblies for type forwarding from .NET Framework 4.6.1 (and above) to .NET Core. This means that as long as a module uses only APIs that exist in .NET Core, PowerShell 6+ can load and run it when it has been built for .NET Framework 4.6.1 (the `net461` runtime target).

This means that binary modules using PowerShell Standard to target multiple PowerShell versions with a single published DLL have two options:

1. Publishing an assembly built for the `net461` target runtime. This involves:
    - Publishing the project for the `net461` runtime
    - Also compiling against the `netstandard2.0` runtime (without using its build output) to ensure that all APIs used are also present in .NET Core.
2. Publishing an assembly build for the `netstandard2.0` target runtime. This requires:

- Publishing the project for the `netstandard2.0` runtime
- Taking the `net461` dependencies of NETStandard.Library and copying them into the project assembly's publish location so that the assembly is type-forwarded corrected in .NET Framework.

To build PowerShell modules or libraries targeting older .NET Framework versions, it may be preferable to target multiple .NET runtimes. This will publish an assembly for each target runtime, and the correct assembly will need to be loaded at module load time (for example with a small psm1 as the root module).

Testing PowerShell Standard projects in .NET

When it comes to testing your module in .NET test runners like xUnit, remember that compile-time checks can only go so far. You must test your module against the relevant PowerShell platforms.

To test APIs built against PowerShell Standard in .NET, you should add `Microsoft.Powershell.SDK` as a testing dependency with .NET Core (with the version set to match the desired PowerShell version), and the appropriate Windows PowerShell reference assemblies with .NET Framework.

For more information on PowerShell Standard and using it to write a binary module that works in multiple PowerShell versions, see this blog post. Also see the PowerShell Standard repository on GitHub.

Microsoft.PowerShell.SDK

`Microsoft.PowerShell.SDK` is a meta-package that pulls together all of the components of the PowerShell SDK into a single NuGet package. A self-contained .NET application can use Microsoft.PowerShell.SDK to run arbitrary PowerShell functionality without depending on any external PowerShell installations or libraries.

> **Note**
>
> The PowerShell SDK just refers to all the component packages that make up PowerShell, and which can be used for .NET development with PowerShell.

A given `Microsoft.Powershell.SDK` version contains the concrete implementation of the same version of the PowerShell application; version 7.0 contains the implementation of PowerShell 7.0 and running commands or scripts with it will largely behave like running them in PowerShell 7.0.

Running PowerShell commands from the SDK is mostly, but not totally, the same as running them from `pwsh`. For example, Start-Job currently depends on the `pwsh` executable being available, and so will not work with `Microsoft.Powershell.SDK` by default.

Targeting `Microsoft.Powershell.SDK` from a .NET application allows you to integrate with all of PowerShell's implementation assemblies, such as `System.Management.Automation`, `Microsoft.PowerShell.Management`, and other module assemblies.

Publishing an application targeting `Microsoft.Powershell.SDK` will include all these assemblies, and any dependencies PowerShell requires. It will also include other assets that PowerShell required in its build, such as the module manifests for `Microsoft.PowerShell.*` modules and the `ref` directory required by Add-Type.

Given the completeness of `Microsoft.Powershell.SDK`, it's best suited for:

- Implementation of PowerShell hosts.
- xUnit testing of libraries targeting PowerShell reference assemblies.
- Invoking PowerShell in-process from a .NET application.

`Microsoft.PowerShell.SDK` may also be used as a reference target when a .NET project is intended to be used as a module or otherwise loaded by PowerShell, but depends on APIs only present in a particular version of PowerShell. Note that an assembly published against a specific version of `Microsoft.PowerShell.SDK` will only be safe to load and use in that version of PowerShell. To target multiple PowerShell versions with specific APIs, multiple builds are required, each targeting their own version of `Microsoft.Powershell.SDK`.

> ⓘ **Note**
>
> The PowerShell SDK is only available for PowerShell versions 6 and up. To provide equivalent functionality with Windows PowerShell, use the Windows PowerShell reference assemblies described below.

System.Management.Automation

The `System.Management.Automation` package is the heart of the PowerShell SDK. It exists on NuGet, primarily, as an asset for `Microsoft.Powershell.SDK` to pull in. However, it can also be used directly as a package for smaller hosting scenarios and version-targeting modules.

Specifically, the `System.Management.Automation` package may be a preferable provider of PowerShell functionality when:

- You're only looking to use PowerShell language functionality (in the `System.Management.Automation.Language` namespace) like the PowerShell parser, AST, and AST visitor APIs (for example for static analysis of PowerShell).
- You only wish to execute specific commands from the `Microsoft.PowerShell.Core` module and can execute them in a session state created with the CreateDefault2 factory method.

Additionally, `System.Management.Automation` is a useful reference assembly when:

- You wish to target APIs that are only present within a specific PowerShell version
- You won't be depending on types occurring outside the `System.Management.Automation` assembly (for example, types exported by cmdlets in `Microsoft.PowerShell.*` modules).

Windows PowerShell reference assemblies

For PowerShell versions 5.1 and older (Windows PowerShell), there is no SDK to provide an implementation of PowerShell, since Windows PowerShell's implementation is a part of Windows.

Instead, the Windows PowerShell reference assemblies provide both reference targets and a way to rehost Windows PowerShell, acting the same as the PowerShell SDK does for versions 6 and up.

Rather than being differentiated by version, Windows PowerShell reference assemblies have a different package for each version of Windows PowerShell:

- PowerShell 5.1
- PowerShell 4
- PowerShell 3

Information on how to use the Windows PowerShell reference assemblies can be found in the Windows PowerShell SDK.

Real-world examples using these NuGet packages

Different PowerShell tooling projects target different PowerShell NuGet packages depending on their needs. Listed here are some notable examples.

PSReadLine

PSReadLine, the PowerShell module that provides much of PowerShell's rich console experience, targets PowerShell Standard as a dependency rather than a specific PowerShell version, and targets the `net461` .NET runtime in its csproj.

PowerShell 6+ supplies its own shim assemblies that allow a DLL targeting the `net461` runtime to "just work" when loaded in (by redirecting binding to .NET Framework's `mscorlib.dll` to the relevant .NET Core assembly).

This simplifies PSReadLine's module layout and delivery significantly, since PowerShell Standard ensures the only APIs used will be present in both PowerShell 5.1 and PowerShell 6+, while also allowing the module to ship with only a single assembly.

The .NET 4.6.1 target does mean that Windows PowerShell running on .NET 4.5.2 and .NET 4.6 is not supported though.

PowerShell Editor Services

PowerShell Editor Services (PSES) is the backend for the PowerShell extension for Visual Studio Code, and is actually a form of PowerShell module that gets loaded by a PowerShell executable and then takes over that process to rehost PowerShell within itself while also providing Language Service Protocol and Debug Adapter features.

PSES provides concrete implementation targets for `netcoreapp2.1` to target PowerShell 6+ (since PowerShell 7's `netcoreapp3.1` runtime is backwards compatible) and `net461` to target Windows PowerShell 5.1, but contains most of its logic in a second assembly that targets `netstandard2.0` and PowerShell Standard. This allows it to pull in dependencies required for .NET Core and .NET Framework platforms, while still simplifying most of the codebase behind a uniform abstraction.

Because it is built against PowerShell Standard, PSES requires a runtime implementation of PowerShell in order to be tested correctly. To do this, PSES's xUnit tests pull in `Microsoft.PowerShell.SDK` and `Microsoft.PowerShell.5.ReferenceAssemblies` in order to provide a PowerShell implementation in the test environment.

As with PSReadLine, PSES cannot support .NET 4.6 and below, but it performs a check at runtime before calling any of the APIs that could cause a crash on the lower .NET Framework runtimes.

PSScriptAnalyzer

PSScriptAnalyzer, the linter for PowerShell, must target syntactic elements only introduced in certain versions of PowerShell. Because recognition of these syntactic elements is accomplished by implementing an AstVisitor2, it's not possible to use PowerShellStandard and also implement AST visitor methods for newer PowerShell syntaxes.

Instead, PSScriptAnalyzer targets each PowerShell version as a build configuration, and produces a separate DLL for each of them. This increases build size and complexity, but allows:

- Version-specific API targeting
- Version-specific functionality to be implemented with essentially no runtime cost
- Total support for Windows PowerShell all the way down to .NET Framework 4.5.2

Summary

In this article, we've listed and discussed the NuGet packages available to target when implementing a .NET project that uses PowerShell, and the reasons you might have for using one over another.

If you've skipped to the summary, some broad recommendations are:

- PowerShell **modules** should compile against PowerShell Standard if they only require APIs common to different PowerShell versions.
- PowerShell **hosts and applications** that need to run PowerShell internally should target the PowerShell SDK for PowerShell 6+ or the relevant Windows PowerShell reference assemblies for Windows PowerShell.
- PowerShell modules that need **version-specific APIs** should target the PowerShell SDK or Windows PowerShell reference assemblies for the required PowerShell versions, using them as reference assemblies (that is, not publishing the PowerShell dependencies).

Resolving PowerShell module assembly dependency conflicts

Article • 09/08/2022

When writing a binary PowerShell module in C#, it's natural to take dependencies on other packages or libraries to provide functionality. Taking dependencies on other libraries is desirable for code reuse. PowerShell always loads assemblies into the same context. This presents issues when a module's dependencies conflict with already-loaded DLLs and may prevent using two otherwise unrelated modules in the same PowerShell session.

If you've had this problem, you've seen an error message like this:

```
C:\Users\Robert Holt\Documents\Dev\sandbox\ModuleConflict
> ipmo .\FunCsv\FunCsv\
C:\Users\Robert Holt\Documents\Dev\sandbox\ModuleConflict
> Get-FunCsv -Path .\ex.csv
C:\Users\Robert Holt\Documents\Dev\sandbox\ModuleConflict
> ipmo .\TotallyUnrelatedModule\TotallyUnrelatedModule\
C:\Users\Robert Holt\Documents\Dev\sandbox\ModuleConflict
> Test-UnrelatedThing -path .\ex.csv
Test-UnrelatedThing: Could not load file or assembly 'CsvHelper, Version=15.0.0.0, Culture=neutral, Pu
blicKeyToken=8c4959082be5c823'. Could not find or load a specific file. (0x80131621)
```

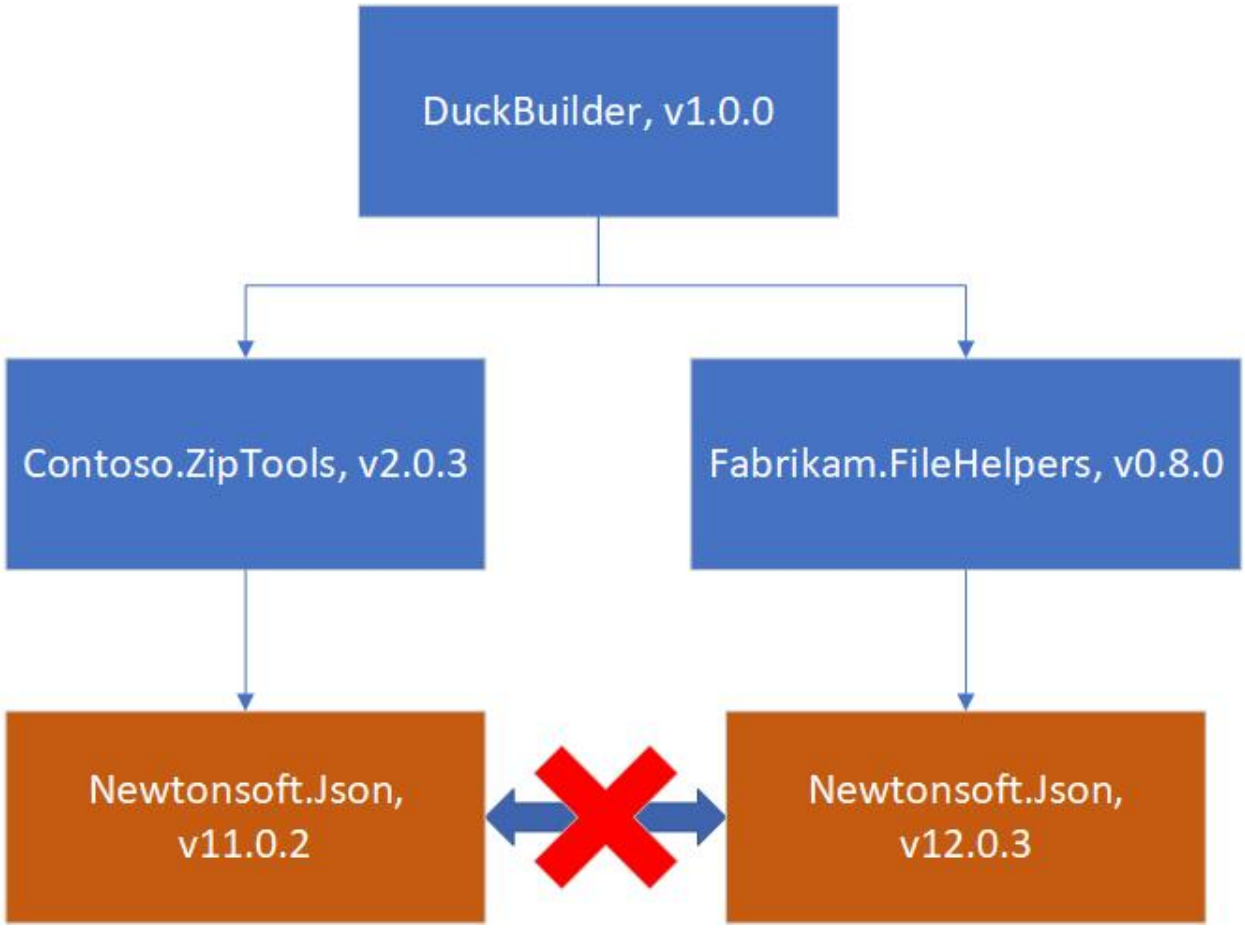
This article looks at some ways dependency conflicts occur in PowerShell and ways to mitigate dependency conflict issues. Even if you're not a module author, there are some tricks in here that might help you with dependency conflicts occurring in modules that you use.

Why do dependency conflicts occur?

In .NET, dependency conflicts occur when two versions of the same assembly are loaded into the same *Assembly Load Context*. This term means slightly different things on different .NET platforms, which is covered later in this article. This conflict is a common problem that occurs in any software where versioned dependencies are used.

Conflict issues are compounded by the fact that a project almost never deliberately or directly depends on two versions of the same dependency. Instead, the project has two or more dependencies that each require a different version of the same dependency.

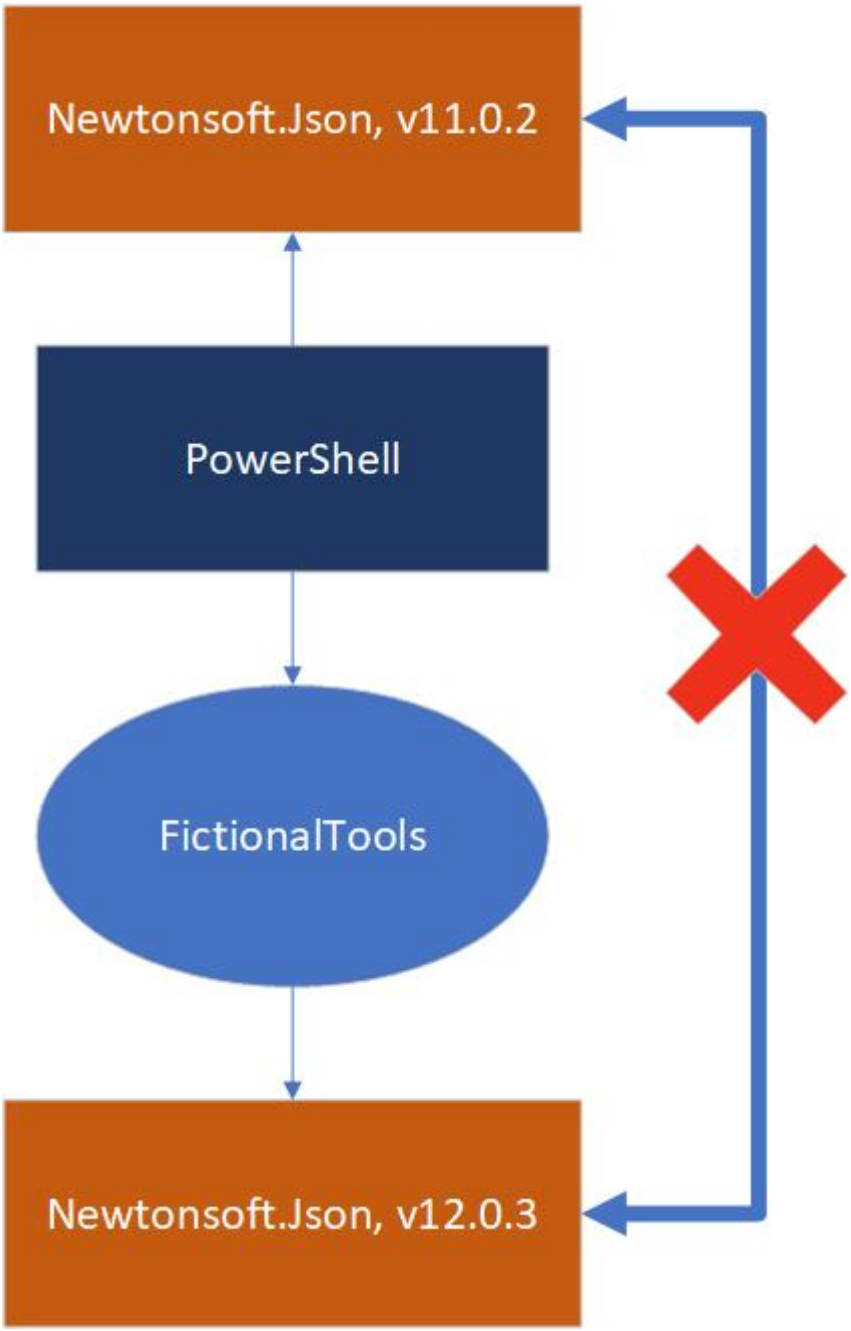
For example, say your .NET application, `DuckBuilder`, brings in two dependencies, to perform parts of its functionality and looks like this:



Because `Contoso.ZipTools` and `Fabrikam.FileHelpers` both depend on different versions of **Newtonsoft.Json**, there may be a dependency conflict depending on how each dependency is loaded.

Conflicting with PowerShell's dependencies

In PowerShell, the dependency conflict issue is magnified because PowerShell's own dependencies are loaded into the same shared context. This means the PowerShell engine and all loaded PowerShell modules must not have conflicting dependencies. A classic example of this is **Newtonsoft.Json**:



In this example, the module `FictionalTools` depends on **Newtonsoft.Json** version `12.0.3`, which is a newer version of **Newtonsoft.Json** than `11.0.2` that ships in the example PowerShell.

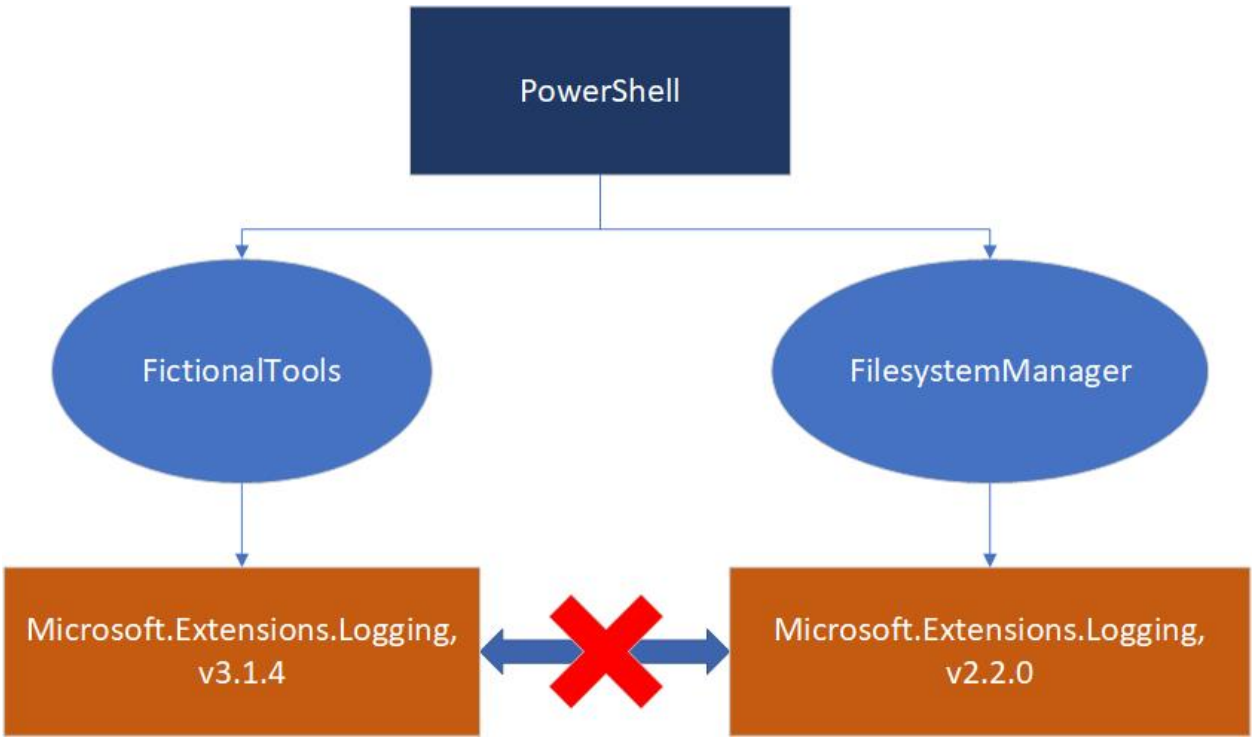
> ⓘ **Note**
>
> This is an example. PowerShell 7.0 currently ships with **Newtonsoft.Json 12.0.3**. Newer versions of PowerShell have newer versions of **Newtonsoft.Json**.

Because the module depends on a newer version of the assembly, it won't accept the version that PowerShell already has loaded. But because PowerShell has already loaded a version of the assembly, the module can't load its own version using the conventional load mechanism.

Conflicting with another module's dependencies

Another common scenario in PowerShell is that a module is loaded that depends on one version of an assembly, and then another module is loaded later that depends on a different version of that assembly.

This often looks like the following:



In this case, the `FictionalTools` module requires a newer version of `Microsoft.Extensions.Logging` than the `FilesystemManager` module.

Imagine these modules load their dependencies by placing the dependency assemblies in the same directory as the root module assembly. This allows .NET to implicitly load them by name. If we're running PowerShell 7.0 (on top of .NET Core 3.1), we can load and run `FictionalTools`, then load and run `FilesystemManager` without issue. However, in a new session, if we load and run `FilesystemManager`, then load `FictionalTools`, we get a `FileLoadException` from the `FictionalTools` command because it requires a newer version of `Microsoft.Extensions.Logging` than the one loaded. `FictionalTools` can't load the version needed because an assembly of the same name has already been loaded.

PowerShell and .NET

PowerShell runs on the .NET platform, which is responsible for resolving and loading assembly dependencies. We must understand how .NET operates here to understand dependency conflicts.

We must also confront the fact that different versions of PowerShell run on different .NET implementations. In general, PowerShell 5.1 and below run on .NET Framework, while PowerShell 6 and above run on .NET Core. These two implementations of .NET load and handle assemblies differently. This means that resolving dependency conflicts can vary depending on the underlying .NET platform.

Assembly Load Contexts

In .NET, an *Assembly Load Context* (ALC) is a runtime namespace into which assemblies are loaded. The assemblies' names must be unique. This concept allows assemblies to be uniquely resolved by name in each ALC.

Assembly reference loading in .NET

The semantics of assembly loading depend on both the .NET implementation (.NET Core vs .NET Framework) and the .NET API used to load a particular assembly. Rather than go into detail here, there are links in the Further reading section that go into great detail on how .NET assembly loading works in each .NET implementation.

In this article we'll refer to the following mechanisms:

- Implicit assembly loading (effectively `Assembly.Load(AssemblyName)`), when .NET implicitly tries to load an assembly by name from a static assembly reference in .NET code.
- `Assembly.LoadFrom()`, a plugin-oriented loading API that adds handlers to resolve dependencies of the loaded DLL. This method may not resolve dependencies the way we want.
- `Assembly.LoadFile()`, a basic loading API intended to load only the assembly asked for and does not handle any dependencies.

Differences in .NET Framework vs .NET Core

The way these APIs work has changed in subtle ways between .NET Core and .NET Framework, so it's worth reading through the included links. Importantly, Assembly Load Contexts and other assembly resolution mechanisms have changed between .NET Framework and .NET Core.

In particular, .NET Framework has the following features:

- The Global Assembly Cache, for machine-wide assembly resolution
- Application Domains, which work like in-process sandboxes for assembly isolation, but also present a serialization layer to contend with

- A limited assembly load context model that has a fixed set of assembly load contexts, each with their own behavior:
  - The default load context, where assemblies are loaded by default
  - The load-from context, for loading assemblies manually at runtime
  - The reflection-only context, for safely loading assemblies to read their metadata without running them
  - The mysterious void that assemblies loaded with `Assembly.LoadFile(string path)` and `Assembly.Load(byte[] asmBytes)` live in

For more information, see Best Practices for Assembly Loading.

.NET Core (and .NET 5+) has replaced this complexity with a simpler model:

- No Global Assembly Cache. Applications bring all their own dependencies. This removes an external factor for dependency resolution in applications, making dependency resolution more reproducible. PowerShell, as the plugin host, complicates this slightly for modules. Its dependencies in `$PSHOME` are shared with all modules.
- Only one Application Domain, and no ability to create new ones. The Application Domain concept is maintained in .NET to be the global state of the .NET process.
- A new, extensible Assembly Load Context (ALC) model. Assembly resolution can be namespaced by putting it in a new ALC. .NET processes begin with a single default ALC into which all assemblies are loaded (except for those loaded with `Assembly.LoadFile(string)` and `Assembly.Load(byte[])`). But the process can create and define its own custom ALCs with its own loading logic. When an assembly is loaded, the first ALC it's loaded into is responsible for resolving its dependencies. This creates opportunities to implement powerful .NET plugin loading mechanisms.

In both implementations, assemblies are loaded lazily. This means that they're loaded when a method requiring their type is run for the first time.

For example, here are two versions of the same code that load a dependency at different times.

The first always loads its dependency when `Program.GetRange()` is called, because the dependency reference is lexically present within the method:

C#

```
using Dependency.Library;

public static class Program
{
```

```
    public static List<int> GetRange(int limit)
    {
        var list = new List<int>();
        for (int i = 0; i < limit; i++)
        {
            if (i >= 20)
            {
                // Dependency.Library will be loaded when GetRange is run
                // because the dependency call occurs directly within the
method
                DependencyApi.Use();
            }

            list.Add(i);
        }
        return list;
    }
}
```

The second loads its dependency only if the `limit` parameter is 20 or more, because of the internal indirection through a method:

C#

```
using Dependency.Library;

public static class Program
{
    public static List<int> GetNumbers(int limit)
    {
        var list = new List<int>();
        for (int i = 0; i < limit; i++)
        {
            if (i >= 20)
            {
                // Dependency.Library is only referenced within
                // the UseDependencyApi() method,
                // so will only be loaded when limit >= 20
                UseDependencyApi();
            }

            list.Add(i);
        }
        return list;
    }

    private static void UseDependencyApi()
    {
        // Once UseDependencyApi() is called, Dependency.Library is loaded
        DependencyApi.Use();
    }
}
```

This is a good practice since it minimizes the memory and filesystem I/O and uses the resources more efficiently. The unfortunate a side effect of this is that we won't know that the assembly fails to load until we reach the code path that tries to load the assembly.

It can also create a timing condition for assembly load conflicts. If two parts of the same program try to load different versions of the same assembly, the version loaded depends on which code path is run first.

For PowerShell, this means that the following factors can affect an assembly load conflict:

- Which module was loaded first?
- Was the code path that uses the dependency library run?
- Does PowerShell load a conflicting dependency at startup or only under certain code paths?

Quick fixes and their limitations

In some cases, it's possible to make small adjustments to your module and fix things with minimal effort. But these solutions tend to come with caveats. While they may apply to your module, they won't work for every module.

Change your dependency version

The simplest way to avoid dependency conflicts is to agree on a dependency. This may be possible when:

- Your conflict is with a direct dependency of your module and you control the version.
- Your conflict is with an indirect dependency, but you can configure your direct dependencies to use a workable indirect dependency version.
- You know the conflicting version and can rely on it not changing.

The **Newtonsoft.Json** package is a good example of this last scenario. This is a dependency of PowerShell 6 and above, and isn't used in Windows PowerShell. Meaning a simple way to resolve versioning conflicts is to target the lowest version of **Newtonsoft.Json** across the PowerShell versions you wish to target.

For example, PowerShell 6.2.6 and PowerShell 7.0.2 both currently use **Newtonsoft.Json** version 12.0.3. To create a module targeting Windows PowerShell, PowerShell 6, and PowerShell 7, you would target **Newtonsoft.Json 12.0.3** as a dependency and include it

in your built module. When the module is loaded in PowerShell 6 or 7, PowerShell's own **Newtonsoft.Json** assembly is already loaded. Since it's the version required for your module, resolution succeeds. In Windows PowerShell, the assembly isn't already present in PowerShell, so it's loaded from your module folder instead.

Generally, when targeting a concrete PowerShell package, like **Microsoft.PowerShell.Sdk** or **System.Management.Automation**, NuGet should be able to resolve the right dependency versions required. Targeting both Windows PowerShell and PowerShell 6+ becomes more difficult because you must choose between targeting multiple frameworks or **PowerShellStandard.Library**.

Circumstances where pinning to a common dependency version won't work include:

- The conflict is with an indirect dependency, and none of your dependencies can be configured to use a common version.
- The other dependency version is likely to change often, so settling on a common version is only a short-term fix.

Use the dependency out of process

This solution is more for module users than module authors. This is a solution to use when confronted with a module that won't work due to an existing dependency conflict.

Dependency conflicts occur because two versions of the same assembly are loaded into the same .NET process. A simple solution is to load them into different processes, as long as you can still use the functionality from both together.

In PowerShell, there are several ways to achieve this:

- Invoke PowerShell as a subprocess

  To run a PowerShell command out of the current process, start a new PowerShell process directly with the command call:

  ```PowerShell
  pwsh -c 'Invoke-ConflictingCommand'
  ```

  The main limitation here is that restructuring the result can be trickier or more error prone than other options.

- The PowerShell job system

The PowerShell job system also runs commands out of process, by sending commands to a new PowerShell process and returning the results:

```PowerShell
$result = Start-Job { Invoke-ConflictingCommand } | Receive-Job -Wait
```

In this case, you just need to be sure that any variables and state are passed in correctly.

The job system can also be slightly cumbersome when running small commands.

- PowerShell remoting

  When it's available, PowerShell remoting can be a useful way to run commands out of process. With remoting, you can create a fresh **PSSession** in a new process, call its commands over PowerShell remoting, then use the results locally with the other modules containing the conflicting dependencies.

  An example might look like this:

  ```PowerShell
  # Create a local PowerShell session
  # where the module with conflicting assemblies will be loaded
  $s = New-PSSession

  # Import the module with the conflicting dependency via remoting,
  # exposing the commands locally
  Import-Module -PSSession $s -Name ConflictingModule

  # Run a command from the module with the conflicting dependencies
  Invoke-ConflictingCommand
  ```

- Implicit remoting to Windows PowerShell

  Another option in PowerShell 7 is to use the `-UseWindowsPowerShell` flag on `Import-Module`. This imports the module through a local remoting session into Windows PowerShell:

  ```PowerShell
  Import-Module -Name ConflictingModule -UseWindowsPowerShell
  ```

  Be aware that modules may not be compatible with or may work differently with Windows PowerShell.

When out-of-process invocation should not be used

As a module author, out-of-process command invocation is difficult to bake into a module and may have edge cases that cause issues. In particular, remoting and jobs may not be available in all environments where your module needs to work. However, the general principle of moving the implementation out of process and allowing the PowerShell module to be a thinner client, may still be applicable.

As a module user, there are cases where out-of-process invocation won't work:

- When PowerShell remoting is unavailable because you don't have privileges to use it or it is not enabled.
- When a particular .NET type is needed from output as input to a method or another command. Commands running over PowerShell remoting emit deserialized objects rather than strongly-typed .NET objects. This means that method calls and strongly typed APIs don't work with the output of commands imported over remoting.

More robust solutions

The previous solutions all had scenarios and modules that don't work. However, they also have the virtue of being relatively simple to implement correctly. The following solutions are more robust, but require more effort to implement correctly and can introduce subtle bugs if not written carefully.

Loading through .NET Core Assembly Load Contexts

Assembly Load Contexts (ALCs) were introduced in .NET Core 1.0 to specifically address the need to load multiple versions of the same assembly into the same runtime.

Within .NET, they offer the most robust solution to the problem of loading conflicting versions of an assembly. However, custom ALCs are not available in .NET Framework. This means that this solution only works in PowerShell 6 and above.

Currently, the best example of using an ALC for dependency isolation in PowerShell is in PowerShell Editor Services, the language server for the PowerShell extension for Visual Studio Code. An ALC is used to prevent PowerShell Editor Services' own dependencies from clashing with those in PowerShell modules.

Implementing module dependency isolation with an ALC is conceptually difficult, but we will work through a minimal example. Imagine we have a simple module that is only intended to work in PowerShell 7. The source code is organized as follows:

```
+ AlcModule.psd1
+ src/
    + TestAlcModuleCommand.cs
    + AlcModule.csproj
```

The cmdlet implementation looks like this:

C#

```
using Shared.Dependency;

namespace AlcModule
{
    [Cmdlet(VerbsDiagnostic.Test, "AlcModule")]
    public class TestAlcModuleCommand : Cmdlet
    {
        protected override void EndProcessing()
        {
            // Here's where our dependency gets used
            Dependency.Use();
            // Something trivial to make our cmdlet do *something*
            WriteObject("done!");
        }
    }
}
```

The (heavily simplified) manifest, looks like this:

PowerShell

```
@{
    Author = 'Me'
    ModuleVersion = '0.0.1'
    RootModule = 'AlcModule.dll'
    CmdletsToExport = @('Test-AlcModule')
    PowerShellVersion = '7.0'
}
```

And the `csproj` looks like this:

XML

```
<Project Sdk="Microsoft.NET.Sdk">
  <PropertyGroup>
    <TargetFramework>netcoreapp3.1</TargetFramework>
  </PropertyGroup>
  <ItemGroup>
    <PackageReference Include="Shared.Dependency" Version="1.0.0" />
```

```
    <PackageReference Include="Microsoft.PowerShell.Sdk" Version="7.0.1"
PrivateAssets="all" />
  </ItemGroup>
</Project>
```

When we build this module, the generated output has the following layout:

```
AlcModule/
  + AlcModule.psd1
  + AlcModule.dll
  + Shared.Dependency.dll
```

In this example, our problem is in the `Shared.Dependency.dll` assembly, which is our imaginary conflicting dependency. This is the dependency that we need to put behind an ALC so that we can use the module-specific version.

We need to re-engineer the module so that:

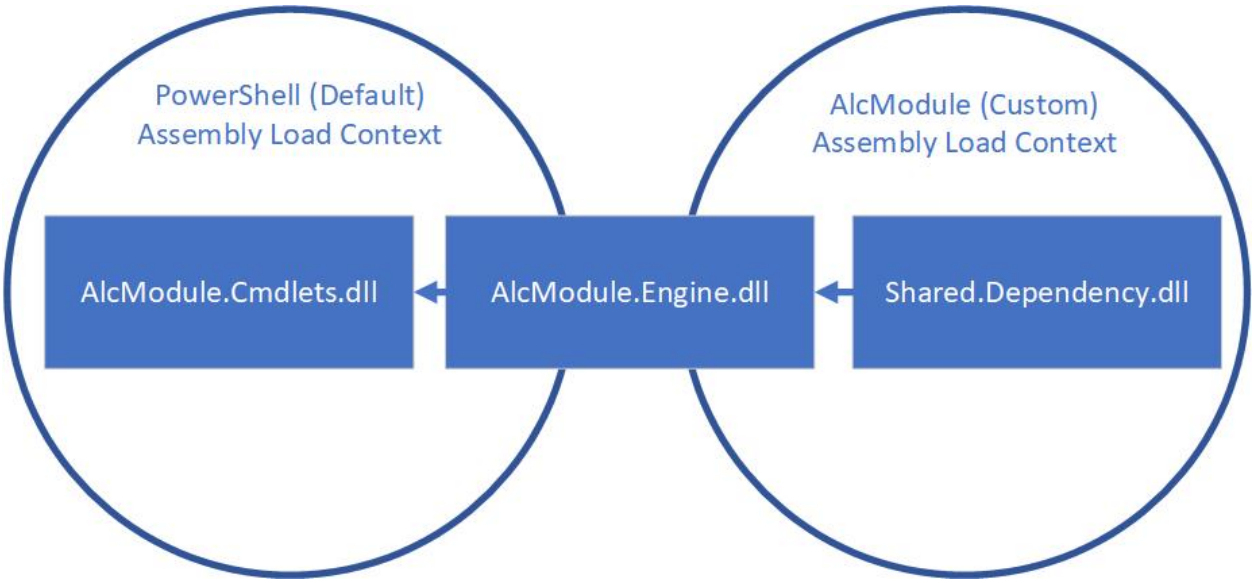
- Module dependencies are only loaded into our custom ALC, and not into PowerShell's ALC, so there can be no conflict. Moreover, as we add more dependencies to our project, we don't want to continuously add more code to keep loading working. Instead, we want reusable, generic dependency resolution logic.
- Loading the module still works as normal in PowerShell. Cmdlets and other types that the PowerShell module system needs are defined within PowerShell's own ALC.

To mediate these two requirements, we must break up our module into two assemblies:

- A cmdlets assembly, `AlcModule.Cmdlets.dll`, that contains definitions of all the types that PowerShell's module system needs to load our module correctly. Namely, any implementations of the `Cmdlet` base class and the class that implements `IModuleAssemblyInitializer`, which sets up the event handler for `AssemblyLoadContext.Default.Resolving` to properly load `AlcModule.Engine.dll` through our custom ALC. Since PowerShell 7 deliberately hides types defined in assemblies loaded in other ALCs, any types that are meant to be publicly exposed to PowerShell must also be defined here. Finally, our custom ALC definition needs to be defined in this assembly. Beyond that, as little code as possible should live in this assembly.
- An engine assembly, `AlcModule.Engine.dll`, that handles the actual implementation of the module. Types from this are available in the PowerShell ALC,

but it's initially loaded through our custom ALC. Its dependencies are only loaded into the custom ALC. Effectively, this becomes a *bridge* between the two ALCs.

Using this bridge concept, our new assembly situation looks like this:



To make sure the default ALC's dependency probing logic doesn't resolve the dependencies to be loaded into the custom ALC, we need to separate these two parts of the module in different directories. The new module layout has the following structure:

```
AlcModule/
  AlcModule.Cmdlets.dll
  AlcModule.psd1
  Dependencies/
  | + AlcModule.Engine.dll
  | + Shared.Dependency.dll
```

To see how the implementation changes, we'll start with the implementation of `AlcModule.Engine.dll`:

C#

```
using Shared.Dependency;

namespace AlcModule.Engine
{
    public class AlcEngine
    {
        public static void Use()
        {
            Dependency.Use();
        }
```

```
    }
}
```

This is a simple container for the dependency, `Shared.Dependency.dll`, but you should think of it as the .NET API for your functionality that the cmdlets in the other assembly wrap for PowerShell.

The cmdlet in `AlcModule.Cmdlets.dll` looks like this:

C#

```
// Reference our module's Engine implementation here
using AlcModule.Engine;

namespace AlcModule.Cmdlets
{
    [Cmdlet(VerbsDiagnostic.Test, "AlcModule")]
    public class TestAlcModuleCommand : Cmdlet
    {
        protected override void EndProcessing()
        {
            AlcEngine.Use();
            WriteObject("done!");
        }
    }
}
```

At this point, if we were to load **AlcModule** and run `Test-AlcModule`, we get a **FileNotFoundException** when the default ALC tries to load `Alc.Engine.dll` to run `EndProcessing()`. This is good, since it means the default ALC can't find the dependencies we want to hide.

Now we need to add code to `AlcModule.Cmdlets.dll` so that it knows how to resolve `AlcModule.Engine.dll`. First we must define our custom ALC to resolve assemblies from our module's `Dependencies` directory:

C#

```
namespace AlcModule.Cmdlets
{
    internal class AlcModuleAssemblyLoadContext : AssemblyLoadContext
    {
        private readonly string _dependencyDirPath;

        public AlcModuleAssemblyLoadContext(string dependencyDirPath)
        {
            _dependencyDirPath = dependencyDirPath;
        }
```

```
        protected override Assembly Load(AssemblyName assemblyName)
        {
            // We do the simple logic here of looking for an assembly of the
given name
            // in the configured dependency directory.
            string assemblyPath = Path.Combine(
                _dependencyDirPath,
                $"{assemblyName.Name}.dll");

            if (File.Exists(assemblyPath))
            {
                // The ALC must use inherited methods to load assemblies.
                // Assembly.Load*() won't work here.
                return LoadFromAssemblyPath(assemblyPath);
            }

            // For other assemblies, return null to allow other resolutions
to continue.
            return null;
        }
    }
}
```

Then we need to hook up our custom ALC to the default ALC's `Resolving` event, which is the ALC version of the `AssemblyResolve` event on Application Domains. This event is fired to find `AlcModule.Engine.dll` when `EndProcessing()` is called.

C#

```
namespace AlcModule.Cmdlets
{
    public class AlcModuleResolveEventHandler : IModuleAssemblyInitializer,
IModuleAssemblyCleanup
    {
        // Get the path of the dependency directory.
        // In this case we find it relative to the AlcModule.Cmdlets.dll
location
        private static readonly string s_dependencyDirPath =
Path.GetFullPath(
            Path.Combine(

Path.GetDirectoryName(Assembly.GetExecutingAssembly().Location),
                "Dependencies"));

        private static readonly AlcModuleAssemblyLoadContext s_dependencyAlc
=
            new AlcModuleAssemblyLoadContext(s_dependencyDirPath);

        public void OnImport()
        {
            // Add the Resolving event handler here
```

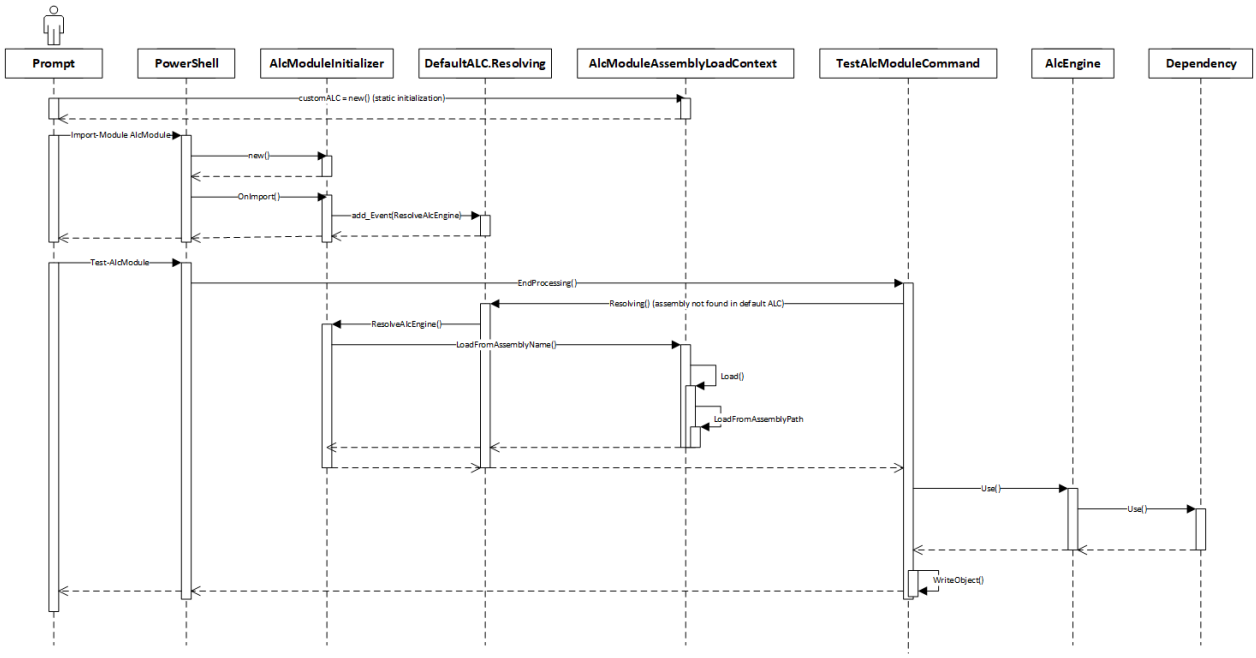
```
            AssemblyLoadContext.Default.Resolving += ResolveAlcEngine;
        }

        public void OnRemove(PSModuleInfo psModuleInfo)
        {
            // Remove the Resolving event handler here
            AssemblyLoadContext.Default.Resolving -= ResolveAlcEngine;
        }

        private static Assembly ResolveAlcEngine(AssemblyLoadContext
defaultAlc, AssemblyName assemblyToResolve)
        {
            // We only want to resolve the Alc.Engine.dll assembly here.
            // Because this will be loaded into the custom ALC,
            // all of *its* dependencies will be resolved
            // by the logic we defined for that ALC's implementation.
            //
            // Note that we are safe in our assumption that the name is
enough
            // to distinguish our assembly here,
            // since it's unique to our module.
            // There should be no other AlcModule.Engine.dll on the system.
            if (!assemblyToResolve.Name.Equals("AlcModule.Engine"))
            {
                return null;
            }

            // Allow our ALC to handle the directory discovery concept
            //
            // This is where Alc.Engine.dll is loaded into our custom ALC
            // and then passed through into PowerShell's ALC,
            // becoming the bridge between both
            return s_dependencyAlc.LoadFromAssemblyName(assemblyToResolve);
        }
    }
}
```

With the new implementation, take a look at the sequence of calls that occurs when the module is loaded and `Test-AlcModule` is run:



Some points of interest are:

- The `IModuleAssemblyInitializer` is run first when the module loads and sets the `Resolving` event.
- We don't load the dependencies until `Test-AlcModule` is run and its `EndProcessing()` method is called.
- When `EndProcessing()` is called, the default ALC fails to find `AlcModule.Engine.dll` and fires the `Resolving` event.
- Our event handler hooks up the custom ALC to the default ALC and loads `AlcModule.Engine.dll` only.
- When `AlcEngine.Use()` is called within `AlcModule.Engine.dll`, the custom ALC again kicks in to resolve `Shared.Dependency.dll`. Specifically, it always loads *our* `Shared.Dependency.dll` since it never conflicts with anything in the default ALC and only looks in our `Dependencies` directory.

Assembling the implementation, our new source code layout looks like this:

```
+ AlcModule.psd1
+ src/
  + AlcModule.Cmdlets/
  | + AlcModule.Cmdlets.csproj
  | + TestAlcModuleCommand.cs
  | + AlcModuleAssemblyLoadContext.cs
  | + AlcModuleInitializer.cs
  |
  + AlcModule.Engine/
  | + AlcModule.Engine.csproj
  | + AlcEngine.cs
```

AlcModule.Cmdlets.csproj looks like:

XML

```
<Project Sdk="Microsoft.NET.Sdk">
  <PropertyGroup>
    <TargetFramework>netcoreapp3.1</TargetFramework>
  </PropertyGroup>
  <ItemGroup>
    <ProjectReference Include="..\AlcModule.Engine\AlcModule.Engine.csproj"
/>
    <PackageReference Include="Microsoft.PowerShell.Sdk" Version="7.0.1"
PrivateAssets="all" />
  </ItemGroup>
</Project>
```

AlcModule.Engine.csproj looks like this:

XML

```
<Project Sdk="Microsoft.NET.Sdk">
  <PropertyGroup>
    <TargetFramework>netcoreapp3.1</TargetFramework>
  </PropertyGroup>
  <ItemGroup>
    <PackageReference Include="Shared.Dependency" Version="1.0.0" />
  </ItemGroup>
</Project>
```

So, when we build the module, our strategy is:

- Build `AlcModule.Engine`
- Build `AlcModule.Cmdlets`
- Copy everything from `AlcModule.Engine` into the `Dependencies` directory, and remember what we copied
- Copy everything from `AlcModule.Cmdlets` that wasn't in `AlcModule.Engine` into the base module directory

Since the module layout here is so crucial to dependency separation, here's a build script to use from the source root:

PowerShell

```
param(
    # The .NET build configuration
    [ValidateSet('Debug', 'Release')]
    [string]
```

```
    $Configuration = 'Debug'
)

# Convenient reusable constants
$mod = "AlcModule"
$netcore = "netcoreapp3.1"
$copyExtensions = @('.dll', '.pdb')

# Source code locations
$src = "$PSScriptRoot/src"
$engineSrc = "$src/$mod.Engine"
$cmdletsSrc = "$src/$mod.Cmdlets"

# Generated output locations
$outDir = "$PSScriptRoot/out/$mod"
$outDeps = "$outDir/Dependencies"

# Build AlcModule.Engine
Push-Location $engineSrc
dotnet publish -c $Configuration
Pop-Location

# Build AlcModule.Cmdlets
Push-Location $cmdletsSrc
dotnet publish -c $Configuration
Pop-Location

# Ensure out directory exists and is clean
Remove-Item -Path $outDir -Recurse -ErrorAction Ignore
New-Item -Path $outDir -ItemType Directory
New-Item -Path $outDeps -ItemType Directory

# Copy manifest
Copy-Item -Path "$PSScriptRoot/$mod.psd1"

# Copy each Engine asset and remember it
$deps = [System.Collections.Generic.Hashtable[string]]::new()
Get-ChildItem -Path "$engineSrc/bin/$Configuration/$netcore/publish/" |
    Where-Object { $_.Extension -in $copyExtensions } |
    ForEach-Object { [void]$deps.Add($_.Name); Copy-Item -Path $_.FullName -
Destination $outDeps }

# Now copy each Cmdlets asset, not taking any found in Engine
Get-ChildItem -Path "$cmdletsSrc/bin/$Configuration/$netcore/publish/" |
    Where-Object { -not $deps.Contains($_.Name) -and $_.Extension -in
$copyExtensions } |
    ForEach-Object { Copy-Item -Path $_.FullName -Destination $outDir }
```

Finally, we have a general way to isolate our module's dependencies in an Assembly Load Context that remains robust over time as more dependencies are added.

For a more detailed example, go to this GitHub repository. This example demonstrates how to migrate a module to use an ALC, while keeping that module working in .NET

Framework. It also shows how to use .NET Standard and PowerShell Standard to simplify the core implementation.

This solution is also used by the Bicep PowerShell module, and the blog post Resolving PowerShell Module Conflicts is another good read about this solution.

Assembly resolving handler for side-by-side loading

Although being robust, the solution described above requires the module assembly to not directly reference the dependency assemblies, but instead, reference a wrapper assembly that references the dependency assemblies. The wrapper assembly acts like a bridge, forwarding the calls from the module assembly to the dependency assemblies. This makes it usually a non-trivial amount of work to adopt this solution:

- For a new module, this would add additional complexity to the design and implementation
- For an existing module, this would require significant refactoring

There is a simplified solution to achieve side-by-side assembly loading, by hooking up a `Resolving` event with a custom `AssemblyLoadContext` instance. Using this method is easier for the module author but has two limitations. Check out the PowerShell-ALC-Samples repository for sample code and documentation that describes these limitations and detailed scenarios for this solution.

> **Important**
>
> Do not use `Assembly.LoadFile` for the dependency isolation purpose. Using `Assembly.LoadFile` creates a *Type Identity* issue when another module loads a different version of the same assembly into the default `AssemblyLoadContext`. While this API loads an assembly to a separate `AssemblyLoadContext` instance, the assemblies loaded are discoverable by PowerShell's **type resolution code**. Therefore, there could be duplicate types with the same fully qualifed type name available from two different ALCs.

Custom Application Domains

The final and most extreme option for assembly isolation is to use custom **Application Domains**. **Application Domains** are only available in .NET Framework. They are used to provide in-process isolation between parts of a .NET application. One of the uses is to isolate assembly loads from each other within the same process.

However, **Application Domains**are serialization boundaries. Objects in one application domain can't be referenced and used directly by objects in another application domain. You can work around this by implementing `MarshalByRefObject`. But when you don't control the types, as is often the case with dependencies, it's not possible to force an implementation here. The only solution is to make large architectural changes. The serialization boundary also has serious performance implications.

Because **Application Domains** have this serious limitation, are complicated to implement, and only work in .NET Framework, we won't give an example of how you might use them here. While they're worth mentioning as a possibility, they're not recommended.

If you're interested in trying to use a custom application domain, the following links might help:

- Conceptual documentation on Application Domains
- Examples for using Application Domains

Solutions for dependency conflicts that don't work for PowerShell

Finally, we'll address some possibilities that come up when researching .NET dependency conflicts in .NET that can look promising, but generally won't work for PowerShell.

These solutions have the common theme that they are changes to deployment configurations for an environment where you control the application and possibly the entire machine. These solutions are oriented toward scenarios like web servers and other applications deployed to server environments, where the environment is intended to host the application and is free to be configured by the deploying user. They also tend to be very much .NET Framework oriented, meaning they don't work with PowerShell 6 or higher.

If you know that your module is only used in Windows PowerShell 5.1 environments that you have total control over, some of these may be options. In general however, **modules shouldn't modify global machine state like this**. It can break configurations that cause problems in `powershell.exe`, other modules, or other dependent applications that cause your module to fail in unexpected ways.

Static binding redirect with app.config to force using the same dependency version

.NET Framework applications can take advantage of an `app.config` file to configure some application behaviors declaratively. It's possible to write an `app.config` entry that configures assembly binding to redirect assembly loading to a particular version.

Two issues with this for PowerShell are:

- .NET Core doesn't support `app.config`, so this solution only applies to `powershell.exe`.
- `powershell.exe` is a shared application that lives in the `System32` directory. It's likely that your module won't be able to modify its contents on many systems. Even if it can, modifying the `app.config` could break an existing configuration or affect the loading of other modules.

Setting `codebase` with app.config

For the same reasons, trying to configure the `codebase` setting in `app.config` is not going to work in PowerShell modules.

Installing dependencies to the Global Assembly Cache (GAC)

Another way to resolve dependency version conflicts in .NET Framework is to install dependencies to the GAC, so that different versions can be loaded side-by-side from the GAC.

Again, for PowerShell modules, the chief issues here are:

- The GAC only applies to .NET Framework, so this does not help in PowerShell 6 and above.
- Installing assemblies to the GAC is a modification of global machine state and may cause side-effects in other applications or to other modules. It may also be difficult to do correctly, even when your module has the required access privileges. Getting it wrong could cause serious, machine-wide issues in other .NET applications.

Further reading

There's plenty more to read on .NET assembly version dependency conflicts. Here are some nice jumping off points:

- .NET: Assemblies in .NET
- .NET Core: The managed assembly loading algorithm

- .NET Core: Understanding System.Runtime.Loader.AssemblyLoadContext
- .NET Core: Discussion about side-by-side assembly loading solutions
- .NET Framework: Redirecting assembly versions
- .NET Framework: Best practices for assembly loading
- .NET Framework: How the runtime locates assemblies
- .NET Framework: Resolve assembly loads
- StackOverflow: Assembly binding redirect, how and why?
- PowerShell: Discussion about implementing AssemblyLoadContexts
- PowerShell: Assembly.LoadFile() doesn't load into default AssemblyLoadContext
- Rick Strahl: When does a .NET assembly dependency get loaded?
- Jon Skeet: Summary of versioning in .NET
- Nate McMaster: Deep dive into .NET Core primitives

How to create a command-line predictor

Article • 07/10/2023

PSReadLine 2.1.0 introduced the concept of a smart command-line predictor by implementing the Predictive IntelliSense feature. PSReadLine 2.2.2 expanded on that feature by adding a plugin model that allows you create your own command-line predictors.

Predictive IntelliSense enhances tab completion by providing suggestions, on the command line, as you type. The prediction suggestion appears as colored text following your cursor. This enables you to discover, edit, and execute full commands based on matching predictions from your command history or additional domain-specific plugins.

System requirements

To create and use a plugin predictor, you must be using the following versions of software:

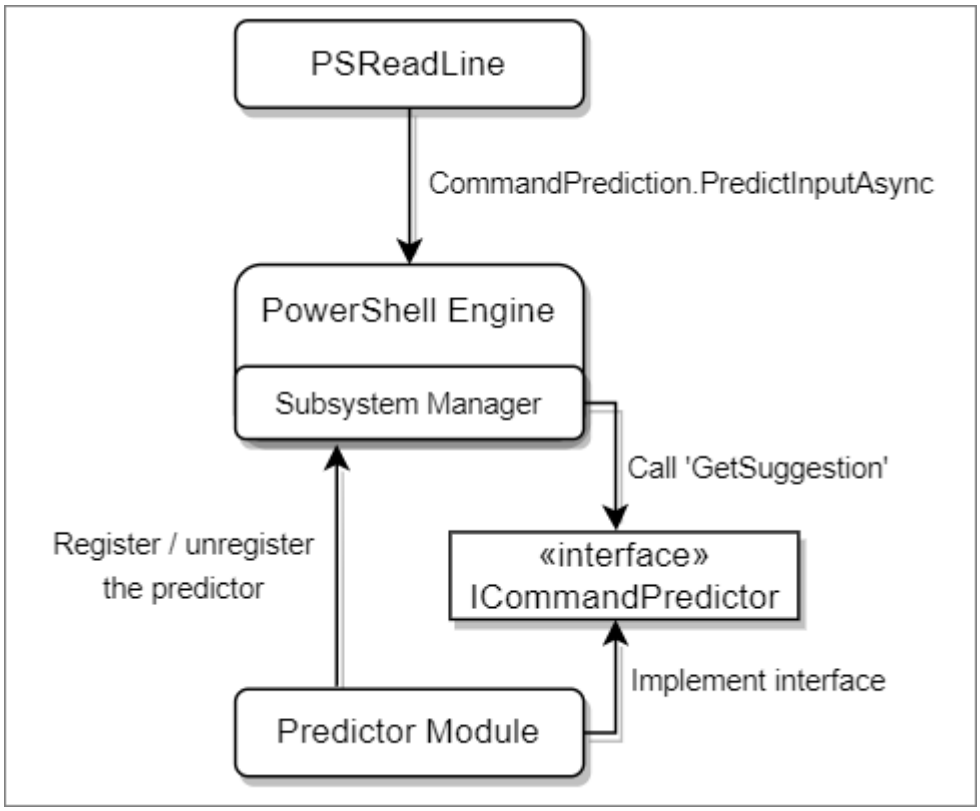
- PowerShell 7.2 (or higher) - provides the APIs necessary for creating a command predictor
- PSReadLine 2.2.2 (or higher) - allows you to configure PSReadLine to use the plugin

Overview of a predictor

A predictor is a PowerShell binary module. The module must implement the `System.Management.Automation.Subsystem.Prediction.ICommandPredictor` interface. This interface declares the methods used to query for prediction results and provide feedback.

A predictor module must register a `CommandPredictor` subsystem with PowerShell's `SubsystemManager` when loaded and unregister itself when unloaded.

The following diagram shows the architecture of a predictor in PowerShell.



Creating the code

To create a predictor, you must have the .NET 6 SDK installed for your platform. For more information on the SDK, see Download .NET 6.0.

Create a new PowerShell module project by following these steps:

1. Use the `dotnet` command-line tool to create a starter classlib project.

   PowerShell

   ```
   dotnet new classlib --name SamplePredictor
   ```

2. Edit the `SamplePredictor.csproj` to contain the following information:

   XML

   ```
   <Project Sdk="Microsoft.NET.Sdk">

     <PropertyGroup>
       <TargetFramework>net6.0</TargetFramework>
     </PropertyGroup>

     <ItemGroup>
       <PackageReference Include="Microsoft.PowerShell.SDK"
   Version="7.2.0" />
     </ItemGroup>
   ```

```
</Project>
```

3. Delete the default `Class1.cs` file created by `dotnet` and copy the following code to a `SamplePredictorClass.cs` file in your project folder.

C#

```
using System;
using System.Collections.Generic;
using System.Threading;
using System.Management.Automation;
using System.Management.Automation.Subsystem;
using System.Management.Automation.Subsystem.Prediction;

namespace PowerShell.Sample
{
    public class SamplePredictor : ICommandPredictor
    {
        private readonly Guid _guid;

        internal SamplePredictor(string guid)
        {
            _guid = new Guid(guid);
        }

        /// <summary>
        /// Gets the unique identifier for a subsystem implementation.
        /// </summary>
        public Guid Id => _guid;

        /// <summary>
        /// Gets the name of a subsystem implementation.
        /// </summary>
        public string Name => "SamplePredictor";

        /// <summary>
        /// Gets the description of a subsystem implementation.
        /// </summary>
        public string Description => "A sample predictor";

        /// <summary>
        /// Get the predictive suggestions. It indicates the start of a
suggestion rendering session.
        /// </summary>
        /// <param name="client">Represents the client that initiates
the call.</param>
        /// <param name="context">The <see cref="PredictionContext"/>
object to be used for prediction.</param>
        /// <param name="cancellationToken">The cancellation token to
cancel the prediction.</param>
        /// <returns>An instance of <see cref="SuggestionPackage"/>.
</returns>
```

```
        public SuggestionPackage GetSuggestion(PredictionClient client,
PredictionContext context, CancellationToken cancellationToken)
        {
            string input = context.InputAst.Extent.Text;
            if (string.IsNullOrWhiteSpace(input))
            {
                return default;
            }

            return new SuggestionPackage(new List<PredictiveSuggestion>
{
                new PredictiveSuggestion(string.Concat(input, " HELLO
WORLD"))
            });
        }

        #region "interface methods for processing feedback"

        /// <summary>
        /// Gets a value indicating whether the predictor accepts a
specific kind of feedback.
        /// </summary>
        /// <param name="client">Represents the client that initiates
the call.</param>
        /// <param name="feedback">A specific type of feedback.</param>
        /// <returns>True or false, to indicate whether the specific
feedback is accepted.</returns>
        public bool CanAcceptFeedback(PredictionClient client,
PredictorFeedbackKind feedback) => false;

        /// <summary>
        /// One or more suggestions provided by the predictor were
displayed to the user.
        /// </summary>
        /// <param name="client">Represents the client that initiates
the call.</param>
        /// <param name="session">The mini-session where the displayed
suggestions came from.</param>
        /// <param name="countOrIndex">
        /// When the value is greater than 0, it's the number of
displayed suggestions from the list
        /// returned in <paramref name="session"/>, starting from the
index 0. When the value is
        /// less than or equal to 0, it means a single suggestion from
the list got displayed, and
        /// the index is the absolute value.
        /// </param>
        public void OnSuggestionDisplayed(PredictionClient client, uint
session, int countOrIndex) { }

        /// <summary>
        /// The suggestion provided by the predictor was accepted.
        /// </summary>
        /// <param name="client">Represents the client that initiates
the call.</param>
```

```
        /// <param name="session">Represents the mini-session where the
accepted suggestion came from.</param>
        /// <param name="acceptedSuggestion">The accepted suggestion
text.</param>
        public void OnSuggestionAccepted(PredictionClient client, uint
session, string acceptedSuggestion) { }

        /// <summary>
        /// A command line was accepted to execute.
        /// The predictor can start processing early as needed with the
latest history.
        /// </summary>
        /// <param name="client">Represents the client that initiates
the call.</param>
        /// <param name="history">History command lines provided as
references for prediction.</param>
        public void OnCommandLineAccepted(PredictionClient client,
IReadOnlyList<string> history) { }

        /// <summary>
        /// A command line was done execution.
        /// </summary>
        /// <param name="client">Represents the client that initiates
the call.</param>
        /// <param name="commandLine">The last accepted command line.
</param>
        /// <param name="success">Shows whether the execution was
successful.</param>
        public void OnCommandLineExecuted(PredictionClient client,
string commandLine, bool success) { }

        #endregion;
    }

    /// <summary>
    /// Register the predictor on module loading and unregister it on
module un-loading.
    /// </summary>
    public class Init : IModuleAssemblyInitializer,
IModuleAssemblyCleanup
    {
        private const string Identifier = "843b51d0-55c8-4c1a-8116-
f0728d419306";

        /// <summary>
        /// Gets called when assembly is loaded.
        /// </summary>
        public void OnImport()
        {
            var predictor = new SamplePredictor(Identifier);

SubsystemManager.RegisterSubsystem(SubsystemKind.CommandPredictor,
predictor);
        }
```

```
        /// <summary>
        /// Gets called when the binary module is unloaded.
        /// </summary>
        public void OnRemove(PSModuleInfo psModuleInfo)
        {

SubsystemManager.UnregisterSubsystem(SubsystemKind.CommandPredictor,
new Guid(Identifier));
        }
    }
}
```

The following example code returns the string "HELLO WORLD" for the prediction result for all user input. Since the sample predictor doesn't process any feedback, the code doesn't implement the feedback methods from the interface. Change the prediction and feedback code to meet the needs of your predictor.

> ⓘ **Note**
>
> The list view of **PSReadLine** doesn't support multiline suggestions. Each suggestion should be a single line. If your code has a multiline suggestion, you should split the lines into separate suggestions or join the lines with a semicolon (`;`).

4. Run `dotnet build` to produce the assembly. You can find the compiled assembly in the `bin/Debug/net6.0` location of your project folder.

> ⓘ **Note**
>
> To ensure a responsive user experience, the ICommandPredictor interface has a 20ms time out for responses from the Predictors. Your predictor code must return results in less than 20ms to be displayed.

Using your predictor plugin

To try out your new predictor, open a new PowerShell 7.2 session and run the following commands:

PowerShell

```
Set-PSReadLineOption -PredictionSource HistoryAndPlugin
Import-Module .\bin\Debug\net6.0\SamplePredictor.dll
```

With the assembly is loaded in the session, you see the text "HELLO WORLD" appear as you type in the terminal. You can press `F2` to switch between the `Inline` view and the `List` view.

For more information about PSReadLine options, see Set-PSReadLineOption.

You can get a list of installed predictors, using the following command:

PowerShell

```powershell
Get-PSSubsystem -Kind CommandPredictor
```

Output

```
Kind              SubsystemType      IsRegistered Implementations
----              -------------      ------------ ---------------
CommandPredictor  ICommandPredictor          True {SamplePredictor}
```

> **Note**
>
> `Get-PSSubsystem` is an experimental cmdlet that was introduced in PowerShell 7.1 You must enable the `PSSubsystemPluginModel` experimental feature to use this cmdlet. For more information, see **Using Experimental Features**.

Create XML-based help using PlatyPS

Article • 06/28/2023

When creating a PowerShell module, it's always recommended that you include detailed help for the cmdlets you create. If your cmdlets are implemented in compiled code, you must use the XML-based help. This XML format is known as the Microsoft Assistance Markup Language (MAML).

The legacy PowerShell SDK documentation covers the details of creating help for PowerShell cmdlets packaged into modules. However, PowerShell doesn't provide any tools for creating the XML-based help. The SDK documentation explains the structure of MAML help, but leaves you the task of creating the complex, and deeply nested, MAML content by hand.

This is where the PlatyPS module can help.

What is PlatyPS?

PlatyPS is an open-source tool that started as a *hackathon* project to make the creation and maintenance of MAML easier. PlatyPS documents the syntax of parameter sets and the individual parameters for each cmdlet in your module. PlatyPS creates structured Markdown files that contain the syntax information. It can't create descriptions or provide examples.

PlatyPS creates placeholders for you to fill in descriptions and examples. After adding the required information, PlatyPS compiles the Markdown files into MAML files. PowerShell's help system also allows for plain-text conceptual help files (about topics). PlatyPS has a cmdlet to create a structured Markdown template for a new *about* file, but these `about_*.help.txt` files must be maintained manually.

You can include the MAML and Text help files with your module. You can also use PlatyPS to compile the help files into a CAB package that can be hosted for updateable help.

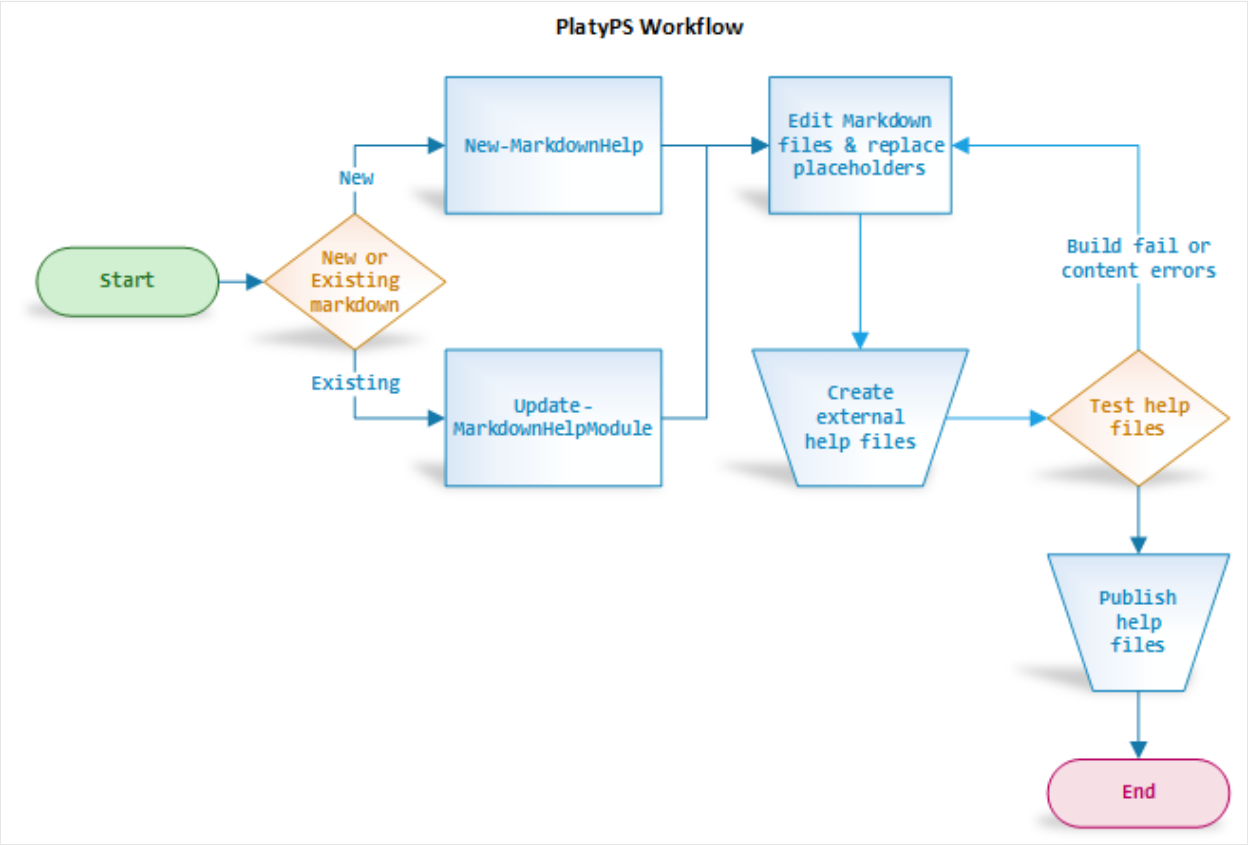
Get started using PlatyPS

First you must install PlatyPS from the PowerShell Gallery.

```
PowerShell
```

```
Install-Module platyps -Force
Import-Module platyps
```

The following flowchart outlines the process for creating or updating PowerShell reference content.



Create Markdown content for a PowerShell module

1. Import your new module into the session. Repeat this step for each module you need to document.

   Run the following command to import your modules:

   PowerShell

   ```
   Import-Module <your module name>
   ```

2. Use PlatyPS to generate Markdown files for your module page and all associated cmdlets within the module. Repeat this step for each module you need to document.

   PowerShell

```
$OutputFolder = <output path>
$parameters = @{
    Module = <ModuleName>
    OutputFolder = $OutputFolder
    AlphabeticParamsOrder = $true
    WithModulePage = $true
    ExcludeDontShow = $true
    Encoding = [System.Text.Encoding]::UTF8
}
New-MarkdownHelp @parameters

New-MarkdownAboutHelp -OutputFolder $OutputFolder -AboutName
"topic_name"
```

If the output folder doesn't exist, `New-MarkdownHelp` creates it. In this example, `New-MarkdownHelp` creates a Markdown file for each cmdlet in the module. It also creates the *module page* in a file named `<ModuleName>.md`. This module page contains a list of the cmdlets contained in the module and placeholders for the **Synopsis** description. The metadata in the module page comes from the module manifest and is used by PlatyPS to create the HelpInfo XML file (as explained below).

`New-MarkdownAboutHelp` creates a new *about* file named `about_topic_name.md`.

For more information, see New-MarkdownHelp and New-MarkdownAboutHelp.

Update existing Markdown content when the module changes

PlatyPS can also update existing Markdown files for a module. Use this step to update existing modules that have new cmdlets, new parameters, or parameters that have changed.

1. Import your new module into the session. Repeat this step for each module you need to document.

   Run the following command to import your modules:

   PowerShell

   ```
   Import-Module <your module name>
   ```

2. Use PlatyPS to update Markdown files for your module landing page and all associated cmdlets within the module. Repeat this step for each module you need

to document.

```PowerShell
$parameters = @{
    Path = <folder with Markdown>
    RefreshModulePage = $true
    AlphabeticParamsOrder = $true
    UpdateInputOutput = $true
    ExcludeDontShow = $true
    LogPath = <path to store log file>
    Encoding = [System.Text.Encoding]::UTF8
}
Update-MarkdownHelpModule @parameters
```

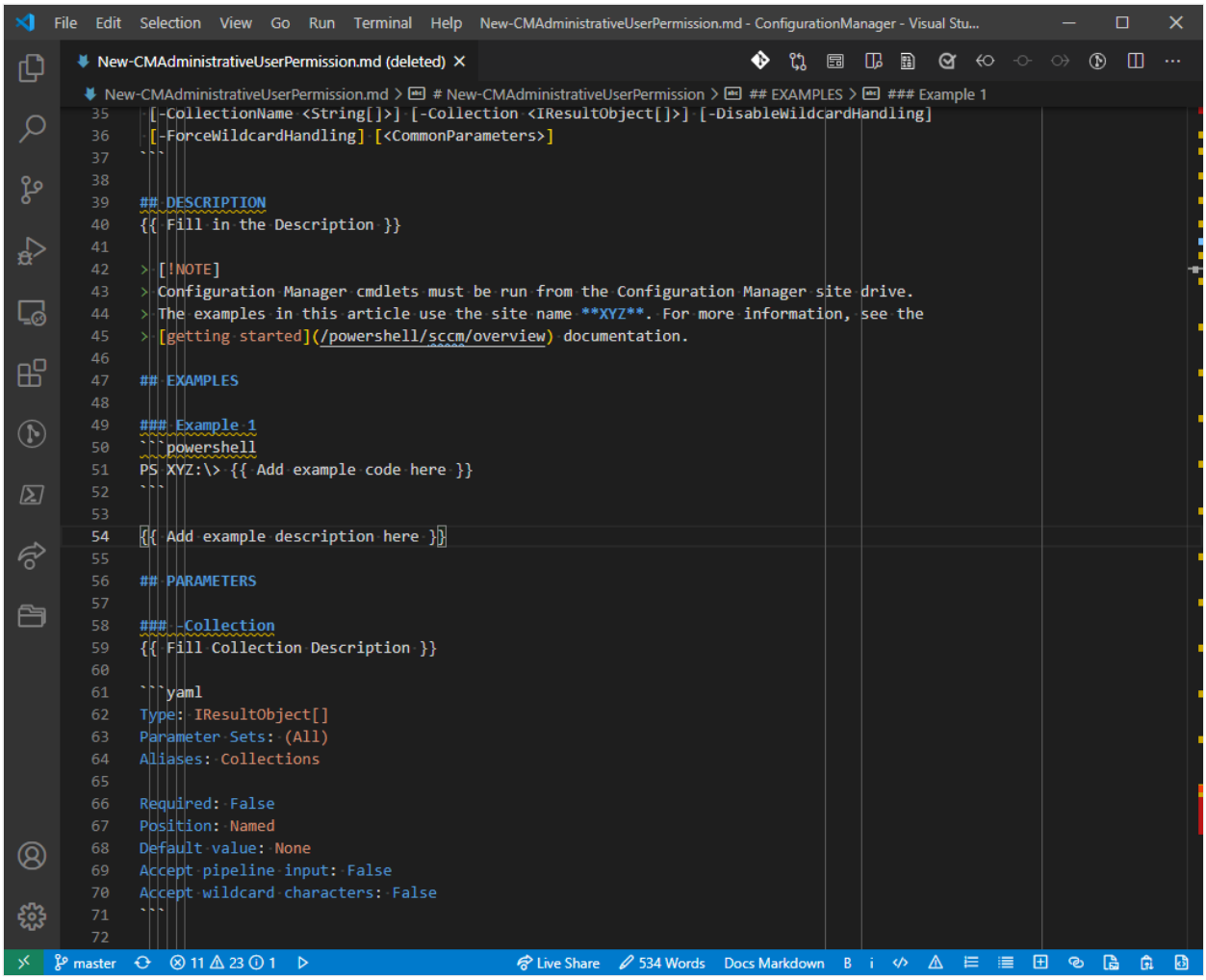
`Update-MarkdownHelpModule` updates the cmdlet and module Markdown files in the specified folder. It doesn't update the `about_*.md` files. The module file (`ModuleName.md`) receives any new **Synopsis** text that has been added to the cmdlet files. Updates to cmdlet files include the following change:

- New parameter sets
- New parameters
- Updated parameter metadata
- Updated input and output type information

For more information, see Update-MarkdownHelpModule.

Edit the new or updated Markdown files

PlatyPS documents the syntax of the parameter sets and the individual parameters. It can't create descriptions or provide examples. The specific areas where content is needed are contained in curly braces. For example: `{{ Fill in the Description }}`



You need to add a synopsis, a description of the cmdlet, descriptions for each parameter, and at least one example.

For detailed information about writing PowerShell content, see the following articles:

- PowerShell style guide
- Editing reference articles

> **Note**
>
> PlatyPS has a specific schema that's uses for cmdlet reference. That schema only allows certain Markdown blocks in specific sections of the document. If you put content in the wrong location, the PlatyPS build step fails. For more information, see the **schema** documentation in the PlatyPS repository. For a complete example of well-formed cmdlet reference, see **Get-Item**.

After providing the required content for each of your cmdlets, you need to make sure that you update the module landing page. Verify your module has the correct `Module Guid` and `Download Help Link` values in the YAML metadata of the `<module-name>.md` file. Add any missing metadata.

Also, you may notice that some cmdlets may be missing a **Synopsis** (*short description*). The following command updates the module landing page with your **Synopsis** description text. Open the module landing page to verify the descriptions.

```
PowerShell

Update-MarkdownHelpModule -Path <full path output folder> -RefreshModulePage
```

Now that you have entered all the content, you can create the MAML help files that are displayed by `Get-Help` in the PowerShell console.

Create the external help files

This step creates the MAML help files that are displayed by `Get-Help` in the PowerShell console.

To build the MAML files, run the following command:

```
PowerShell

New-ExternalHelp -Path <folder with MDs> -OutputPath <output help folder>
```

`New-ExternalHelp` converts all cmdlet Markdown files into one (or more) MAML files. About files are converted to plain-text files with the following name format: `about_topic_name.help.txt`. The Markdown content must meet the requirement of the PlatyPS schema. `New-ExternalHelp` exits with errors when the content doesn't follow the schema. You must edit the files to fix the schema violations.

> **⊗ Caution**
>
> PlatyPS does a poor job converting the `about_*.md` files to plain text. You must use very simple Markdown to get acceptable results. You may want to maintain the files in plain-text `about_topic_name.help.txt` format, rather than allowing PlatyPS to convert them.

Once this step is complete, you will see `*-help.xml` and `about_*.help.txt` files in the target output folder.

For more information, see New-ExternalHelp

Test the compiled help files

You can verify the content with the Get-HelpPreview cmdlet:

```PowerShell
Get-HelpPreview -Path "<ModuleName>-Help.xml"
```

The cmdlet reads the compiled MAML file and outputs the content in the same format you would receive from `Get-Help`. This allows you to inspect the results to verify that the Markdown files compiled correctly and produce the desired results. If you find an error, re-edit the Markdown files and recompile the MAML.

Now you are ready to publish your help files.

Publishing your help

Now that you have compiled the Markdown files into PowerShell help files, you are ready to make the files available to users. There are two options for providing help in the PowerShell console.

- Package the help files with the module
- Create an updateable help package that users install with the `Update-Help` cmdlet

Packaging help with the module

The help files can be packaged with your module. See Writing Help for Modules for details of the folder structure. You should include the list of Help files in the value of the **FileList** key in the module manifest.

Creating an updateable help package

At a high level, the steps to create updateable help include:

1. Find an internet site to host your help files
2. Add a **HelpInfoURI** key to your module manifest
3. Create a HelpInfo XML file
4. Create CAB files
5. Upload your files

For more information, see Supporting Updateable Help: Step-by-step.

PlatyPS assists you with some of these steps.

The **HelpInfoURI** is a URL that points to location where your help files are hosted on the internet. This value is configured in the module manifest. `Update-Help` reads the module manifest to get this URL and download the updateable help content. This URL should only point to the folder location and not to individual files. `Update-Help` constructs the filenames to download based on other information from the module manifest and the HelpInfo XML file.

> **ⓘ Important**
>
> The **HelpInfoURI** must end with a forward-slash character (`/`). Without that character, `Update-Help` can't construct the correct file paths to download the content. Also, most HTTP-based file services are case-sensitive. It's important that the module metadata in the HelpInfo XML file contains the proper letter case.

The `New-ExternalHelp` cmdlet creates the HelpInfo XML file in the output folder. The HelpInfo XML file is built using YAML metadata contained in the module Markdown files (`ModuleName.md`).

The `New-ExternalHelpCab` cmdlet creates ZIP and CAB files containing the MAML and `about_*.help.txt` files you compiled. CAB files are compatible with all versions of PowerShell. PowerShell 6 and higher can use ZIP files.

PowerShell

```
$helpCabParameters = @{
    CabFilesFolder = $MamlOutputFolder
    LandingPagePath = $LandingPage
    OutputFolder = $CabOutputFolder
}
New-ExternalHelpCab @helpCabParameters
```

After creating the ZIP and CAB files, upload the ZIP, CAB, and HelpInfo XML files to your HTTP file server. Put the files in the location indicated by the **HelpInfoURI**.

For more information, see New-ExternalHelpCab.

Other publishing options

Markdown is a versatile format that's easy to transform to other formats for publishing. Using a tool like Pandoc, you can convert your Markdown help files to many different

document formats, including plain text, HTML, PDF, and Office document formats.

Also, the cmdlets ConvertFrom-Markdown and Show-Markdown in PowerShell 6 and higher can be used to convert Markdown to HTML or create a colorful display in the PowerShell console.

Known issues

PlatyPS is very sensitive to the schema for the structure of the Markdown files it creates and compiles. It's very easy write valid Markdown that violates this schema. For more information, see the PowerShell style guide and Editing reference articles.

Windows PowerShell Language Specification 3.0

Article • 09/22/2022

The *Windows PowerShell Language Specification 3.0* was published in December 2012 and is based on PowerShell 3.0. The specification document is available as a Microsoft Word document from the Microsoft Download Center at: https://www.microsoft.com/download/details.aspx?id=36389

That Word document has been converted for presentation here on Microsoft Learn. During conversion, some editorial changes have been made to accommodate formatting for the Docs platform. Some typos and minor errors have been corrected.

> **Important**
>
> The contents of this documentation may not reflect the current state of PowerShell in its current version. There is no plan to update this documentation to reflect the current state. This documentation is presented here for historical reference.

1. Introduction

PowerShell is a command-line *shell* and scripting language, designed especially for system administrators.

Most shells operate by executing a command or utility in a new process, and presenting the results to the user as text. These shells also have commands that are built into the shell and run in the shell process. Because there are few built-in commands, many utilities have been created to supplement them. PowerShell is very different. Instead of processing text, the shell processes objects. PowerShell also includes a large set of built-in commands with each having a consistent interface and these can work with user-written commands.

An *object* is a data entity that has *properties* (i.e., characteristics) and *methods* (i.e., actions that can be performed on the object). All objects of the same type have the same base set of properties and methods, but each *instance* of an object can have different property values.

A major advantage of using objects is that it is much easier to *pipeline* commands; that is, to write the output of one command to another command as input. (In a traditional

command-line environment, the text output from one command needs to be manipulated to meet the input format of another.)

PowerShell includes a very rich scripting language that supports constructs for looping, conditions, flow-control, and variable assignment. This language has syntax features and keywords similar to those used in the C# programming language (§C.).

There are four kinds of commands in PowerShell: scripts, functions and methods, cmdlets, and native commands.

- A file of commands is called a *script*. By convention, a script has a filename extension of .ps1. The top-most level of a PowerShell program is a script, which, in turn, can invoke other commands.
- PowerShell supports modular programming via named procedures. A procedure written in PowerShell is called a *function*, while an external procedure made available by the execution environment (and typically written in some other language) is called a *method*.
- A *cmdlet* (pronounced "command-let") is a simple, single-task command-line tool. Although a cmdlet can be used on its own, the full power of cmdlets is realized when they are used in combination to perform complex tasks.
- A *native command* is a command that is built in to the host environment.

Each time the PowerShell runtime environment begins execution, it begins what is called a *session*. Commands then execute within the context of that session.

This specification defines the PowerShell language, the built-in cmdlets, and the use of objects via the pipeline.

Unlike most shells, which accept and return text, Windows PowerShell is built on top of the .NET Framework common language runtime (CLR) and the .NET Framework, and accepts and returns .NET Framework objects.

2. Lexical Structure

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2.1 Grammars

This specification shows the syntax of the PowerShell language using two grammars. The *lexical grammar* (§B.1) shows how Unicode characters are combined to form line terminators, comments, white space, and tokens. The *syntactic grammar* (§B.2) shows how the tokens resulting from the lexical grammar are combined to form PowerShell scripts.

For convenience, fragments of these grammars are replicated in appropriate places throughout this specification.

Any use of the characters 'a' through 'z' in the grammars is case insensitive. This means that letter case in variables, aliases, function names, keywords, statements, and operators is ignored. However, throughout this specification, such names are written in lowercase, except for some automatic and preference variables.

2.2 Lexical analysis

2.2.1 Scripts

Syntax:

> **Tip**
>
> The `~opt~` notation in the syntax definitions indicates that the lexical entity is optional in the syntax.

Syntax

```
input:
    input-elements~opt~   signature-block~opt~

input-elements:
    input-element
    input-elements   input-element

input-element:
    whitespace
```

```
    comment
    token

signature-block:
    signature-begin   signature   signature-end

signature-begin:
    new-line-character   # SIG # Begin signature block   new-line-character

signature:
    base64 encoded signature blob in multiple single-line-comments

signature-end:
    new-line-character   # SIG # End signature block   new-line-character
```

Description:

The input source stream to a PowerShell translator is the *input* in a script, which contains a sequence of Unicode characters. The lexical processing of this stream involves the reduction of those characters into a sequence of tokens, which go on to become the input of syntactic analysis.

A script is a group of PowerShell commands stored in a *script-file*. The script itself has no name, per se, and takes its name from its source file. The end of that file indicates the end of the script.

A script may optionally contain a digital signature. A host environment is not required to process any text that follows a signature or anything that looks like a signature. The creation and use of digital signatures are not covered by this specification.

2.2.2 Line terminators

Syntax:

Syntax

```
new-line-character:
    Carriage return character (U+000D)
    Line feed character (U+000A)
    Carriage return character (U+000D) followed by line feed character
(U+000A)

new-lines:
    new-line-character
    new-lines new-line-character
```

Description:

The presence of *new-line-character*s in the input source stream divides it into lines that can be used for such things as error reporting and the detection of the end of a single-line comment.

A line terminator can be treated as white space (§2.2.4).

2.2.3 Comments

Syntax:

Syntax

```
comment:
single-line-comment
    requires-comment
    delimited-comment

single-line-comment:
    # input-characters~opt~

input-characters:
    input-character
    input-characters input-character

input-character:
    Any Unicode character except a new-line-character

requires-comment:
    #requires whitespace command-arguments

dash:
    - (U+002D)
    EnDash character (U+2013)
    EmDash character (U+2014)
    Horizontal bar character (U+2015)

dashdash:
    dash dash

delimited-comment:
    < # delimited-comment-text~opt~ hashes >

delimited-comment-text:
    delimited-comment-section
    delimited-comment-text delimited-comment-section

delimited-comment-section:
    >
    hashes~opt~  not-greater-than-or-hash

hashes:
    #
```

```
    hashes #

not-greater-than-or-hash:
    Any Unicode character except > or #
```

Description:

Source code can be annotated by the use of *comments*.

A *single-line-comment* begins with the character `#` and ends with a *new-line-character*.

A *delimited-comment* begins with the character pair `<#` and ends with the character pair `#>`. It can occur as part of a source line, as a whole source line, or it can span any number of source lines.

A comment is treated as white space.

The productions above imply that

- Comments do not nest.
- The character sequences <# and #> have no special meaning in a single-line comment.
- The character # has no special meaning in a delimited comment.

The lexical grammar implies that comments cannot occur inside tokens.

(See §A for information about creating script files that contain special-valued comments that are used to generate documentation from script files.)

A *requires-comment* specifies the criteria that have to be met for its containing script to be allowed to run. The primary criterion is the version of PowerShell being used to run the script. The minimum version requirement is specified as follows:

`#requires -Version N[.n]`

Where *N* is the (required) major version and *n* is the (optional) minor version.

A *requires-comment* can be present in any script file; however, it cannot be present inside a function or cmdlet. It must be the first item on a source line. A script can contain multiple *requires-comment*s.

A character sequence is only recognized as a comment if that sequence begins with `#` or `<#`. For example, hello#there is considered a single token whereas hello #there is considered the token hello followed by a single-line comment. As well as following white space, the comment start sequence can also be preceded by any expression-terminating or statement-terminating character (such as `)`, `}`, `]`, `'`, `"`, or `;`).

A *requires-comment* cannot be present inside a snap-in.

There are four other forms of a *requires-comment*:

Syntax

```
#requires --Assembly AssemblyId
#requires --Module ModuleName
#requires --PsSnapIn PsSnapIn [ -Version *N* [.n] ]
#requires --ShellId ShellId
```

2.2.4 White space

Syntax:

Syntax

```
whitespace:
    Any character with Unicode class Zs, Zl, or Zp
    Horizontal tab character (U+0009)
    Vertical tab character (U+000B)
    Form feed character (U+000C)
    ` (The backtick character U+0060) followed by new-line-character
```

Description:

White space consists of any sequence of one or more *whitespace* characters.

Except for the fact that white space may act as a separator for tokens, it is ignored.

Unlike some popular languages, PowerShell does not consider line-terminator characters (§2.2.2) to be white space. However, a line terminator can be treated as white space by preceding it immediately by a backtick character, `` ` `` (U+0060). This is necessary when the contents of a line are complete syntactically, yet the following line contains tokens intended to be associated with the previous line. For example,

PowerShell

```
$number = 10 # assigns 10 to $number; nothing is written to the pipeline
+ 20 # writes 20 to the pipeline
- 50 # writes -50 to the pipeline
$number # writes $number's value, 10, to the pipeline
```

In this example, the backtick indicates the source line is continued. The following expression is equivalent to `$number = 10 + 20 - 50`.

PowerShell

```
$number = 10 `
+ 20 `
- 50
$number # writes $number's value to the pipeline
-20
```

2.3 Tokens

Syntax:

Syntax

```
token:
    keyword
    variable
    command
    command-parameter
    command-argument-token
    integer-literal
    real-literal
    string-literal
    type-literal
    operator-or-punctuator
```

Description:

A *token* is the smallest lexical element within the PowerShell language.

Tokens can be separated by *new-lines*, comments, white space, or any combination thereof.

2.3.1 Keywords

Syntax:

Syntax

```
keyword: one of
    begin           break           catch       class
    continue        data            define      do
    dynamicparam    else            elseif      end
    exit            filter          finally     for
    foreach         from            function    if
    in              inlinescript    parallel    param
    process         return          switch      throw
```

```
    trap            try             until       using
    var             while           workflow
```

Description:

A *keyword* is a sequence of characters that has a special meaning when used in a context-dependent place. Most often, this is as the first token in a *statement*; however, there are other locations, as indicated by the grammar. (A token that looks like a keyword, but is not being used in a keyword context, is a *command-name* or a *command-argument*.)

The keywords `class`, `define`, `from`, `using`, and `var` are reserved for future use.

> ⓘ **Note**
>
> Editor's Note: The `class` and `using` keywords were introduced in PowerShell 5.0. See **about_Classes** and **about_Using**.

2.3.2 Variables

Syntax:

Syntax

```
variable:
    $$
    $?
    $^
    $   variable-scope~opt~  variable-characters
    @   variable-scope~opt~  variable-characters
    braced-variable


braced-variable:
    ${   variable-scope~opt~   braced-variable-characters   }

variable-scope:
    global:
    local:
    private:
    script:
    using:
    workflow:
    variable-namespace

variable-namespace:
    variable-characters   :
```

```
variable-characters:
    variable-character
    variable-characters   variable-character

variable-character:
    A Unicode character of classes Lu, Ll, Lt, Lm, Lo, or Nd
    _   (The underscore character U+005F)
    ?

braced-variable-characters:
    braced-variable-character
    braced-variable-characters   braced-variable-character

braced-variable-character:
    Any Unicode character except
        }   (The closing curly brace character U+007D)
        `   (The backtick character U+0060)
    escaped-character

escaped-character:
    `   (The backtick character U+0060) followed by any Unicode character
```

Description:

Variables are discussed in detail in (§5). The variable $? is discussed in §2.3.2.2. Scopes are discussed in §3.5.

The variables `$$` and `$^` are reserved for use in an interactive environment, which is outside the scope of this specification.

There are two ways of writing a variable name: A *braced variable name*, which begins with `$`, followed by a curly bracket-delimited set of one or more almost-arbitrary characters; and an *ordinary variable name*, which also begins with `$`, followed by a set of one or more characters from a more restrictive set than a braced variable name allows. Every ordinary variable name can be expressed using a corresponding braced variable name.

PowerShell

```
$totalCost
$Maximum_Count_26

$végösszeg # Hungarian
$итог # Russian
$総計 # Japanese (Kanji)

${Maximum_Count_26}
${Name with`twhite space and `{punctuation`}}
${E:\\File.txt}
```

There is no limit on the length of a variable name, all characters in a variable name are significant, and letter case is *not* distinct.

There are several different kinds of variables: user-defined (§2.3.2.1), automatic (§2.3.2.2), and preference (§2.3.2.3). They can all coexist in the same scope (§3.5).

Consider the following function definition and calls:

```
PowerShell
```

```
function Get-Power ([long]$base, [int]$exponent) { ... }

Get-Power 5 3 # $base is 5, $exponent is 3
Get-Power -exponent 3 -base 5 # " " "
```

Each argument is passed by position or name, one at a time. However, a set of arguments can be passed as a group with expansion into individual arguments being handled by the runtime environment. This automatic argument expansion is known as *splatting*. For example,

```
PowerShell
```

```
$values = 5,3 # put arguments into an array
Get-Power @values

$hash = @{ exponent = 3; base = 5 } # put arguments into a Hashtable
Get-Power @hash

function Get-Power2 { Get-Power @args } # arguments are in an array

Get-Power2 --exponent 3 --base 5 # named arguments splatted named in
@args
Get-Power2 5 3 # position arguments splatted positionally in @args
```

This is achieved by using `@` instead of `$` as the first character of the variable being passed. This notation can only be used in an argument to a command.

Names are partitioned into various namespaces each of which is stored on a virtual drive (§3.1). For example, variables are stored on `Variable:`, environment variables are stored on `Env:`, functions are stored on `Function:`, and aliases are stored on `Alias:`. All of these names can be accessed as variables using the *variable-namespace* production within *variable-scope*. For example,

```
PowerShell
```

```
function F { "Hello from F" }
$Function:F # invokes function F

Set-Alias A F
$Alias:A # invokes function F via A

$Count = 10
$Variable:Count # accesses variable Count
$Env:Path # accesses environment variable Path
```

Any use of a variable name with an explicit `Variable:` namespace is equivalent to the use of that same variable name without that qualification. For example, `$v` and `$Variable:v` are interchangeable.

As well as being defined in the language, variables can also be defined by the cmdlet New-Variable.

2.3.2.1 User-defined variables

Any variable name allowed by the grammar but not used by automatic or preference variables is available for user-defined variables.

User-defined variables are created and managed by user-defined script.

2.3.2.2 Automatic variables

Automatic variables store state information about the PowerShell environment. Their values can be read in user-written script but not written.

> ⓘ Note
>
> The table originally found in this document was removed to reduce duplication. For a complete list of automatic variables, see **about_Automatic_Variables**.

2.3.2.3 Preference variables

Preference variables store user preferences for the session. They are created and initialized by the PowerShell runtime environment. Their values can be read and written in user-written script.

> ⓘ Note

The table originally found in this document was removed to reduce duplication. For a complete list of preference variables, see **about_Preference_Variables**.

2.3.3 Commands

Syntax:

Syntax

```
generic-token:
    generic-token-parts

generic-token-parts:
    generic-token-part
    generic-token-parts generic-token-part

generic-token-part:
    expandable-string-literal
    verbatim-here-string-literal
    variable
    generic-token-char

generic-token-char:
    Any Unicode character except
        {   }   (   )   ;   ,   |   &   $
        ` (The backtick character U+0060)
        double-quote-character
        single-quote-character
        whitespace
        new-line-character
        escaped-character

generic-token-with-subexpr-start:
    generic-token-parts $(
```

2.3.4 Parameters

Syntax:

Syntax

```
command-parameter:
    dash first-parameter-char parameter-chars colon~opt~

first-parameter-char:
    A Unicode character of classes Lu, Ll, Lt, Lm, or Lo
    _ (The underscore character U+005F)
    ?
```

```
parameter-chars:
    parameter-char
    parameter-chars parameter-char

parameter-char:
    Any Unicode character except
        { } ( ) ; , \| & . [
        colon
        whitespace
        new-line-character

colon:
    : (The colon character U+003A)

verbatim-command-argument-chars:
    verbatim-command-argument-part
    verbatim-command-argument-chars verbatim-command-argument-part

verbatim-command-argument-part:
    verbatim-command-string
    & non-ampersand-character
    Any Unicode character except
        |
        new-line-character

non-ampersand-character:
    Any Unicode character except &

verbatim-command-string:
    double-quote-character non-double-quote-chars
    double-quote-character

non-double-quote-chars:
    non-double-quote-char
    non-double-quote-chars non-double-quote-char

non-double-quote-char:
    Any Unicode character except
        double-quote-character
```

Description:

When a command is invoked, information may be passed to it via one or more *arguments* whose values are accessed from within the command through a set of corresponding *parameters*. The process of matching parameters to arguments is called *parameter binding*.

There are three kinds of argument:

- Switch parameter (§8.10.5) -- This has the form *command-parameter* where *first-parameter-char* and *parameter-chars* together make up the switch name, which

corresponds to the name of a parameter (without its leading `-`) in the command being invoked. If the trailing colon is omitted, the presence of this argument indicates that the corresponding parameter be set to `$true`. If the trailing colon is present, the argument immediately following must designate a value of type bool, and the corresponding parameter is set to that value. For example, the following invocations are equivalent:

```PowerShell
Set-MyProcess -Strict
Set-MyProcess -Strict: $true
```

- Parameter with argument (§8.10.2) -- This has the form *command-parameter* where *first-parameter-char* and *parameter-chars* together make up the parameter name, which corresponds to the name of a parameter (without its leading -) in the command being invoked. There must be no trailing colon. The argument immediately following designates an associated value. For example, given a command `Get-Power`, which has parameters `$base` and `$exponent`, the following invocations are equivalent:

```PowerShell
Get-Power -base 5 -exponent 3
Get-Power -exponent 3 -base 5
```

- Positional argument (§8.10.2) - Arguments and their corresponding parameters inside commands have positions with the first having position zero. The argument in position 0 is bound to the parameter in position 0; the argument in position 1 is bound to the parameter in position 1; and so on. For example, given a command `Get-Power`, that has parameters `$base` and `$exponent` in positions 0 and 1, respectively, the following invokes that command:

```PowerShell
Get-Power 5 3
```

See §8.2 for details of the special parameters `--` and `--%`.

When a command is invoked, a parameter name may be abbreviated; any distinct leading part of the full name may be used, provided that is unambiguous with respect to the names of the other parameters accepted by the same command.

For information about parameter binding see §8.14.

2.3.5 Literals

Syntax:

Syntax

```
literal:
    integer-literal
    real-literal
    string-literal
```

2.3.5.1 Numeric literals

There are two kinds of numeric literals: integer (§2.3.5.1.1) and real (§2.3.5.1.2). Both can have multiplier suffixes (§2.3.5.1.3).

2.3.5.1.1 Integer literals

Syntax:

Syntax

```
integer-literal:
    decimal-integer-literal
    hexadecimal-integer-literal

decimal-integer-literal:
    decimal-digits numeric-type-suffix~opt~ numeric-multiplier~opt~

decimal-digits:
    decimal-digit
    decimal-digit decimal-digits

decimal-digit: one of
    0  1  2  3  4  5  6  7  8  9

numeric-type-suffix:
    long-type-suffix
    decimal-type-suffix

hexadecimal-integer-literal:
    0x hexadecimal-digits long-type-suffix~opt~
    numeric-multiplier~opt~

hexadecimal-digits:
    hexadecimal-digit
    hexadecimal-digit decimal-digits

hexadecimal-digit: one of
```

```
    0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f

long-type-suffix:
    l

numeric-multiplier: one of
    kb mb gb tb pb
```

Description:

The type of an integer literal is determined by its value, the presence or absence of *long-type-suffix*, and the presence of a *numeric-multiplier* (§2.3.5.1.3).

For an integer literal with no *long-type-suffix*

- If its value can be represented by type int (§4.2.3), that is its type;
- Otherwise, if its value can be represented by type long (§4.2.3), that is its type.
- Otherwise, if its value can be represented by type decimal (§2.3.5.1.2), that is its type.
- Otherwise, it is represented by type double (§2.3.5.1.2).

For an integer literal with *long-type-suffix*

- If its value can be represented by type long (§4.2.3), that is its type;
- Otherwise, that literal is ill formed.

In the twos-complement representation of integer values, there is one more negative value than there is positive. For the int type, that extra value is -2147483648. For the long type, that extra value is -9223372036854775808. Even though the token 2147483648 would ordinarily be treated as a literal of type long, if it is preceded immediately by the unary - operator, that operator and literal are treated as a literal of type int having the smallest value. Similarly, even though the token 9223372036854775808 would ordinarily be treated as a real literal of type decimal, if it is immediately preceded by the unary - operator, that operator and literal are treated as a literal of type long having the smallest value.

Some examples of integer literals are 123 (int), 123L (long), and 200000000000 (long).

There is no such thing as an integer literal of type byte.

2.3.5.1.2 Real literals

Syntax:

```
Syntax
```

```
real-literal:
    decimal-digits . decimal-digits exponent-part~opt~ decimal-type-
suffix~opt~ numeric-multiplier~opt~
    . decimal-digits exponent-part~opt~ decimal-type-suffix~opt~ numeric-
multiplier~opt~
    decimal-digits exponent-part decimal-type-suffix~opt~ numeric-
multiplier~opt~

exponent-part:
    e sign~opt~  decimal-digits

sign: one of
    +
    dash

decimal-type-suffix:
    d
    l

numeric-multiplier: one of
    kb mb gb tb pb

dash:
    - (U+002D)
    EnDash character (U+2013)
    EmDash character (U+2014)
    Horizontal bar character (U+2015)
```

Description:

A real literal may contain a *numeric-multiplier* (§2.3.5.1.3).

There are two kinds of real literal: *double* and *decimal*. These are indicated by the absence or presence, respectively, of *decimal-type-suffix*. (There is no such thing as a *float real literal*.)

A double real literal has type double (§4.2.4.1). A decimal real literal has type decimal (§4.2.4.2). Trailing zeros in the fraction part of a decimal real literal are significant.

If the value of *exponent-part*'s *decimal-digits* in a double real literal is less than the minimum supported, the value of that double real literal is 0. If the value of *exponent-part*'s *decimal-digits* in a decimal real literal is less than the minimum supported, that literal is ill formed. If the value of *exponent-part*'s *decimal-digits* in a double or decimal real literal is greater than the maximum supported, that literal is ill formed.

Some examples of double real literals are 1., 1.23, .45e35, 32.e+12, and 123.456E-231.

Some examples of decimal real literals are 1d (which has scale 0), 1.20d (which has scale 2), 1.23450e1d (i.e., 12.3450, which has scale 4), 1.2345e3d (i.e., 1234.5, which has scale

1), 1.2345e-1d (i.e., 0.12345, which has scale 5), and 1.2345e-3d (i.e., 0.0012345, which has scale 7).

> ⓘ **Note**
>
> Because a double real literal need not have a fraction or exponent part, the grouping parentheses in (123).M are needed to ensure that the property or method M is being selected for the integer object whose value is 123. Without those parentheses, the real literal would be ill-formed.

> ⓘ **Note**
>
> Although PowerShell does not provide literals for infinities and NaNs, double real literal-like equivalents can be obtained from the static read-only properties PositiveInfinity, NegativeInfinity, and NaN of the types float and double (**§4.2.4.1**).

The grammar permits what starts out as a double real literal to have an `l` or `L` type suffix. Such a token is really an integer literal whose value is represented by type long.

> ⓘ **Note**
>
> This feature has been retained for backwards compatibility with earlier versions of PowerShell. However, programmers are discouraged from using integer literals of this form as they can easily obscure the literal's actual value. For example, 1.2L has value 1, 1.2345e1L has value 12, and 1.2345e-5L has value 0, none of which is immediately obvious.

2.3.5.1.3 Multiplier suffixes

Syntax:

Syntax

```
numeric-multiplier: *one of*
    kb mb gb tb pb
```

Description:

For convenience, integer and real literals can contain a *numeric-multiplier*, which indicates one of a set of commonly used powers of 10. *numeric-multiplier* can be written

in any combination of upper- or lowercase letters.

Multiplier	Meaning	Example
kb	kilobyte (1024)	1kb ≡ 1024
mb	megabyte (1024 x 1024)	1.30Dmb ≡ 1363148.80
gb	gigabyte (1024 x 1024 x 1024)	0x10Gb ≡ 17179869184
tb	terabyte (1024 x 1024 x 1024 x 1024)	1.4e23tb ≡ 1.5393162788864E+35
pb	petabyte (1024 x 1024 x 1024 x 1024 x 1024)	0x12Lpb ≡ 20266198323167232

2.3.5.2 String literals

Syntax:

Syntax

```
string-literal:
    expandable-string-literal
    expandable-here-string-literal
    verbatim-string-literal
    verbatim-here-string-literal

expandable-string-literal:
    double-quote-character expandable-string-characters~opt~  dollars~opt~
double-quote-character

double-quote-character:
    " (U+0022)
    Left double quotation mark (U+201C)
    Right double quotation mark (U+201D)
    Double low-9 quotation mark (U+201E)

expandable-string-characters:
      expandable-string-part
      expandable-string-characters
      expandable-string-part

expandable-string-part:
    Any Unicode character except
        $
        double-quote-character
        ` (The backtick character U+0060)
    braced-variable
    $ Any Unicode character except
        (
        {
        double-quote-character
        ` (The backtick character U+0060)*
```

```
    $ escaped-character
    escaped-character
    double-quote-character double-quote-character

dollars:
    $
    dollars $

expandable-here-string-literal:
    @  double-quote-character  whitespace~opt~  new-line-character
        expandable-here-string-characters~opt~  new-line-character  double-
quote-character  @

expandable-here-string-characters:
    expandable-here-string-part
    expandable-here-string-characters  expandable-here-string-part

expandable-here-string-part:
    Any Unicode character except
        $
        new-line-character
    braced-variable
    $ Any Unicode character except
        (
        new-line-character
    $ new-line-character  Any Unicode character except double-quote-char
    $ new-line-character double-quote-char  Any Unicode character except @
    new-line-character  Any Unicode character except double-quote-char
    new-line-character double-quote-char  Any Unicode character except @

expandable-string-with-subexpr-start:
    double-quote-character  expandable-string-chars~opt~  $(

expandable-string-with-subexpr-end:
    double-quote-char

expandable-here-string-with-subexpr-start:
    @  double-quote-character  whitespace~opt~  new-line-character
expandable-here-string-chars~opt~  $(

expandable-here-string-with-subexpr-end:
    new-line-character  double-quote-character  @

verbatim-string-literal:
    single-quote-character verbatim-string-characters~opt~ single-quote-char

single-quote-character:
    ' (U+0027)
    Left single quotation mark (U+2018)
    Right single quotation mark (U+2019)
    Single low-9 quotation mark (U+201A)
    Single high-reversed-9 quotation mark (U+201B)

verbatim-string-characters:
    verbatim-string-part
```

```
    verbatim-string-characters verbatim-string-part

verbatim-string-part:
    *Any Unicode character except* single-quote-character
    single-quote-character  single-quote-character

verbatim-here-string-literal:
    @ single-quote-character whitespace~opt~  new-line-character
        verbatim-here-string-characters~opt~  new-line-character
            single-quote-character *@*

verbatim-*here-string-characters:
    verbatim-here-string-part
    verbatim-here-string-characters  verbatim-here-string-part

verbatim-here-string-part:
    Any Unicode character except* new-line-character
    new-line-character  Any Unicode character except single-quote-character
    new-line-character  single-quote-character  Any Unicode character except
@
```

Description:

There are four kinds of string literals:

- *verbatim-string-literal* (single-line single-quoted), which is a sequence of zero or more characters delimited by a pair of *single-quote-character*s. Examples are '' and 'red'.
- *expandable-string-literal* (single-line double-quoted), which is a sequence of zero or more characters delimited by a pair of *double-quote-character*s. Examples are "" and "red".
- *verbatim-here-string-literal* (multi-line single-quoted), which is a sequence of zero or more characters delimited by the character pairs @*single-quote-character* and *single-quote-character*@, respectively, all contained on two or more source lines. Examples are:

  PowerShell

  ```
  @'
  '@

  @'
  line 1
  '@

  @'
  line 1
  ```

```
line 2
'@
```

- *expandable-here-string-literal* (multi-line double-quoted), which is a sequence of zero or more characters delimited by the character pairs @*double-quote-character* and *double-quote-character*@, respectively, all contained on two or more source lines. Examples are:

```PowerShell
@"
"@

@"
line 1
"@

@"
line 1
line 2
"@
```

For *verbatim-here-string-literal*s and *expandable-here-string-literal*s, except for white space (which is ignored) no characters may follow on the same source line as the opening delimiter-character pair, and no characters may precede on the same source line as the closing delimiter character pair.

The *body* of a *verbatim-here-string-literal* or an *expandable-here-string-literal* begins at the start of the first source line following the opening delimiter, and ends at the end of the last source line preceding the closing delimiter. The body may be empty. The line terminator on the last source line preceding the closing delimiter is not part of that literal's body.

A literal of any of these kinds has type string (§4.3.1).

The character used to delimit a *verbatim-string-literal* or *expandable-string-literal* can be contained in such a string literal by writing that character twice, in succession. For example, `'What''s the time?'` and `"I said, ""Hello""."`. However, a *single-quote-character* has no special meaning inside an *expandable-string-literal*, and a *double-quote-character* has no special meaning inside a *verbatim-string-literal*.

An *expandable-string-literal* and an *expandable-here-string-literal* may contain *escaped-character*s (§2.3.7). For example, when the following string literal is written to the pipeline, the result is as shown below:

```
```

PowerShell

```
"column1`tcolumn2`nsecond line, `"Hello`", ```Q`5`!"
```

Output

```
column1<horizontal-tab>column2<new-line>
second line, "Hello", `Q5!
```

If an *expandable-string-literal* or *expandable-here-string-literal* contains the name of a variable, unless that name is preceded immediately by an escape character, it is replaced by the string representation of that variable's value (§6.7). This is known as *variable substitution*.

> **Note**
>
> If the variable name is part of some larger expression, only the variable name is replaced. For example, if `$a` is an array containing the elements 100 and 200, `">$a.Length<"` results in `>100 200.Length<` while `">$($a.Length)<"` results in `>2<`. See sub-expression expansion below.

For example, the source code

PowerShell

```
$count = 10
"The value of `$count is $count"
```

results in the *expandable-string-literal*

Output

```
The value of $count is 10.
```

Consider the following:

PowerShell

```
$a = "red","blue"
"`$a[0] is $a[0], `$a[0] is $($a[0])" # second [0] is taken literally
```

The result is

Output

```
$a[0] is red blue[0], $a[0] is red
```

*expandable-string-literal*s and *expandable-here-string-literal*s also support a kind of substitution called *sub-expression expansion*, by treating text of the form `$( ... )` as a *sub-expression* (§7.1.6). Such text is replaced by the string representation of that expression's value (§6.8). Any white space used to separate tokens within *sub-expression*'s *statement-list* is ignored as far as the result string's construction is concerned.

The examples,

PowerShell

```
$count = 10
"$count + 5 is $($count + 5)"
"$count + 5 is `$($count + 5)"
"$count + 5 is `$(`$count + 5)"
```

result in the following *expandable-string-literal*s:

Output

```
10 + 5 is 15
10 + 5 is $(10 + 5)
10 + 5 is $($count + 5)
```

The following source,

PowerShell

```
$i = 5; $j = 10; $k = 15
"`$i, `$j, and `$k have the values $( $i; $j; $k )"
```

results in the following *expandable-string-literal*:

Output

```
$i, $j, and $k have the values 5 10 15
```

These four lines could have been written more succinctly as follows:

PowerShell

```
"`$i, `$j, and `$k have the values $(($i = 5); ($j = 10); ($k = 15))"
```

In the following example,

PowerShell

```
"First 10 squares: $(for ($i = 1; $i -le 10; ++$i) { "$i $($i*$i) " })"
```

the resulting *expandable-string-literal* is as follows:

Output

```
First 10 squares: 1 1 2 4 3 9 4 16 5 25 6 36 7 49 8 64 9 81 10 100
```

As shown, a *sub-expression* can contain string literals having both variable substitution and sub-expression expansion. Note also that the inner *expandable-string-literal*'s delimiters need not be escaped; the fact that they are inside a *sub-expression* means they cannot be terminators for the outer *expandable-string-literal*.

An *expandable-string-literal* or *expandable-here-string-literal* containing a variable substitution or sub-expression expansion is evaluated each time that literal is used; for example,

PowerShell

```
$a = 10
$s1 = "`$a = $($a; ++$a)"
"`$s1 = >$s1<"
$s2 = "`$a = $($a; ++$a)"
"`$s2 = >$s2<"
$s2 = $s1
"`$s2 = >$s2<"
```

which results in the following *expandable-string-literals*:

Output

```
$s1 = >$a = 10<
$s2 = >$a = 11<
$s2 = >$a = 10<
```

The contents of a *verbatim-here-string-literal* are taken verbatim, including any leading or trailing white space within the body. As such, embedded *single-quote-characters* need not be doubled-up, and there is no substitution or expansion. For example,

PowerShell

```
$lit = @'
That's it!
2 * 3 = $(2*3)
'@
```

which results in the literal

Output

```
That's it!
2 * 3 = $(2*3)
```

The contents of an *expandable-here-string-literal* are subject to substitution and expansion, but any leading or trailing white space within the body but outside any *sub-expression*s is taken verbatim, and embedded *double-quote-character*s need not be doubled-up. For example,

PowerShell

```
$lit = @"
That's it!
2 * 3 = $(2*3)
"@
```

which results in the following literal when expanded:

PowerShell

```
That's it!
2 * 3 = 6
```

For both *verbatim-here-string-literal*s and *expandable-here-string-literal*s, each line terminator within the body is represented in the resulting literal in an implementation-defined manner. For example, in

PowerShell

```
$lit = @"
abc
xyz
"@
```

the second line of the body has two leading spaces, and the first and second lines of the body have line terminators; however, the terminator for the second line of the body is *not* part of that body. The resulting literal is equivalent to: `"abc<implementation-defined character sequence>xyz"`.

> ⓘ Note
>
> To aid readability of source, long string literals can be broken across multiple source lines without line terminators being inserted. This is done by writing each part as a separate literal and concatenating the parts with the + operator (§7.7.2). This operator allows its operands to designate any of the four kinds of string literal.

> ⓘ Note
>
> Although there is no such thing as a character literal per se, the same effect can be achieved by accessing the first character in a 1-character string, as follows: `[char]"A"` or `"A"[0]`.

For both *verbatim-here-string-literal*s and *expandable-here-string-literal*s, each line terminator within the body is represented exactly as it was provided.

2.3.5.3 Null literal

See the automatic variable `$null` (§2.3.2.2).

2.3.5.4 Boolean literals

See the automatic variables `$false` and `$true` (§2.3.2.2).

2.3.5.5 Array literals

PowerShell allows expressions of array type (§9) to be written using the unary comma operator (§7.2.1), *array-expression* (§7.1.7), the binary comma operator (§7.3), and the range operator (§7.4).

2.3.5.6 Hash literals

PowerShell allows expressions of type Hashtable (§10) to be written using a *hash-literal-expression* (§7.1.9)

2.3.5.7 Type names

Syntax:

Syntax

```
type-name:
    type-identifier
    type-name . type-identifier

type-identifier:
    type-characters

type-characters:
    type-character
    type-characters type-character

type-character:
    A Unicode character of classes Lu, Ll, Lt, Lm, Lo, or Nd
    _ (The underscore character U+005F)

array-type-name:
    type-name [

generic-type-name:
    type-name [
```

2.3.6 Operators and punctuators

Syntax:

Syntax

```
operator-or-punctuator: one of
    {   }   [   ]   (   )   @(   @{   $(   ;
    &&  ||  &   |   ,   ++  ..   ::   .
    !   *   /   %   +   -   --
    -and   -band   -bnot   -bor
    -bxor   -not   -or     -xor
    assignment-operator
    merging-redirection-operator
    file-redirection-operator
    comparison-operator
    format-operator

assignment-operator: one of
    =  -=  +=  *=  /=  %=

file-redirection-operator: one of
    >  >>  2>  2>>  3>  3>>  4>  4>>
    5>  5>>  6>  6>>  *>  *>>  <
```

```
merging-redirection-operator: one of
    *>&1  2>&1  3>&1  4>&1  5>&1  6>&1
    *>&2  1>&2  3>&2  4>&2  5>&2  6>&2

comparison-operator: *one of
    -as           -ccontains      -ceq
    -cge          -cgt            -cle
    -clike        -clt            -cmatch
    -cne          -cnotcontains   -cnotlike
    -cnotmatch    -contains       -creplace
    -csplit       -eq             -ge
    -gt           -icontains      -ieq
    -ige          -igt            -ile
    -ilike        -ilt            -imatch
    -in           -ine            -inotcontains
    -inotlike     -inotmatch      -ireplace
    -is           -isnot          -isplit
    -join         -le             -like
    -lt           -match          -ne
    -notcontains  -notin         -notlike
    -notmatch     -replace       -shl*
    -shr          -split

format-operator:
    -f
```

Description:

`&&` and `||` are reserved for future use.

> ⓘ **Note**
>
> Editor's Note: The pipeline chain operators `&&` and `||` were introduced in PowerShell 7. See **about_Pipeline_Chain_Operators**.

The name following *dash* in an operator is reserved for that purpose only in an operator context.

An operator that begins with *dash* must not have any white space between that *dash* and the token that follows it.

2.3.7 Escaped characters

Syntax:

```
Syntax
```

```
escaped-character:
    ` (The backtick character U+0060) followed by any Unicode character
```

Description:

An *escaped character* is a way to assign a special interpretation to a character by giving it a prefix Backtick character (U+0060). The following table shows the meaning of each *escaped-character*:

Escaped Character	Meaning
`` `a ``	Alert (U+0007)
`` `b ``	Backspace (U+0008)
`` `f ``	Form-feed (U+000C)
`` `n ``	New-line (U+000A)
`` `r ``	Carriage return (U+000D)
`` `t ``	Horizontal tab (U+0009)
`` `v ``	Vertical tab (U+0009)
`` `' ``	Single quote (U+0027)
`` `" ``	Double quote (U+0022)
`` `` ``	Backtick (U+0060)
`` `0 ``	NUL (U+0000)
`` `x ``	If `x` is a character other than those characters shown above, the backtick character is ignored and `x` is taken literally.

The implication of the final entry in the table above is that spaces that would otherwise separate tokens can be made part of a token instead. For example, a file name containing a space can be written as `Test` Data.txt` (as well as `'Test Data.txt'` or `"Test Data.txt"`).

3. Basic concepts

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3.1 Providers and drives

A *provider* allows access to data and components that would not otherwise be easily accessible at the command line. The data is presented in a consistent format that resembles a file system drive.

The data that a provider exposes appears on a *drive*, and the data is accessed via a *path* just like with a disk drive. Built-in cmdlets for each provider manage the data on the provider drive.

PowerShell includes the following set of built-in providers to access the different types of data stores:

Provider	Drive Name	Description	Ref.
Alias	Alias:	PowerShell aliases	§3.1.1
Environment	Env:	Environment variables	§3.1.2
FileSystem	A:, B:, C:, ...	Disk drives, directories, and files	§3.1.3
Function	Function:	PowerShell functions	§3.1.4
Variable	Variable:	PowerShell variables	§3.1.5

Windows PowerShell:

Provider	Drive Name	Description
Certificate	Cert:	x509 certificates for digital signatures
Registry	HKLM: (HKEY_LOCAL_MACHINE), HKCU: (HKEY_CURRENT_USER)	Windows registry
WSMan	WSMan:	WS-Management configuration information

The following cmdlets deal with providers and drives:

- Get-PSProvider: Gets information about one or more providers
- Get-PSDrive: Gets information about one or more drives

The type of an object that represents a provider is described in §4.5.1. The type of an object that represents a drive is described in §4.5.2.

3.1.1 Aliases

An *alias* is an alternate name for a command. A command can have multiple aliases, and the original name and all of its aliases can be used interchangeably. An alias can be reassigned. An alias is an item (§3.3).

An alias can be assigned to another alias; however, the new alias is not an alias of the original command.

The provider Alias is a flat namespace that contains only objects that represent the aliases. The variables have no child items.

Some aliases are built in to PowerShell.

The following cmdlets deal with aliases:

- New-Alias: Creates an alias
- Set-Alias: Creates or changes one or more aliases
- Get-Alias: Gets information about one or more aliases
- Export-Alias: Exports one or more aliases to a file

When an alias is created for a command using `New-Alias`, parameters to that command cannot be included in that alias. However, direct assignment to a variable in the Alias: namespace does permit parameters to be included.

> ⓘ **Note**
>
> It is a simple matter, however, to create a function that does nothing more than contain the invocation of that command with all desired parameters, and to assign an alias to that function.

The type of an object that represents an alias is described in §4.5.4.

Alias objects are stored on the drive Alias: (§3.1).

3.1.2 Environment variables

The PowerShell environment provider allows operating system environment variables to be retrieved, added, changed, cleared, and deleted.

The provider Environment is a flat namespace that contains only objects that represent the environment variables. The variables have no child items.

An environment variable's name cannot include the equal sign (`=`).

Changes to the environment variables affect the current session only.

An environment variable is an item (§3.3).

The type of an object that represents an environment variable is described in §4.5.6.

Environment variable objects are stored on the drive Env: (§3.1).

3.1.3 File system

The PowerShell file system provider allows directories and files to be created, opened, changed, and deleted.

The file system provider is a hierarchical namespace that contains objects that represent the underlying file system.

Files are stored on drives with names like A:, B:, C:, and so on (§3.1). Directories and files are accessed using path notation (§3.4).

A directory or file is an item (§3.3).

3.1.4 Functions

The PowerShell function provider allows functions (§8.10) and filters (§8.10.1) to be retrieved, added, changed, cleared, and deleted.

The provider Function is a flat namespace that contains only the function and filter objects. Neither functions nor filters have child items.

Changes to the functions affect the current session only.

A function is an item (§3.3).

The type of an object that represents a function is described in §4.5.10. The type of an object that represents a filter is described in §4.5.11.

Function objects are stored on drive Function: (§3.1).

3.1.5 Variables

Variables can be defined and manipulated directly in the PowerShell language.

The provider Variable is a flat namespace that contains only objects that represent the variables. The variables have no child items.

The following cmdlets also deal with variables:

- New-Variable: Creates a variable
- Set-Variable: Creates or changes the characteristics of one or more variables
- Get-Variable: Gets information about one or more variables
- Clear-Variable: Deletes the value of one or more variables
- Remove-Variable: Deletes one or more variables

As a variable is an item (§3.3), it can be manipulated by most Item-related cmdlets.

The type of an object that represents a variable is described in §4.5.3.

Variable objects are stored on drive Variable: (§3.1).

3.2 Working locations

The *current working location* is the default location to which commands point. This is the location used if an explicit path (§3.4) is not supplied when a command is invoked. This location includes the *current drive*.

A PowerShell host may have multiple drives, in which case, each drive has its own current location.

When a drive name is specified without a directory, the current location for that drive is implied.

The current working location can be saved on a stack, and then set to a new location. Later, that saved location can be restored from that stack and made the current working location. There are two kinds of location stacks: the *default working location stack*, and zero or more user-defined *named working location stacks*. When a session begins, the default working location stack is also the *current working location stack*. However, any named working location stack can be made the current working location stack.

The following cmdlets deal with locations:

- Set-Location: Establishes the current working location
- Get-Location: Determines the current working location for the specified drive(s), or the working locations for the specified stack(s)

- Push-Location: Saves the current working location on the top of a specified stack of locations
- Pop-Location: Restores the current working location from the top of a specified stack of locations

The object types that represents a working location and a stack of working locations are described in §4.5.5.

3.3 Items

An *item* is an alias (§3.1.1), a variable (§3.1.5), a function (§3.1.4), an environment variable (§3.1.2), or a file or directory in a file system (§3.1.3).

The following cmdlets deal with items:

- New-Item: Creates a new item
- Set-Item: Changes the value of one or more items
- Get-Item: Gets the items at the specified location
- Get-ChildItem: Gets the items and child items at the specified location
- Copy-Item: Copies one or more items from one location to another
- Move-Item: Moves one or more items from one location to another
- Rename-Item: Renames an item
- Invoke-Item: Performs the default action on one or more items
- Clear-Item: Deletes the contents of one or more items, but does not delete the items (see
- Remove-Item: Deletes the specified items

The following cmdlets deal with the content of items:

- Get-Content: Gets the content of the item
- Add-Content: Adds content to the specified items
- Set-Content: Writes or replaces the content in an item
- Clear-Content: Deletes the contents of an item

The type of an object that represents a directory is described in §4.5.17. The type of an object that represents a file is described in §4.5.18.

3.4 Path names

All items in a data store accessible through a PowerShell provider can be identified uniquely by their path names. A *path name* is a combination of the item name, the

container and subcontainers in which the item is located, and the PowerShell drive through which the containers are accessed.

Path names are divided into one of two types: fully qualified and relative. A *fully qualified path name* consists of all elements that make up a path. The following syntax shows the elements in a fully qualified path name:

> **Tip**
>
> The `~opt~` notation in the syntax definitions indicates that the lexical entity is optional in the syntax.

Syntax

```
path:
    provider~opt~   drive~opt~   containers~opt~   item

provider:
    module~opt~   provider   ::

module:
    module-name   \

drive:
    drive-name   :

containers:
    container   \
    containers container   \
```

module-name refers to the parent module.

provider refers to the PowerShell provider through which the data store is accessed.

drive refers to the PowerShell drive that is supported by a particular PowerShell provider.

A *container* can contain other containers, which can contain other containers, and so on, with the final container holding an *item*. Containers must be specified in the hierarchical order in which they exist in the data store.

Here is an example of a path name:

`E:\Accounting\InvoiceSystem\Production\MasterAccount\MasterFile.dat`

If the final element in a path contains other elements, it is a *container element*; otherwise, it's a *leaf element*.

In some cases, a fully qualified path name is not needed; a relative path name will suffice. A *relative path name* is based on the current working location. PowerShell allows an item to be identified based on its location relative to the current working location. A relative path name involves the use of some special characters. The following table describes each of these characters and provides examples of relative path names and fully qualified path names. The examples in the table are based on the current working directory being set to C:\Windows:

Symbol	Description	Relative path	Fully qualified path
`.`	Current working location	`.\System`	`C:\Windows\System`
`..`	Parent of the current working location	`..\Program Files`	`C:\Program Files`
`\`	Drive root of the current working location	`\Program Files`	`C:\Program Files`
none	No special characters	`System`	`C:\Windows\System`

To use a path name in a command, enter that name as a fully qualified or relative path name.

The following cmdlets deal with paths:

- Convert-Path: Converts a path from a PowerShell path to a PowerShell provider path
- Join-Path: Combines a path and a child path into a single path
- Resolve-Path: Resolves the wildcard characters in a path
- Split-Path: Returns the specified part of a path
- Test-Path: Determines whether the elements of a path exist or if a path is well formed

Some cmdlets (such as Add-Content and `Copy-Item` use file filters. A *file filter* is a mechanism for specifying the criteria for selecting from a set of paths.

The object type that represents a resolved path is described in §4.5.5. Paths are often manipulated as strings.

3.5 Scopes

3.5.1 Introduction

A name can denote a variable, a function, an alias, an environment variable, or a drive. The same name may denote different items at different places in a script. For each

different item that a name denotes, that name is visible only within the region of script text called its *scope*. Different items denoted by the same name either have different scopes, or are in different name spaces.

Scopes may nest, in which case, an outer scope is referred to as a *parent scope,* and any nested scopes are *child scopes* of that parent. The scope of a name is the scope in which it is defined and all child scopes, unless it is made private. Within a child scope, a name defined there hides any items defined with the same name in parent scopes.

Unless dot source notation (§3.5.5) is used, each of the following creates a new scope:

- A script file
- A script block
- A function or filter

Consider the following example:

PowerShell

```
# start of script
$x = 2; $y = 3
Get-Power $x $y

#function defined in script

function Get-Power([int]$x, [int]$y)
{
if ($y -gt 0) { return $x * (Get-Power $x (--$y)) }

else { return 1 }
}
# end of script
```

The scope of the variables `$x` and `$y` created in the script is the body of that script, including the function defined inside it. Function `Get-Power` defines two parameters with those same names. As each function has its own scope, these variables are different from those defined in the parent scope, and they hide those from the parent scope. The function scope is nested inside the script scope.

Note that the function calls itself recursively. Each time it does so, it creates yet another nested scope, each with its own variables `$x` and `$y`.

Here is a more complex example, which also shows nested scopes and reuse of names:

PowerShell

```
# start of script scope
$x = 2              # top-level script-scope $x created
                    # $x is 2
F1                  # create nested scope with call to function F1
                    # $x is 2
F3                  # create nested scope with call to function F3
                    # $x is 2

function F1 {       # start of function scope
                    # $x is 2
    $x = $true      # function-scope $x created
                    # $x is $true

    & {             # create nested scope with script block
                    # $x is $true
        $x = 12.345 # scriptblock-scope $x created
                    # $x is 12.345
    }               # end of scriptblock scope, local $x goes away

                    # $x is $true
    F2              # create nested scope with call to function F2
                    # $x is $true
}                   # end of function scope, local $x goes away

function F2 {       # start of function scope
                    # $x is $true
    $x = "red"      # function-scope $x created
                    # $x is "red"
}                   # end of function scope, local $x goes away

function F3 {       # start of function scope
                    # $x is 2
    if ($x -gt 0) {
                    # $x is 2
        $x = "green"
                    # $x is "green"
    }               # end of block, but not end of any scope
                    # $x is still "green"
}                   # end of function scope, local $x goes away
# end of script scope
```

3.5.2 Scope names and numbers

PowerShell supports the following scopes:

- Global: This is the top-most level scope. All automatic and preference variables are defined in this scope. The global scope is the parent scope of all other scopes, and all other scopes are child scopes of the global scope.

- Local: This is the current scope at any execution point within a script, script block, or function. Any scope can be the local scope.
- Script: This scope exists for each script file that is executed. The script scope is the parent scope of all scopes created from within it. A script block does *not* have its own script scope; instead, its script scope is that of its nearest ancestor script file. Although there is no such thing as module scope, script scope provides the equivalent.

Names can be declared private, in which case, they are not visible outside of their parent scope, not even to child scopes. The concept of private is not a separate scope; it's an alias for local scope with the addition of hiding the name if used as a writable location.

Scopes can be referred to by a number, which describes the relative position of one scope to another. Scope 0 denotes the local scope, scope 1 denotes a 1-generation ancestor scope, scope 2 denotes a 2-generation ancestor scope, and so on. (Scope numbers are used by cmdlets that manipulate variables.)

3.5.3 Variable name scope

As shown by the following production, a variable name can be specified with any one of six different scopes:

Syntax

```
variable-scope:
    global:
    local:
    private:
    script:
    using:
    workflow:
    variable-namespace
```

The scope is optional. The following table shows the meaning of each in all possible contexts. It also shows the scope when no scope is specified explicitly:

Scope Modifier	Within a Script File	Within a Script Block	Within a Function
global	Global scope	Global scope	Global scope

Scope Modifier	Within a Script File	Within a Script Block	Within a Function
script	Nearest ancestor script file's scope or Global if there is no nearest ancestor script file	Nearest ancestor script file's scope or Global if there is no nearest ancestor script file	Nearest ancestor script file's scope or Global if there is no nearest ancestor script file
private	Global/Script/Local scope	Local scope	Local scope
local	Global/Script/Local scope	Local scope	Local scope
using	Implementation defined	Implementation defined	Implementation defined
workflow	Implementation defined	Implementation defined	Implementation defined
none	Global/Script/Local scope	Local scope	Local scope

Variable scope information can also be specified when using the family of cmdlets listed in (§3.1.5). In particular, refer to the parameter `Scope`, and the parameters `Option Private` and `Option AllScope` for more information.

The scope `using` is used to access variables defined in another scope while running scripts via cmdlets like `Start-Job`, `Invoke-Command`, or within an *inlinescript-statement*. For example:

PowerShell

```
$a = 42
Invoke-Command --ComputerName RemoteServer { $using:a } # returns 42
workflow foo
{
    $b = "Hello"
    inlinescript { $using:b }
}
foo # returns "Hello"
```

The scope workflow is used with a *parallel-statement* or *sequence-statement* to access a variable defined in the workflow.

3.5.4 Function name scope

A function name may also have one of the four different scopes, and the visibility of that name is the same as for variables (§3.5.3).

3.5.5 Dot source notation

When a script file, script block, or function is executed from within another script file, script block, or function, the executed script file creates a new nested scope. For example,

PowerShell

```
Script1.ps1
& "Script1.ps1"
& { ... }
FunctionA
```

However, when *dot source notation* is used, no new scope is created before the command is executed, so additions/changes it would have made to its own local scope are made to the current scope instead. For example,

PowerShell

```
. Script2.ps1
. "Script2.ps1"
. { ... }
. FunctionA
```

3.5.6 Modules

Just like a top-level script file is at the root of a hierarchical nested scope tree, so too is each module (§3.14). However, by default, only those names exported by a module are available by name from within the importing context. The Global parameter of the cmdlet Import-Module allows exported names to have increased visibility.

3.6 ReadOnly and Constant Properties

Variables and aliases are described by objects that contain a number of properties. These properties are set and manipulated by two families of cmdlets (§3.1.5, §3.1.1). One such property is Options, which can be set to ReadOnly or Constant (using the Option parameter). A variable or alias marked ReadOnly can be removed, and its properties can changed provided the Force parameter is specified. However, a variable or alias marked Constant cannot be removed nor have its properties changed.

3.7 Method overloads and call resolution

3.7.1 Introduction

As stated in §1, an external procedure made available by the execution environment (and written in some language other than PowerShell) is called a *method*.

The name of a method along with the number and types of its parameters are collectively called that method's *signature*. (Note that the signature does not include the method's return type.) The execution environment may allow a type to have multiple methods with the same name provided each has a different signature. When multiple versions of some method are defined, that method is said to be *overloaded*. For example, the type Math (§4.3.8) contains a set of methods called `Abs`, which computes the absolute value of a specified number, where the specified number can have one of a number of types. The methods in that set have the following signatures:

```
PowerShell

Abs(decimal)
Abs(float)
Abs(double)
Abs(int)
Abs(long)
Abs(SByte)
Abs(Int16)
```

In this case, all of the methods have the same number of arguments; their signatures differ by argument type only.

Another example involves the type Array (§4.3.2), which contains a set of methods called Copy that copies a range of elements from one array to another, starting at the beginning of each array (by default) or at some designated element. The methods in that set have the following signatures:

```
PowerShell

Copy(Array, Array, int)
Copy(Array, Array, long)
Copy(Array, int, Array, int, int)
Copy(Array, long, Array, long, long)
```

In this case, the signatures differ by argument type and, in some cases, by argument number as well.

In most calls to overloaded methods, the number and type of the arguments passed exactly match one of the overloads, and the method selected is obvious. However, if that is not the case, there needs to be a way to resolve which overloaded version to call, if any. For example,

PowerShell

```
[Math]::Abs([byte]10) # no overload takes type byte
[Array]::Copy($source, 3, $dest, 5L, 4) # both int and long indexes
```

Other examples include the type **string** (i.e.; **System.String**), which has numerous overloaded methods.

Although PowerShell has rules for resolving method calls that do not match an overloaded signature exactly, PowerShell does not itself provide a way to define overloaded methods.

> ⓘ **Note**
>
> Editor's Note: PowerShell 5.0 added the ability to define script-based classes. These classes can contain overloaded methods.

3.7.2 Method overload resolution

Given a method call (§7.1.3) having a list of argument expressions, and a set of *candidate method*s (i.e., those methods that could be called), the mechanism for selecting the *best method* is called *overload resolution*.

Given the set of applicable candidate methods (§3.7.3), the best method in that set is selected. If the set contains only one method, then that method is the best method. Otherwise, the best method is the one method that is better than all other methods with respect to the given argument list using the rules shown in §3.7.4. If there is not exactly one method that is better than all other methods, then the method invocation is ambiguous and an error is reported.

The best method must be accessible in the context in which it is called. For example, a PowerShell script cannot call a method that is private or protected.

The best method for a call to a static method must be a static method, and the best method for a call to an instance method must be an instance method.

3.7.3 Applicable method

A method is said to be *applicable* with respect to an argument list A when one of the following is true:

- The number of arguments in A is identical to the number of parameters that the method accepts.
- The method has M required parameters and N optional parameters, and the number of arguments in A is greater than or equal to M, but less than N.
- The method accepts a variable number of arguments and the number of arguments in A is greater than the number of parameters that the method accepts.

In addition to having an appropriate number of arguments, each argument in A must match the parameter-passing mode of the argument, and the argument type must match the parameter type, or there must be a conversion from the argument type to the parameter type.

If the argument type is ref (§4.3.6), the corresponding parameter must also be ref, and the argument type for conversion purposes is the type of the property Value from the ref argument.

If the argument type is `ref`, the corresponding parameter could be `out` instead of `ref`.

If the method accepts a variable number of arguments, the method may be applicable in either *normal form* or *expanded form*. If the number of arguments in A is identical to the number of parameters that the method accepts and the last parameter is an array, then the form depends on the rank of one of two possible conversions:

- The rank of the conversion from the type of the last argument in A to the array type for the last parameter.
- The rank of the conversion from the type of the last argument in A to the element type of the array type for the last parameter.

If the first conversion (to the array type) is better than the second conversion (to the element type of the array), then the method is applicable in normal form, otherwise it is applicable in expanded form.

If there are more arguments than parameters, the method may be applicable in expanded form only. To be applicable in expanded form, the last parameter must have array type. The method is replaced with an equivalent method that has the last parameter replaced with sufficient parameters to account for each unmatched argument in A. Each additional parameter type is the element type of the array type for the last parameter in the original method. The above rules for an applicable method are applied to this new method and argument list A.

3.7.4 Better method

Given an argument list A with a set of argument expressions `{ E~1~, E~2~, ..., E~N~ }` and two application methods `M~P~` and `M~Q~` with parameter types `{ P~1~, P~2~, ..., P~N~ }` and `{ Q~1~, Q~2~, ..., Q~N~ }`, `M~P~` is defined to be a better method than `M~Q~` if the *cumulative ranking of conversions* for `M~P~` is better than that for `M~Q~`.

The cumulative ranking of conversions is calculated as follows. Each conversion is worth a different value depending on the number of parameters, with the conversion of `E~1~` worth N, `E~2~` worth N-1, down to `E~N~` worth 1. If the conversion from `E~X~` to `P~X~` is better than that from `E~X~` to `Q~X~`, the `M~P~` accumulates N-X+1; otherwise, `M~Q~` accumulates N-X+1. If `M~P~` and `M~Q~` have the same value, then the following tie breaking rules are used, applied in order:

- The cumulative ranking of conversions between parameter types (ignoring argument types) is computed in a manner similar to the previous ranking, so `P~1~` is compared against `Q~1~`, `P~2~` against `Q~2~`, ..., and `P~N~` against `Q~N~`. The comparison is skipped if the argument was `$null`, or if the parameter types are not numeric types. The comparison is also skipped if the argument conversion `E~X~` loses information when converted to `P~X~` but does not lose information when converted to `Q~X~`, or vice versa. If the parameter conversion types are compared, then if the conversion from `P~X~` to `Q~X~` is better than that from `Q~X~` to `P~X~`, the `M~P~` accumulates N-X+1; otherwise, `M~Q~` accumulates N-X+1. This tie breaking rule is intended to prefer the *most specific method* (i.e., the method with parameters having the smallest data types) if no information is lost in conversions, or to prefer the *most general method* (i.e., the method with the parameters with the largest data types) if conversions result in loss of information.
- If both methods use their expanded form, the method with more parameters is the better method.
- If one method uses the expanded form and the other uses normal form, the method using normal form is the better method.

3.7.5 Better conversion

The text below marked like this is specific to Windows PowerShell.

Conversions are ranked in the following manner, from lowest to highest:

- `T~1~[]` to `T~2~[]` where no assignable conversion between `T~1~` and `T~2~` exists
- T to string where T is any type
- `T~1~` to `T~2~` where `T~1~` or `T~2~` define a custom conversion in an implementation-defined manner

- `T~1~` to `T~2~` where `T~1~` implements IConvertible
- `T~1~` to `T~2~` where `T~1~` or `T~2~` implements the method `T~2~ op_Implicit(T1)`
- `T~1~` to `T~2~` where `T~1~` or `T~2~` implements the method `T~2~ op_Explicit(T1)`
- `T~1~` to `T~2~` where `T~2~` implements a constructor taking a single argument of type `T~1~`
- Either of the following conversions:
  - string to `T` where `T` implements a static method `T Parse(string)` or `T Parse(string, IFormatProvider)`
  - `T~1~` to `T~2~` where `T~2~` is any enum and `T~1~` is either string or a collection of objects that can be converted to string
- `T` to PSObject where `T` is any type
- Any of the following conversions: `Language`
  - T to bool where `T` is any numeric type
  - string to `T` where `T` is `regex`, `wmisearcher`, `wmi`, `wmiclass`, `adsi`, `adsisearcher`, or `type`
  - `T` to `bool`
  - T~1~ to `Nullable[T~2~]` where a conversion from `T~1~` to `T~2~` exists
  - `T` to void
  - `T~1~[]` to `T~2~[]` where an assignable conversion between `T~1~` and `T~2~` exists
  - `T~1~` to `T~2~[]` where `T~1~` is a collection
  - `IDictionary` to `Hashtable`
  - `T` to `ref`
  - `T` to `xml`
  - `scriptblock` to `delegate`
  - `T~1~` to `T~2~` where `T~1~` is an integer type and `T~2~` is an enum
- `$null` to `T` where `T` is any value type
- `$null` to `T` where `T` is any reference type
- Any of the following conversions:
  - byte to `T` where `T` is `SByte`
  - `UInt16` to `T` where `T` is `SByte`, `byte`, or `Int16`
  - `Int16` to `T` where `T` is `SByte` or `byte`
  - `UInt32` to `T` where `T` is `SByte`, `byte`, `Int16`, `UInt16`, or `int`
  - `int` to `T` where `T` is `SByte`, `byte`, `Int16`, or `UInt16`

    - `UInt64` to `T` where `T` is `SByte`, `byte`, `Int16`, `UInt16`, `int`, `UInt32`, or `long`
    - `long` to `T` where `T` is `SByte`, `byte`, `Int16`, `UInt16`, `int`, or `UInt32`
    - `float` to `T` where `T` is any integer type or `decimal`
    - `double` to `T` where `T` is any integer type or `decimal`
    - `decimal` to `T` where `T` is any integer type
- Any of the following conversions:
    - `SByte` to `T` where `T` is `byte`, `uint6`, `UInt32`, or `UInt64`
    - `Int16` to `T` where `T` is `UInt16`, `UInt32`, or `UInt64`
    - `int` to `T` where `T` is `UInt32` or `UInt64`
    - `long` to `UInt64`
    - `decimal` to `T` where `T` is `float` or `double`
- Any of the following conversions:
    - `T` to `string` where `T` is any numeric type
    - `T` to `char` where `T` is any numeric type
    - `string` to `T` where `T` is any numeric type
- Any of the following conversions, these conversion are considered an assignable conversions:
    - `byte` to `T` where `T` is `Int16`, `UInt16`, `int`, `UInt32`, `long`, `UInt64`, `single`, `double`, or `decimal`
    - `SByte` to `T` where `T` is `Int16`, `UInt16`, `int`, `UInt32`, `long`, `UInt64`, `single`, `double`, or `decimal`
    - `UInt16` to `T` where `T` is `int`, `UInt32`, `long`, or `UInt64`, `single`, `double`, or `decimal`
    - `Int16` to `T` where `T` is `int`, `UInt32`, `long`, or `UInt64`, `single`, `double`, or `decimal`
    - `UInt32` to `T` where `T` is `long`, or `UInt64`, `single`, `double`, or `decimal`
    - `int` to `T` where `T` is `long`, `UInt64`, `single`, `double`, or `decimal`
    - `single` to `double`
- `T~1~` to `T~2~` where `T~2~` is a base class or interface of `T~1~`. This conversion is considered an assignable conversion.
- `string` to `char[]`
- `T` to `T` -- This conversion is considered an assignable conversion.

For each conversion of the form `T~1~` to `T~2~[]` where `T~1~` is not an array and no other conversion applies, if there is a conversion from `T~1~` to `T~2~`, the rank of the

conversion is worse than the conversion from `T~1~` to `T~2~`, but better than any conversion ranked less than the conversion from `T~1~` to `T~2~`

3.8 Name lookup

It is possible to have commands of different kinds all having the same name. The order in which name lookup is performed in such a case is alias, function, cmdlet, and external command.

3.9 Type name lookup

§7.1.10 contains the statement, "A *type-literal* is represented in an implementation by some unspecified *underlying type*. As a result, a type name is a synonym for its underlying type." Example of types are `int`, `double`, `long[]`, and `Hashtable`.

Type names are matched as follows: Compare a given type name with the list of built-in *type accelerators*, such as int, long, double. If a match is found, that is the type. Otherwise, presume the type name is fully qualified and see if such a type exists on the host system. If a match is found, that is the type. Otherwise, add the namespace prefix `System.`. If a match is found, that is the type. Otherwise, the type name is in error. This algorithm is applied for each type argument for generic types. However, there is no need to specify the arity (the number of arguments or operands taken by a function or operator).

3.10 Automatic memory management

Various operators and cmdlets result in the allocation of memory for reference-type objects, such as strings and arrays. The allocation and freeing of this memory is managed by the PowerShell runtime system. That is, PowerShell provides automatic *garbage collection*.

3.11 Execution order

A *side effect* is a change in the state of a command's execution environment. A change to the value of a variable (via the assignment operators or the pre- and post-increment and decrement operators) is a side effect, as is a change to the contents of a file.

Unless specified otherwise, statements are executed in lexical order.

Except as specified for some operators, the order of evaluation of terms in an expression and the order in which side effects take place are both unspecified.

An expression that invokes a command involves the expression that designates the command, and zero or more expressions that designate the arguments whose values are to be passed to that command. The order in which these expressions are evaluated relative to each other is unspecified.

3.12 Error handling

When a command fails, this is considered an *error*, and information about that error is recorded in an *error record*, whose type is unspecified (§4.5.15); however, this type supports subscripting.

An error falls into one of two categories. Either it terminates the operation (a *terminating error*) or it doesn't (a *non-terminating error*). With a terminating error, the error is recorded and the operation stops. With a non-terminating error, the error is recorded and the operation continues.

Non-terminating errors are written to the error stream. Although that information can be redirected to a file, the error objects are first converted to strings and important information in those objects would not be captured making diagnosis difficult if not impossible. Instead, the error text can be redirected (§7.12) and the error object saved in a variable, as in `$Error1 = command 2>&1`.

The automatic variable `$Error` contains a collection of error records that represent recent errors, and the most recent error is in `$Error[0]`. This collection is maintained in a buffer such that old records are discarded as new ones are added. The automatic variable `$MaximumErrorCount` controls the number of records that can be stored.

`$Error` contains all of the errors from all commands mixed in together in one collection. To collect the errors from a specific command, use the common parameter ErrorVariable, which allows a user-defined variable to be specified to hold the collection.

3.13 Pipelines

A *pipeline* is a series of one or more commands each separated by the pipe operator `|` (U+007C). Each command receives input from its predecessor and writes output to its successor. Unless the output at the end of the pipeline is discarded or redirected to a file, it is sent to the host environment, which may choose to write it to standard output. Commands in a pipeline may also receive input from arguments. For example, consider

the following use of commands `Get-ChildItem`, `Sort-Object`, and `Process-File`, which create a list of file names in a given file system directory, sort a set of text records, and perform some processing on a text record, respectively:

PowerShell

```
Get-ChildItem
Get-ChildItem e:*.txt | Sort-Object -CaseSensitive | Process-File
>results.txt
```

In the first case, `Get-ChildItem` creates a collection of names of the files in the current/default directory. That collection is sent to the host environment, which, by default, writes each element's value to standard output.

In the second case, `Get-ChildItem` creates a collection of names of the files in the directory specified, using the argument `e:*.txt`. That collection is written to the command `Sort-Object`, which, by default, sorts them in ascending order, sensitive to case (by virtue of the **CaseSensitive** argument). The resulting collection is then written to command `Process-File`, which performs some (unknown) processing. The output from that command is then redirected to the file `results.txt`.

If a command writes a single object, its successor receives that object and then terminates after writing its own object(s) to its successor. If, however, a command writes multiple objects, they are delivered one at a time to the successor command, which executes once per object. This behavior is called *streaming*. In stream processing, objects are written along the pipeline as soon as they become available, not when the entire collection has been produced.

When processing a collection, a command can be written such that it can do special processing before the initial element and after the final element.

3.14 Modules

A *module* is a self-contained reusable unit that allows PowerShell code to be partitioned, organized, and abstracted. A module can contain commands (such as cmdlets and functions) and items (such as variables and aliases) that can be used as a single unit.

Once a module has been created, it must be *imported* into a session before the commands and items within it can be used. Once imported, commands and items behave as if they were defined locally. A module is imported explicitly with the `Import-Module` command. A module may also be imported automatically as determined in an implementation defined manner.

The type of an object that represents a module is described in §4.5.12.

Modules are discussed in detail in §11.

3.15 Wildcard expressions

A wildcard expression may contain zero or more of the following elements:

Element	Description
Character other than *, ?, or [	Matches that one character
*	Matches zero or more characters. To match a * character, use [*].
?	Matches any one character. To match a ? character, use [?].
[*set*]	Matches any one character from *set*, which cannot be empty. If *set* begins with], that right square bracket is considered part of *set* and the next right square bracket terminates the set; otherwise, the first right square bracket terminates the set. If *set* begins or ends with -, that hyphen-minus is considered part of *set*; otherwise, it indicates a range of consecutive Unicode code points with the characters either side of the hyphen-minus being the inclusive range delimiters. For example, A-Z indicates the 26 uppercase English letters, and 0-9 indicates the 10 decimal digits.

> **Note**
>
> More information can be found in, **The Open Group Base Specifications: Pattern Matching", IEEE Std 1003.1, 2004 Edition.** . However, in PowerShell, the escape character is backtick, not backslash.

3.16 Regular expressions

A regular expression may contain zero or more of the following elements:

Element	Description

Element	Description
Character other than ., [, ^, *, $, or \	Matches that one character
.	Matches any one character. To match a . character, use \..
[*set*] [^*set*]	The [*set*] form matches any one character from *set*. The [^*set*] form matches no characters from *set*. *set* cannot be empty. If *set* begins with] or ^], that right square bracket is considered part of *set* and the next right square bracket terminates the set; otherwise, the first right square bracket terminates the set. If *set* begins with - or ^-, or ends with -, that hyphen-minus is considered part of *set*; otherwise, it indicates a range of consecutive Unicode code points with the characters either side of the hyphen-minus being the inclusive range delimiters. For example, A-Z indicates the 26 uppercase English letters, and 0-9 indicates the 10 decimal digits.
*	Matches zero of more occurrences of the preceding element.
+	Matches one of more occurrences of the preceding element.
?	Matches zero of one occurrences of the preceding element.
^	Matches at the start of the string. To match a ^ character, use \^.
$	Matches at the end of the string. To match a $ character, use $.
c	Escapes character *c*, so it isn't recognized as a regular expression element.

> **Note**
>
> More information can be found in, **The Open Group Base Specifications: Regular Expressions, IEEE Std 1003.1, 2004 Edition.**.

Windows PowerShell: Character classes available in Microsoft .NET Framework regular expressions are supported, as follows:

Element	Description
`\p{name}`	Matches any character in the named character class specified by *name*. Supported names are Unicode groups and block ranges such as Ll, Nd, Z, IsGreek, and IsBoxDrawing.
`\P{name}`	Matches text not included in the groups and block ranges specified in *name*.

Element	Description
`\w`	Matches any word character. Equivalent to the Unicode character categories `[\p{Ll}\p{Lu}\p{Lt}\p{Lo}\p{Nd}\p{Pc}]`. If ECMAScript-compliant behavior is specified with the ECMAScript option, \w is equivalent to `[a-zA-Z_0-9]`.
`\W`	Matches any non-word character. Equivalent to the Unicode categories `[\^\p{Ll}\p{Lu}\p{Lt}\p{Lo}\p{Nd}\p{Pc}]`.
`\s`	Matches any white space character. Equivalent to the Unicode character categories `[\f\n\r\t\v\x85\p{Z}]`.
`\S`	Matches any non-white-space character. Equivalent to the Unicode character categories `[\^\f\n\r\t\v\x85\p{Z}]`.
`\d`	Matches any decimal digit. Equivalent to `\p{Nd}` for Unicode and `[0-9]` for non-Unicode behavior.
`\D`	Matches any non-digit. Equivalent to `\P{Nd}` for Unicode and `[\^0-9]` for non-Unicode behavior.

Quantifiers available in Microsoft .NET Framework regular expressions are supported, as follows:

Element	Description
`*`	Specifies zero or more matches; for example, `\w*` or `(abc)*`. Equivalent to `{0,}`.
`+`	Matches repeating instances of the preceding characters.
`?`	Specifies zero or one matches; for example, `\w?` or `(abc)?`. Equivalent to `{0,1}`.
`{n}`	Specifies exactly *n* matches; for example, `(pizza){2}`.
`{n,}`	Specifies at least *n* matches; for example, `(abc){2,}`.
`{n,m}`	Specifies at least *n*, but no more than *m*, matches.

4. Types

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In PowerShell, each value has a type, and types fall into one of two main categories: **value types** and **reference types**. Consider the type `int`, which is typical of value types. A value of type `int` is completely self-contained; all the bits needed to represent that value are stored in that value, and every bit pattern in that value represents a valid value for its type. Now, consider the array type `int[]`, which is typical of reference types. A so-called value of an array type can hold either a reference to an object that actually contains the array elements, or the **null reference** whose value is `$null`. The important distinction between the two type categories is best demonstrated by the differences in their semantics during assignment. For example,

PowerShell

```
$i = 100 # $i designates an int value 100
$j = $i # $j designates an int value 100, which is a copy

$a = 10,20,30 # $a designates an object[], Length 3, value 10,20,30
$b = $a # $b designates exactly the same array as does $a, not a copy
$a[1] = 50 # element 1 (which has a value type) is changed from 20 to 50
$b[1] # $b refers to the same array as $a, so $b[1] is 50
```

As we can see, the assignment of a reference type value involves a **shallow copy**; that is, a copy of the reference to the object rather than its actual value. In contrast, a **deep copy** requires making a copy of the object as well.

A **numeric** type is one that allows representation of integer or fractional values, and that supports arithmetic operations on those values. The set of numerical types includes the integer (§4.2.3) and real number (§4.2.4) types, but does not include bool (§4.2.1) or char (§4.2.2). An implementation may provide other numeric types (such as signed byte, unsigned integer, and integers of other sizes).

A **collection** is a group of one or more related items, which need not have the same type. Examples of collection types are arrays, stacks, queues, lists, and hash tables. A program can *enumerate* (or *iterate*) over the elements in a collection, getting access to each element one at a time. Common ways to do this are with the foreach statement (§8.4.4) and the ForEach-Object cmdlet. The type of an object that represents an enumerator is described in §4.5.16.

In this chapter, there are tables that list the accessible members for a given type. For methods, the **Type** is written with the following form: *returnType/argumentTypeList*. If

the argument type list is too long to fit in that column, it is shown in the **Purpose** column instead.

Other integer types are `SByte`, `Int16`, `UInt16`, `UInt32`, and `UInt64`, all in the namespace **System**.

Many collection classes are defined as part of the **System.Collections** or **System.Collections.Generic** namespaces. Most collection classes implement the interfaces `ICollection`, `IComparer`, `IEnumerable`, `IList`, `IDictionary`, and `IDictionaryEnumerator` and their generic equivalents.

You can also use shorthand names for some types. For more information, see about_Type_Accelerators.

4.1 Special types

4.1.1 The void type

This type cannot be instantiated. It provides a means to discard a value explicitly using the cast operator (§7.2.9).

4.1.2 The null type

The *null type* has one instance, the automatic variable $null (§2.3.2.2), also known as the null value. This value provides a means for expressing "nothingness" in reference contexts. The characteristics of this type are unspecified.

4.1.3 The object type

Every type in PowerShell except the null type (§4.1.2) is derived directly or indirectly from the type object, so object is the ultimate base type of all non-null types. A variable constrained (§5.3) to type object is really not constrained at all, as it can contain a value of any type.

4.2 Value types

4.2.1 Boolean

The Boolean type is `bool`. There are only two values of this type, **False** and **True**, represented by the automatic variables `$false` and `$true`, respectively (§2.3.2.2).

In PowerShell, `bool` maps to `System.Boolean`.

4.2.2 Character

A character value has type char, which is capable of storing any UTF-16-encoded 16-bit Unicode code point.

The type char has the following accessible members:

Member	Member Kind	Type	Purpose
MaxValue	Static property (read-only)	char	The largest possible value of type char
MinValue	Static property (read-only)	char	The smallest possible value of type char
IsControl	Static method	bool/char	Tests if the character is a control character
IsDigit	Static method	bool/char	Tests if the character is a decimal digit
IsLetter	Static method	bool/char	Tests if the character is an alphabetic letter
IsLetterOrDigit	Static method	bool/char	Tests if the character is a decimal digit or alphabetic letter
IsLower	Static method	bool/char	Tests if the character is a lowercase alphabetic letter
IsPunctuation	Static method	bool/char	Tests if the character is a punctuation mark
IsUpper	Static method	bool/char	Tests if the character is an uppercase alphabetic letter
IsWhiteSpace	Static method	bool/char	Tests if the character is a white space character.
ToLower	Static method	char/string	Converts the character to lowercase
ToUpper	Static method	char/string	Converts the character to uppercase

Windows PowerShell: char maps to System.Char.

4.2.3 Integer

There are two signed integer types, both of use two's-complement representation for negative values:

- Type `int`, which uses 32 bits giving it a range of -2147483648 to +2147483647, inclusive.
- Type `long`, which uses 64 bits giving it a range of -9223372036854775808 to +9223372036854775807, inclusive.

Type int has the following accessible members:

Member	Member Kind	Type	Purpose
MaxValue	Static property (read-only)	int	The largest possible value of type int
MinValue	Static property (read-only)	int	The smallest possible value of type int

Type long has the following accessible members:

Member	Member Kind	Type	Purpose
MaxValue	Static property (read-only)	long	The largest possible value of type long
MinValue	Static property (read-only)	long	The smallest possible value of type long

There is one unsigned integer type:

- Type `byte`, which uses 8 bits giving it a range of 0 to 255, inclusive.

Type `byte` has the following accessible members:

Member	Member Kind	Type	Purpose
MaxValue	Static property (read-only)	byte	The largest possible value of type byte
MinValue	Static property (read-only)	byte	The smallest possible value of type byte

In PowerShell, `byte`, `int`, and `long` map to `System.Byte`, `System.Int32`, and `System.Int64`, respectively.

4.2.4 Real number

4.2.4.1 float and double

There are two real (or floating-point) types:

- Type `float` uses the 32-bit IEEE single-precision representation.
- Type `double` uses the 64-bit IEEE double-precision representation.

A third type name, `single`, is a synonym for type `float`; `float` is used throughout this specification.

Although the size and representation of the types `float` and `double` are defined by this specification, an implementation may use extended precision for intermediate results.

Type float has the following accessible members:

Member	Member Kind	Type	Purpose
MaxValue	Static property (read-only)	float	The largest possible value of type float
MinValue	Static property (read-only)	float	The smallest possible value of type float
NaN	Static property (read-only)	float	The constant value Not-a-Number
NegativeInfinity	Static property (read-only)	float	The constant value negative infinity
PositiveInfinity	Static property (read-only)	float	The constant value positive infinity

Type double has the following accessible members:

Member	Member Kind	Type	Purpose
MaxValue	Static property (read-only)	double	The largest possible value of type double
MinValue	Static property (read-only)	double	The smallest possible value of type double
NaN	Static property (read-only)	double	The constant value Not-a-Number
NegativeInfinity	Static property (read-only)	double	The constant value negative infinity
PositiveInfinity	Static property (read-only)	double	The constant value positive infinity

In PowerShell, `float` and `double` map to `System.Single` and `System.Double`, respectively.

4.2.4.2 decimal

Type decimal uses a 128-bit representation. At a minimum it must support a scale **s** such that 0 <= *s* <= at least 28, and a value range -79228162514264337593543950335 to 79228162514264337593543950335. The actual representation of decimal is implementation defined.

Type decimal has the following accessible members:

Member	Member Kind	Type	Purpose
MaxValue	Static property (read-only)	decimal	The largest possible value of type decimal
MinValue	Static property (read-only)	decimal	The smallest possible value of type decimal

> ⓘ **Note**
>
> Decimal real numbers have a characteristic called *scale*, which represents the number of digits to the right of the decimal point. For example, the value 2.340 has a scale of 3 where trailing zeros are significant. When two decimal real numbers are added or subtracted, the scale of the result is the larger of the two scales. For example, 1.0 + 2.000 is 3.000, while 5.0 - 2.00 is 3.00. When two decimal real numbers are multiplied, the scale of the result is the sum of the two scales. For example, 1.0 * 2.000 is 2.0000. When two decimal real numbers are divided, the scale of the result is the scale of the first less the scale of the second. For example, 4.00000/2.000 is 2.00. However, a scale cannot be less than that needed to preserve the correct result. For example, 3.000/2.000, 3.00/2.000, 3.0/2.000, and 3/2 are all 1.5.

In PowerShell, `decimal` maps to `System.Decimal`. The representation of decimal is as follows:

- When considered as an array of four `int` values it contains the following elements:
  - Index 0 (bits 0-31) contains the low-order 32 bits of the decimal's coefficient.
  - Index 1 (bits 32-63) contains the middle 32 bits of the decimal's coefficient.
  - Index 2 (bits 64-95) contains the high-order 32 bits of the decimal's coefficient.
  - Index 3 (bits 96-127) contains the sign bit and scale, as follows:
    - bits 0--15 are zero
    - bits 16-23 contains the scale as a value 0--28
    - bits 24-30 are zero
    - bit 31 is the sign (0 for positive, 1 for negative)

4.2.5 The switch type

This type is used to constrain the type of a parameter in a command (§8.10.5). If an argument having the corresponding parameter name is present the parameter tests $true; otherwise, it tests `$false`.

In PowerShell, `switch` maps to `System.Management.Automation.SwitchParameter`.

4.2.6 Enumeration types

An enumeration type is one that defines a set of named constants representing all the possible values that can be assigned to an object of that enumeration type. In some cases, the set of values are such that only one value can be represented at a time. In other cases, the set of values are distinct powers of two, and by using the -bor operator (§7.8.5), multiple values can be encoded in the same object.

The PowerShell environment provides a number of enumeration types, as described in the following sections.

4.2.6.1 Action-Preference type

This implementation-defined type has the following mutually exclusive-valued accessible members:

Member	Member Kind	Purpose
Continue	Enumeration constant	The PowerShell runtime will continue processing and notify the user that an action has occurred.
Inquire	Enumeration constant	The PowerShell runtime will stop processing and ask the user how it should proceed.
SilentlyContinue	Enumeration constant	The PowerShell runtime will continue processing without notifying the user that an action has occurred.
Stop	Enumeration constant	The PowerShell runtime will stop processing when an action occurs.

In PowerShell, this type is `System.Management.Automation.ActionPreference`.

4.2.6.2 Confirm-Impact type

This implementation-defined type has the following mutually exclusive-valued accessible members:

Member	Member Kind	Purpose
High	Enumeration constant	The action performed has a high risk of losing data, such as reformatting a hard disk.
Low	Enumeration constant	The action performed has a low risk of losing data.
Medium	Enumeration constant	The action performed has a medium risk of losing data.
None	Enumeration constant	Do not confirm any actions (suppress all requests for confirmation).

In PowerShell, this type is `System.Management.Automation.ConfirmImpact`.

4.2.6.3 File-Attributes type

This implementation-defined type has the following accessible members, which can be combined:

Member	Member Kind	Purpose
Archive	Enumeration constant	The file's archive status. Applications use this attribute to mark files for backup or removal.
Compressed	Enumeration constant	The file is compressed.
Device		Reserved for future use.
Directory	Enumeration constant	The file is a directory.
Encrypted	Enumeration constant	The file or directory is encrypted. For a file, this means that all data in the file is encrypted. For a directory, this means that encryption is the default for newly created files and directories.
Hidden	Enumeration constant	The file is hidden, and thus is not included in an ordinary directory listing.
Normal	Enumeration constant	The file is normal and has no other attributes set. This attribute is valid only if used alone.
NotContentIndexed	Enumeration constant	The file will not be indexed by the operating system's content indexing service.

Member	Member Kind	Purpose
Offline	Enumeration constant	The file is offline. The data of the file is not immediately available.
ReadOnly	Enumeration constant	The file is read-only.
ReparsePoint	Enumeration constant	The file contains a reparse point, which is a block of user-defined data associated with a file or a directory.
SparseFile	Enumeration constant	The file is a sparse file. Sparse files are typically large files whose data are mostly zeros.
System	Enumeration constant	The file is a system file. The file is part of the operating system or is used exclusively by the operating system.
Temporary	Enumeration constant	The file is temporary. File systems attempt to keep all of the data in memory for quicker access rather than flushing the data back to mass storage. A temporary file should be deleted by the application as soon as it is no longer needed.

In PowerShell, this type is System.IO.FileAttributes with attribute FlagsAttribute.

4.2.6.4 Regular-Expression-Option type

This implementation-defined type has the following accessible members, which can be combined:

Member	Member Kind	Purpose
IgnoreCase	Enumeration constant	Specifies that the matching is case-insensitive.
None	Enumeration constant	Specifies that no options are set.

An implementation may provide other values.

In PowerShell, this type is `System.Text.RegularExpressions.RegexOptions` with attribute `FlagsAttribute`. The following extra values are defined: `Compiled`, `CultureInvariant`, `ECMAScript`, `ExplicitCapture`, `IgnorePatternWhitespace`, `Multiline`, `RightToLeft`, `Singleline`.

4.3 Reference types

4.3.1 Strings

A string value has type string and is an immutable sequence of zero or more characters of type char each containing a UTF-16-encoded 16-bit Unicode code point.

Type string has the following accessible members:

Member	Member Kind	Type	Purpose
Length	Instance Property	int (read-only)	Gets the number of characters in the string
ToLower	Instance Method	string	Creates a new string that contains the lowercase equivalent
ToUpper	Instance Method	string	Creates a new string that contains the uppercase equivalent

In PowerShell, `string` maps to `System.String`.

4.3.2 Arrays

All array types are derived from the type `Array`. This type has the following accessible members:

Member	Member Kind	Type	Purpose
Length	Instance Property (read-only)	int	Number of elements in the array
Rank	Instance Property (read-only)	int	Number of dimensions in the array

Member	Member Kind	Type	Purpose
Copy	Static Method	void/see Purpose column	Copies a range of elements from one array to another. There are four versions, where *source* is the source array, *destination* is the destination array, *count* is the number of elements to copy, and *sourceIndex* and *destinationIndex* are the starting locations in their respective arrays: Copy(*source*, *destination*, int *count*) Copy(*source*, *destination*, long *count*) Copy(*source*, *sourceIndex*, *destination*, *destinationIndex*, int *count*) Copy(*source*, *sourceIndex*, *destination*, *destinationIndex*, long *count*)
GetLength	Instance Method (read-only)	int/none	Number of elements in a given dimension GetLength(int *dimension*)

For more details on arrays, see §9.

In PowerShell, `Array` maps to `System.Array`.

4.3.3 Hashtables

Type Hashtable has the following accessible members:

Member	Member Kind	Type	Purpose
Count	Instance Property	int	Gets the number of key/value pairs in the Hashtable
Keys	Instance Property	Implementation-defined	Gets a collection of all the keys
Values	Instance Property	Implementation-defined	Gets a collection of all the values
Remove	Instance Method	void/none	Removes the designated key/value

For more details on Hashtables, see §10.

In PowerShell, `Hashtable` maps to `System.Collections.Hashtable`. `Hashtable` elements are stored in an object of type `DictionaryEntry`, and the collections returned by Keys and Values have type `ICollection`.

4.3.4 The xml type

Type xml implements the W3C Document Object Model (DOM) Level 1 Core and the Core DOM Level 2. The DOM is an in-memory (cache) tree representation of an XML document and enables the navigation and editing of this document. This type supports the subscript operator [] (§7.1.4.4).

In PowerShell, `xml` maps to `System.Xml.XmlDocument`.

4.3.5 The regex type

Type `regex` provides machinery for supporting regular expression processing. It is used to constrain the type of a parameter (§5.3) whose corresponding argument might contain a regular expression.

In PowerShell, `regex` maps to `System.Text.RegularExpressions.Regex`.

4.3.6 The ref type

Ordinarily, arguments are passed to commands by value. In the case of an argument having some value type a copy of the value is passed. In the case of an argument having some reference type a copy of the reference is passed.

Type ref provides machinery to allow arguments to be passed to commands by reference, so the commands can modify the argument's value. Type ref has the following accessible members:

Member	Member Kind	Type	Purpose
Value	Instance property (read-write)	The type of the value being referenced.	Gets/sets the value being referenced.

Consider the following function definition and call:

PowerShell

```
function Doubler {
    param ([ref]$x) # parameter received by reference
    $x.Value *= 2.0 # note that 2.0 has type double
}

$number = 8 # designates a value of type int, value 8
Doubler([ref]$number) # argument received by reference
$number # designates a value of type double, value 8.0
```

Consider the case in which $number is type-constrained:

```PowerShell
[int]$number = 8 # designates a value of type int, value 8
Doubler([ref]$number) # argument received by reference
$number # designates a value of type int, value 8
```

As shown, both the argument and its corresponding parameter must be declared `ref`.

In PowerShell, `ref` maps to `System.Management.Automation.PSReference`.

4.3.7 The scriptblock type

Type `scriptblock` represents a precompiled block of script text (§7.1.8) that can be used as a single unit. It has the following accessible members:

Member	Member Kind	Type	Purpose
Attributes	Instance property (read-only)	Collection of attributes	Gets the attributes of the script block.
File	Instance property (read-only)	string	Gets the name of the file in which the script block is defined.
Module	Instance property (read-only)	implementation defined ([§4.5.12] [§4.5.12])	Gets information about the module in which the script block is defined.
GetNewClosure	Instance method	scriptblock /none	Retrieves a script block that is bound to a module. Any local variables that are in the context of the caller will be copied into the module.
Invoke	Instance method	Collection of object/object[]	Invokes the script block with the specified arguments and returns the results.
InvokeReturnAsIs	Instance method	object/object[]	Invokes the script block with the specified arguments and returns any objects generated.
Create	Static method	scriptblock /string	Creates a new scriptblock object that contains the specified script.

In PowerShell, `scriptblock` maps to `System.Management.Automation.ScriptBlock`. `Invoke` returns a collection of `PSObject`.

4.3.8 The math type

Type `math` provides access to some constants and methods useful in mathematical computations. It has the following accessible members:

Member	Member Kind	Type	Purpose
E	Static property (read-only)	double	Natural logarithmic base
PI	Static property (read-only)	double	Ratio of the circumference of a circle to its diameter
Abs	Static method	numeric/numeric	Absolute value (the return type is the same as the type of the argument passed in)
Acos	Static method	double / double	Angle whose cosine is the specified number
Asin	Static method	double / double	Angle whose sine is the specified number
Atan	Static method	double / double	Angle whose tangent is the specified number
Atan2	Static method	double / double *y*, double *x*	Angle whose tangent is the quotient of two specified numbers *x* and *y*
Ceiling	Static method	decimal / decimal double / double	smallest integer greater than or equal to the specified number
Cos	Static method	double / double	Cosine of the specified angle
Cosh	Static method	double / double	Hyperbolic cosine of the specified angle
Exp	Static method	double / double	e raised to the specified power
Floor	Static method	decimal / decimal double / double	Largest integer less than or equal to the specified number

Member	Member Kind	Type	Purpose
Log	Static method	double / double *number* double / double *number*, double *base*	Logarithm of number using base e or base *base*
Log10	Static method	double / double	Base-10 logarithm of a specified number
Max	Static method	numeric/numeric	Larger of two specified numbers (the return type is the same as the type of the arguments passed in)
Min	Static method	numeric/numeric, numeric	Smaller of two specified numbers (the return type is the same as the type of the arguments passed in)
Pow	Static method	double / double *x*, double *y*	A specified number *x* raised to the specified power *y*
Sin	Static method	double / double	Sine of the specified angle
Sinh	Static method	double / double	Hyperbolic sine of the specified angle
Sqrt	Static method	double / double	Square root of a specified number
Tan	Static method	double / double	Tangent of the specified angle
Tanh	Static method	double / double	Hyperbolic tangent of the specified angle

In PowerShell, `Math` maps to `System.Math`.

4.3.9 The ordered type

Type `ordered` is a pseudo type used only for conversions.

4.3.10 The pscustomobject type

Type `pscustomobject` is a pseudo type used only for conversions.

4.4 Generic types

A number of programming languages and environments provide types that can be *specialized*. Many of these types are referred to as *container types*, as instances of them are able to contain objects of some other type. Consider a type called Stack that can represent a stack of values, which can be pushed on and popped off. Typically, the user of a stack wants to store only one kind of object on that stack. However, if the language or environment does not support type specialization, multiple distinct variants of the type Stack must be implemented even though they all perform the same task, just with different type elements.

Type specialization allows a *generic type* to be implemented such that it can be constrained to handling some subset of types when it is used. For example,

- A generic stack type that is specialized to hold strings might be written as `Stack[string]`.
- A generic dictionary type that is specialized to hold int keys with associated string values might be written as `Dictionary[int,string]`.
- A stack of stack of strings might be written as `Stack[Stack[string]]`.

Although PowerShell does not define any built-in generic types, it can use such types if they are provided by the host environment. See the syntax in §7.1.10.

The complete name for the type `Stack[string]` suggested above is `System.Collections.Generic.Stack[string]`. The complete name for the type `Dictionary[int,string]` suggested above is `System.Collections.Generic.Dictionary[int,string]`.

4.5 Anonymous types

In some circumstances, an implementation of PowerShell creates objects of some type, and those objects have members accessible to script. However, the actual name of those types need not be specified, so long as the accessible members are specified sufficiently for them to be used. That is, scripts can save objects of those types and access their members without actually knowing those types' names. The following subsections specify these types.

4.5.1 Provider description type

This type encapsulates the state of a provider. It has the following accessible members:

Member	Member Kind	Type	Purpose
Drives	Instance property (read-only)	Implementation defined (§4.5.2)	A collection of drive description objects
Name	Instance property (read-only)	string	The name of the provider

In PowerShell, this type is `System.Management.Automation.ProviderInfo`.

4.5.2 Drive description type

This type encapsulates the state of a drive. It has the following accessible members:

Member	Member Kind	Type	Purpose
CurrentLocation	Instance property (read-write)	string	The current working location (§3.1.4) of the drive
Description	Instance property (read-write)	string	The description of the drive
Name	Instance property (read-only)	string	The name of the drive
Root	Instance property (read-only)	string	The name of the drive

In PowerShell, this type is `System.Management.Automation.PSDriveInfo`.

4.5.3 Variable description type

This type encapsulates the state of a variable. It has the following accessible members:

Member	Member Kind	Type	Purpose
Attributes	Instance property (read-only)	Implementation defined	A collection of attributes
Description	Instance property (read-write)	string	The description assigned to the variable via the New-Variable or Set-Variable cmdlets.

Member	Member Kind	Type	Purpose
Module	Instance property (read-only)	Implementation defined (§4.5.12)	The module from which this variable was exported
ModuleName	Instance property (read-only)	string	The module in which this variable was defined
Name	Instance property (read-only)	string	The name assigned to the variable when it was created in the PowerShell language or via the `New-Variable` and `Set-Variable` cmdlets.
Options	Instance property (read-write)	string	The options assigned to the variable via the `New-Variable` and `Set-Variable` cmdlets.
Value	Instance property (read-write)	object	The value assigned to the variable when it was assigned in the PowerShell language or via the `New-Variable` and `Set-Variable` cmdlets.

In PowerShell, this type is `System.Management.Automation.PSVariable`.

Windows PowerShell: The type of the attribute collection is System.Management.Automation.PSVariableAttributeCollection.

4.5.4 Alias description type

This type encapsulates the state of an alias. It has the following accessible members:

Member	Member Kind	Type	Purpose
CommandType	Instance property (read-only)	Implementation defined	Should compare equal with "Alias".
Definition	Instance property (read-only)	string	The command or alias to which the alias was assigned via the New-Alias or Set-Alias cmdlets.

Member	Member Kind	Type	Purpose
Description	Instance property (read-write)	string	The description assigned to the alias via the `New-Alias` or `Set-Alias` cmdlets.
Module	Instance property (read-only)	Implementation defined (§4.5.12)	The module from which this alias was exported
ModuleName	Instance property (read-only)	string	The module in which this alias was defined
Name	Instance property (read-only)	string	The name assigned to the alias when it was created via the `New-Alias` or `Set-Alias` cmdlets.
Options	Instance property (read-write)	string	The options assigned to the alias via the New-Alias `New-Alias` or `Set-Alias` cmdlets.
OutputType	Instance property (read-only)	Implementation defined collection	Specifies the types of the values output by the command to which the alias refers.
Parameters	Instance property (read-only)	Implementation defined collection	The parameters of the command.
ParameterSets	Instance property (read-only)	Implementation defined collection	Information about the parameter sets associated with the command.
ReferencedCommand	Instance property (read-only)	Implementation defined	Information about the command that is immediately referenced by this alias.
ResolvedCommand	Instance property (read-only)	Implementation defined	Information about the command to which the alias eventually resolves.

In PowerShell, this type is `System.Management.Automation.AliasInfo`.

4.5.5 Working location description type

This type encapsulates the state of a working location. It has the following accessible members:

Member	Member Kind	Type	Purpose
Drive	Instance property (read-only)	Implementation defined (§4.5.2)	A drive description object
Path	Instance property (read-only)	string	The working location
Provider	Instance property (read-only)	Implementation defined (§4.5.1)	The provider
ProviderPath	Instance property (read-only)	string	The current path of the provider

A stack of working locations is a collection of working location objects, as described above.

In PowerShell, a current working location is represented by an object of type `System.Management.Automation.PathInfo`. A stack of working locations is represented by an object of type `System.Management.Automation.PathInfoStack`, which is a collection of `PathInfo` objects.

4.5.6 Environment variable description type

This type encapsulates the state of an environment variable. It has the following accessible members:

Member	Member Kind	Type	Purpose
Name	Instance property (read-write)	string	The name of the environment variable
Value	Instance property (read-write)	string	The value of the environment variable

In PowerShell, this type is `System.Collections.DictionaryEntry`. The name of the variable is the dictionary key. The value of the environment variable is the dictionary value. **Name** is an `AliasProperty` that equates to **Key**.

4.5.7 Application description type

This type encapsulates the state of an application. It has the following accessible members:

Member	Member Kind	Type	Purpose

Member	Member Kind	Type	Purpose
CommandType	Instance property (read-only)	Implementation defined	Should compare equal with "Application".
Definition	Instance property (read-only)	string	A description of the application.
Extension	Instance property (read-write)	string	The extension of the application file.
Module	Instance property (read-only)	Implementation defined (§4.5.12)	The module that defines this command.
ModuleName	Instance property (read-only)	string	The name of the module that defines the command.
Name	Instance property (read-only)	string	The name of the command.
OutputType	Instance property (read-only)	Implementation defined collection	Specifies the types of the values output by the command.
Parameters	Instance property (read-only)	Implementation defined collection	The parameters of the command.
ParameterSets	Instance property (read-only)	Implementation defined collection	Information about the parameter sets associated with the command.
Path	Instance property (read-only)	string	Gets the path of the application file.

In PowerShell, this type is `System.Management.Automation.ApplicationInfo`.

4.5.8 Cmdlet description type

This type encapsulates the state of a cmdlet. It has the following accessible members:

Member	Member Kind	Type	Purpose
CommandType	Instance property (read-only)	Implementation defined	Should compare equal with "Cmdlet".
DefaultParameterSet	Instance property (read-only)	Implementation defined	The default parameter set that is used if PowerShell cannot determine which parameter set to use based on the supplied arguments.
Definition	Instance property (read-only)	string	A description of the cmdlet.
HelpFile	Instance property (read-write)	string	The path to the Help file for the cmdlet.
ImplementingType	Instance property (read-write)	Implementation defined	The type that implements the cmdlet.
Module	Instance property (read-only)	Implementation defined (§4.5.12)	The module that defines this cmdlet.
ModuleName	Instance property (read-only)	string	The name of the module that defines the cmdlet.
Name	Instance property (read-only)	string	The name of the cmdlet.
Noun	Instance property (read-only)	string	The noun name of the cmdlet.

Member	Member Kind	Type	Purpose
OutputType	Instance property (read-only)	Implementation defined collection	Specifies the types of the values output by the cmdlet.
Parameters	Instance property (read-only)	Implementation defined collection	The parameters of the cmdlet.
ParameterSets	Instance property (read-only)	Implementation defined collection	Information about the parameter sets associated with the cmdlet.
Verb	Instance property (read-only)	string	The verb name of the cmdlet.
PSSnapIn	Instance property (read-only)	Implementation defined	Windows PowerShell: Information about the Windows Powershell snap-in that is used to register the cmdlet.

In PowerShell, this type is `System.Management.Automation.CmdletInfo`.

4.5.9 External script description type

This type encapsulates the state of an external script (one that is directly executable by PowerShell, but is not built in). It has the following accessible members:

Member	Member Kind	Type	Purpose
CommandType	Instance property (read-only)	Implementation defined	Should compare equal with "ExternalScript".
Definition	Instance property (read-only)	string	A definition of the script.
Module	Instance property (read-only)	Implementation defined (§4.5.12)	The module that defines this script.

Member	Member Kind	Type	Purpose
ModuleName	Instance property (read-only)	string	The name of the module that defines the script.
Name	Instance property (read-only)	string	The name of the script.
OriginalEncoding	Instance property (read-only)	Implementation defined	The original encoding used to convert the characters of the script to bytes.
OutputType	Instance property (read-only)	Implementation defined collection	Specifies the types of the values output by the script.
Parameters	Instance property (read-only)	Implementation defined collection	The parameters of the script.
ParameterSets	Instance property (read-only)	Implementation defined collection	Information about the parameter sets associated with the script.
Path	Instance property (read-only)	string	The path to the script file.
ScriptBlock	Instance property (read-only)	scriptblock	The external script.
ScriptContents	Instance property (read-only)	string	The original contents of the script.

In PowerShell, this type is `System.Management.Automation.ExternalScriptInfo`.

4.5.10 Function description type

This type encapsulates the state of a function. It has the following accessible members:

Member	Member Kind	Type	Purpose

Member	Member Kind	Type	Purpose
CmdletBinding	Instance property (read-only)	bool	Indicates whether the function uses the same parameter binding that compiled cmdlets use (see §12.3.5).
CommandType	Instance property (read-only)	Implementation defined	Can be compared for equality with "Function" or "Filter" to see which of those this object represents.
DefaultParameterSet	Instance property (read-only)	string	Specifies the parameter set to use if that cannot be determined from the arguments (see §12.3.5).
Definition	Instance property (read-only)	string	A string version of ScriptBlock
Description	Instance property (read-write)	string	The description of the function.
Module	Instance property (read-only)	Implementation defined (§4.5.12)	The module from which this function was exported
ModuleName	Instance property (read-only)	string	The module in which this function was defined
Name	Instance property (read-only)	string	The name of the function
Options	Instance property (read-write)	Implementation defined	The scope options for the function (§3.5.4).

Member	Member Kind	Type	Purpose
OutputType	Instance property (read-only)	Implementation defined collection	Specifies the types of the values output, in order (see §12.3.6).
Parameters	Instance property (read-only)	Implementation defined collection	Specifies the parameter names, in order. If the function acts like a cmdlet (see CmdletBinding above) the common parameters are included at the end of the collection.
ParameterSets	Instance property (read-only)	Implementation defined collection	Information about the parameter sets associated with the command. For each parameter, the result shows the parameter name and type, and indicates if the parameter is mandatory, by position or a switch parameter. If the function acts like a cmdlet (see CmdletBinding above) the common parameters are included at the end of the collection.
ScriptBlock	Instance property (read-only)	scriptblock (§4.3.6)	The body of the function

In PowerShell, this type is `System.Management.Automation.FunctionInfo`.

- `CommandType` has type `System.Management.Automation.CommandTypes`.
- `Options` has type `System.Management.Automation.ScopedItemOptions`.
- `OutputType` has type `System.Collections.ObjectModel.ReadOnlyCollection``1[[System.Management.Automation.PSTypeName,System.Management.Automation]]`.
- `Parameters` has type `System.Collections.Generic.Dictionary``2[[System.String,mscorlib],[System.Management.Automation.ParameterMetadata,System.Management.Automation]]`.
- `ParameterSets` has type `System.Collections.ObjectModel.ReadOnlyCollection``1[[System.Management.Automation.CommandParameterSetInfo,System.Management.Automation]]`.
- Visibility has type `System.Management.Automation.SessionStateEntryVisibility`.
- PowerShell also has a property called **Visibility**.

4.5.11 Filter description type

This type encapsulates the state of a filter. It has the same set of accessible members as the function description type (§4.5.10).

In PowerShell, this type is `System.Management.Automation.FilterInfo`. It has the same set of properties as `System.Management.Automation.FunctionInfo` (§4.5.11).

4.5.12 Module description type

This type encapsulates the state of a module. It has the following accessible members:

Member	Member Kind	Type	Purpose
Description	Instance property (read-write)	string	The description of the module (set by the manifest)
ModuleType	Instance property (read-only)	Implementation defined	The type of the module (Manifest, Script, or Binary)
Name	Instance property (read-only)	string	The name of the module
Path	Instance property (read-only)	string	The module's path

In PowerShell, this type is `System.Management.Automation.PSModuleInfo`. The type of `ModuleType` is `System.Management.Automation.ModuleType`.

4.5.13 Custom object description type

This type encapsulates the state of a custom object. It has no accessible members.

In PowerShell, this type is `System.Management.Automation.PSCustomObject`. The cmdlets `Import-Module` and `New-Object` can generate an object of this type.

4.5.14 Command description type

The automatic variable `$PsCmdlet` is an object that represents the cmdlet or function being executed. The type of this object is implementation defined; it has the following accessible members:

Member	Member Kind	Type	Purpose

Member	Member Kind	Type	Purpose
ParameterSetName	Instance property (read-only)	string	Name of the current parameter set (see ParameterSetName)
ShouldContinue	Instance method	Overloaded /bool	Requests confirmation of an operation from the user.
ShouldProcess	Instance method	Overloaded /bool	Requests confirmation from the user before an operation is performed.

In PowerShell, this type is System.Management.Automation.PSScriptCmdlet.

4.5.15 Error record description type

The automatic variable `$Error` contains a collection of error records that represent recent errors (§3.12). Although the type of this collection is unspecified, it does support subscripting to get access to individual error records.

In PowerShell, the collection type is `System.Collections.ArrayList`. The type of an individual error record in the collection is `System.Management.Automation.ErrorRecord`. This type has the following public properties:

- CategoryInfo - Gets information about the category of the error.
- ErrorDetails - Gets and sets more detailed error information, such as a replacement error message.
- Exception - Gets the exception that is associated with this error record.
- FullyQualifiedErrorId - Gets the fully qualified error identifier for this error record.
- InvocationInfo - Gets information about the command that was invoked when the error occurred.
- PipelineIterationInfo - Gets the status of the pipeline when this error record was created
- TargetObject - Gets the object that was being processed when the error occurred.

4.5.16 Enumerator description type

A number of variables are enumerators for collections (§4). The automatic variable `$foreach` is the enumerator created for any `foreach` statement. The automatic variable `$input` is the enumerator for a collection delivered to a function from the pipeline. The automatic variable `$switch` is the enumerator created for any `switch` statement.

The type of an enumerator is implementation defined; it has the following accessible members:

Member	Member Kind	Type	Purpose
Current	Instance property (read-only)	object	Gets the current element in the collection. If the enumerator is not currently positioned at an element of the collection, the behavior is implementation defined.
MoveNext	Instance method	None/bool	Advances the enumerator to the next element of the collection. Returns $true if the enumerator was successfully advanced to the next element; $false if the enumerator has passed the end of the collection.

In PowerShell, these members are defined in the interface `System.IEnumerator`, which is implemented by the types identified below. If the enumerator is not currently positioned at an element of the collection, an exception of type `InvalidOperationException` is raised. For `$foreach`, this type is `System.Array+SZArrayEnumerator`. For `$input`, this type is `System.Collections.ArrayList+ArrayListEnumeratorSimple`. For `$switch`, this type is `System.Array+SZArrayEnumerator`.

4.5.17 Directory description type

The cmdlet New-Item can create items of various kinds including FileSystem directories. The type of a directory description object is implementation defined; it has the following accessible members:

Member	Member Kind	Type	Purpose
Attributes	Instance property (read-write)	Implementation defined (§4.2.6.3)	Gets or sets one or more of the attributes of the directory object.
CreationTime	Instance property (read-write)	Implementation defined (§4.5.19)	Gets and sets the creation time of the directory object.
Extension	Instance property (read-only)	string	Gets the extension part of the directory name.
FullName	Instance property (read-only)	string	Gets the full path of the directory.

Member	Member Kind	Type	Purpose
LastWriteTime	Instance property (read-write)	Implementation defined (§4.5.19)	Gets and sets the time when the directory was last written to.
Name	Instance property (read-only)	string	Gets the name of the directory.

In PowerShell, this type is `System.IO.DirectoryInfo`. The type of the **Attributes** property is `System.IO.FileAttributes`.

4.5.18 File description type

The cmdlet `New-Item` can create items of various kinds including FileSystem files. The type of a file description object is implementation defined; it has the following accessible members:

Member	Member Kind	Type	Purpose
Attributes	Instance property (read-write)	Implementation defined (§4.2.6.3)	Gets or sets one or more of the attributes of the file object.
BaseName	Instance property (read- only)	string	Gets the name of the file excluding the extension.
CreationTime	Instance property (read-write)	Implementation defined (§4.5.19)	Gets and sets the creation time of the file object.
Extension	Instance property (read- only)	string	Gets the extension part of the file name.
FullName	Instance property (read-only)	string	Gets the full path of the file.
LastWriteTime	Instance property (read-write)	Implementation defined (§4.5.19)	Gets and sets the time when the file was last written to.

Member	Member Kind	Type	Purpose
Length	Instance property (read- only)	long	Gets the size of the file, in bytes.
Name	Instance property (read- only)	string	Gets the name of the file.
VersionInfo	Instance property (read- only)	Implementation defined	Windows PowerShell: This ScriptProperty returns a System.Diagnostics.FileVersionInfo for the file.

In PowerShell, this type is `System.IO.FileInfo`.

4.5.19 Date-Time description type

The type of a date-time description object is implementation defined; it has the following accessible members:

Member	Member Kind	Type	Purpose
Day	Instance property (read-only)	int	Gets the day component of the month represented by this instance.
Hour	Instance property (read-only)	int	Gets the hour component of the date represented by this instance.
Minute	Instance property (read-only)	int	Gets the minute component of the date represented by this instance.
Month	Instance property (read-only)	int	Gets the month component of the date represented by this instance.
Second	Instance property (read-only)	int	Gets the seconds component of the date represented by this instance.
Year	Instance property (read-only)	int	Gets the year component of the date represented by this instance.

An object of this type can be created by cmdlet Get-Date.

In PowerShell, this type is `System.DateTime`.

4.5.20 Group-Info description type

The type of a **group-info** description object is implementation defined; it has the following accessible members:

Member	Member Kind	Type	Purpose
Count	Instance property (read-only)	int	Gets the number of elements in the group.
Group	Instance property (read-only)	Implementation-defined collection	Gets the elements of the group.
Name	Instance property (read-only)	string	Gets the name of the group.
Values	Instance property (read-only)	Implementation-defined collection	Gets the values of the elements of the group.

An object of this type can be created by cmdlet Group-Object.

In PowerShell, this type is `Microsoft.PowerShell.Commands.GroupInfo`.

4.5.21 Generic-Measure-Info description type

The type of a **generic-measure-info** description object is implementation defined; it has the following accessible members:

Member	Member Kind	Type	Purpose
Average	Instance property (read-only)	double	Gets the average of the values of the properties that are measured.
Count	Instance property (read-only)	int	Gets the number of objects with the specified properties.
Maximum	Instance property (read-only)	double	Gets the maximum value of the specified properties.
Minimum	Instance property (read-only)	double	Gets the minimum value of the specified properties.
Property	Instance property (read-only)	string	Gets the property to be measured.
Sum	Instance property (read-only)	double	Gets the sum of the values of the specified properties.

An object of this type can be created by cmdlet Measure-Object.

In PowerShell, this type is `Microsoft.PowerShell.Commands.GenericMeasureInfo`.

4.5.22 Text-Measure-Info description type

The type of a **text-info** description object is implementation defined; it has the following accessible members:

Member	Member Kind	Type	Purpose
Characters	Instance property (read-only)	int	Gets the number of characters in the target object.
Lines	Instance property (read-only)	int	Gets the number of lines in the target object.
Property	Instance property (read-only)	string	Gets the property to be measured.
Words	Instance property (read-only)	int	Gets the number of words in the target object.

An object of this type can be created by cmdlet `Measure-Object`.

In PowerShell, this type is `Microsoft.PowerShell.Commands.TextMeasureInfo`.

4.5.23 Credential type

A credential object can then be used in various security operations. The type of a credential object is implementation defined; it has the following accessible members:

Member	Member Kind	Type	Purpose
Password	Instance property (read-only)	Implementation defined	Gets the password.
UserName	Instance property (read-only)	string	Gets the username.

An object of this type can be created by cmdlet Get-Credential.

In PowerShell, this type is `System.Management.Automation.PSCredential`.

4.5.24 Method designator type

The type of a method designator is implementation defined; it has the following accessible members:

Member	Member Kind	Type	Purpose
Invoke	Instance method	object/variable number and type	Takes a variable number of arguments, and indirectly calls the method referred to by the parent method designator, passing in the arguments.

An object of this type can be created by an *invocation-expression* (§7.1.3).

In PowerShell, this type is System.Management.Automation.PSMethod.

4.5.25 Member definition type

This type encapsulates the definition of a member. It has the following accessible members:

Member	Member Kind	Type	Purpose
Definition	Instance property (read-only)	string	Gets the definition of the member.
MemberType	Instance property (read-only)	Implementation defined	Gets the PowerShell type of the member.
Name	Instance property (read-only)	string	Gets the name of the member.
TypeName	Instance property (read-only)	string	Gets the type name of the member.

In PowerShell, this type is `Microsoft.PowerShell.Commands.MemberDefinition`.

4.6 Type extension and adaptation

A PowerShell implementation includes a family of core types (which are documented in this chapter) that each contain their own set of *base members*. Those members can be methods or properties, and they can be instance or static members. For example, the base members of the type string (§4.3.1) are the instance property Length and the instance methods ToLower and ToUpper.

When an object is created, it contains all the instance properties of that object's type, and the instance methods of that type can be called on that object. An object may be customized via the addition of instance members at runtime. The result is called a *custom object*. Any members added to an instance exist only for the life of that instance; other instances of the same core type are unaffected.

The base member set of a type can be augmented by the addition of the following kinds of members:

- *adapted members*, via the *Extended Type System* (ETS), most details of which are unspecified.
- *extended members*, via the cmdlet Add-Member.

In PowerShell, extended members can also be added via `types.ps1xml` files. Adapted and extended members are collectively called **synthetic** *members*.

The ETS adds the following members to all PowerShell objects: **psbase**, **psadapted**, **psextended**, and **pstypenames**. See the **Force** and **View** parameters in the cmdlet Get-Member for more information on these members.

An instance member may hide an extended and/or adapted member of the same name, and an extended member may hide an adapted member. In such cases, the member sets **psadapted** and **psextended** can be used to access those hidden members.

If a `types.ps1xml` specifies a member called **Supports**, `obj.psextended` provides access to just that member and not to a member added via `Add-Member`.

There are three ways create a custom object having a new member M:

1. This approach can be used to add one or more NoteProperty members.

   PowerShell

   ```
   $x = New-Object PSObject -Property @{M = 123}
   ```

2. This approach can be used to add NoteProperty or ScriptMethod members.

   PowerShell

   ```
   $x = New-Module -AsCustomObject {$M = 123 ; Export-ModuleMember --
   Variable M}
   ```

3. This approach can be used to add any kind of member.

   PowerShell

   ```
   $x = New-Object PSObject
   Add-Member -InputObject $x -Name M -MemberType NoteProperty -Value 123
   ```

`PSObject` is the base type of all PowerShell types.

5. Variables

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A variable represents a storage location for a value, and that value has a type. Traditional procedural programming languages are statically typed; that is, the runtime type of a variable is that with which it was declared at compile time. Object-oriented languages add the idea of inheritance, which allows the runtime type of a variable to be that with which it was declared at compile time or some type derived from that type. Being a dynamically typed language, PowerShell's variables do not have types, per se. In fact, variables are not defined; they simply come into being when they are first assigned a value. And while a variable may be constrained (§5.3) to holding a value of a given type, type information in an assignment cannot always be verified statically.

At different times, a variable may be associated with values of different types either through assignment (§7.11) or the use of the `++` and `--` operators (§7.1.5, §7.2.6). When the value associated with a variable is changed, that value's type may change. For example,

PowerShell

```
$i = "abc"          # $i holds a value of type string
$i = 2147483647     # $i holds a value of type int
++$i                # $i now holds a value of type double because
                    # 2147483648 is too big to fit in type int
```

Any use of a variable that has not been created results in the value $null. To see if a variable has been defined, use the Test-Path cmdlet.

5.1 Writable location

A *writable location* is an expression that designates a resource to which a command has both read and write access. A writable location may be a variable (§5), an array element (§9), an associated value in a Hashtable accessed via a subscript (§10), a property (§7.1.2), or storage managed by a provider (§3.1).

5.2 Variable categories

PowerShell defines the following categories of variables: static variables, instance variables, array elements, Hashtable key/value pairs, parameters, ordinary variables, and

variables on provider drives. The subsections that follow describe each of these categories.

In the following example

PowerShell

```
function F ($p1, $p2) {
    $radius = 2.45
    $circumference = 2 * ([Math]::PI) * $radius

    $date = Get-Date -Date "2010-2-1 10:12:14 pm"
    $month = $date.Month

    $values = 10, 55, 93, 102
    $value = $values[2]

    $h1 = @{ FirstName = "James"; LastName = "Anderson" }
    $h1.FirstName = "Smith"

    $Alias:A = "Help"
    $Env:MyPath = "e:\Temp"
    ${E:output.txt} = 123
    $function:F = { "Hello there" }
    $Variable:v = 10
}
```

- `[Math::PI]` is a static variable
- `$date.Month` is an instance variable
- `$values[2]` is an array element
- `$h1.FirstName` is a `Hashtable` key whose corresponding value is $h1['FirstName']`
- `$p1` and `$p2` are parameters
- `$radius`, `$circumference`, `$date`, `$month`, `$values`, `$value`, and `$h1` are ordinary variables
- `$Alias:A`, `$Env:MyPath`, `${E:output.txt}`, and `$function:F` are variables on the corresponding provider drives.
- `$Variable:v` is actually an ordinary variable written with its fully qualified provider drive.

5.2.1 Static variables

A data member of an object that belongs to the object's type rather than to that particular instance of the type is called a *static variable*. See §4.2.3, §4.2.4.1, and §4.3.8 for some examples.

PowerShell provides no way to create new types that contain static variables; however, objects of such types may be provided by the host environment.

Memory for creating and deleting objects containing static variables is managed by the host environment and the garbage collection system.

See §7.1.2 for information about accessing a static variable.

A static data member can be a field or a property.

5.2.2 Instance variables

A data member of an object that belongs to a particular instance of the object's type rather than to the type itself is called an *instance variable*. See §4.3.1, §4.3.2, and §4.3.3 for some examples.

A PowerShell host environment might provide a way to create new types that contain instance variables or to add new instance variables to existing types.

Memory for creating and deleting objects containing static variables is managed by the host environment and the garbage collection system.

See §7.1.2 for information about accessing an instance variable.

An instance data member can be a field or a property.

5.2.3 Array elements

An array can be created via a unary comma operator (§7.2.1), *sub-expression* (§7.1.6), *array-expression* (§7.1.7), binary comma operator (§7.3), range operator (§7.4), or New-Object cmdlet.

Memory for creating and deleting arrays is managed by the host environment and the garbage collection system.

Arrays and array elements are discussed in §9.

5.2.4 Hashtable key/value pairs

A Hashtable is created via a hash literal (§2.3.5.6) or the New-Object cmdlet. A new key/value pair can be added via the `[]` operator (§7.1.4.3).

Memory for creating and deleting Hashtables is managed by the host environment and the garbage collection system.

Hashtables are discussed in §10.

5.2.5 Parameters

A parameter is created when its parent command is invoked, and it is initialized with the value of the argument provided in the invocation or by the host environment. A parameter ceases to exist when its parent command terminates.

Parameters are discussed in §8.10.

5.2.6 Ordinary variables

An *ordinary variable* is defined by an *assignment-expression* (§7.11) or a *foreach-statement* (§8.4.4). Some ordinary variables are predefined by the host environment while others are transient, coming and going as needed at runtime.

The lifetime of an ordinary variable is that part of program execution during which storage is guaranteed to be reserved for it. This lifetime begins at entry into the scope with which it is associated, and ends no sooner than the end of the execution of that scope. If the parent scope is entered recursively or iteratively, a new instance of the local variable is created each time.

The storage referred to by an ordinary variable is reclaimed independently of the lifetime of that variable.

An ordinary variable can be named explicitly with a **Variable:** namespace prefix (§5.2.7).

5.2.7 Variables on provider drives

The concept of providers and drives is introduced in §3.1, with each provider being able to provide its own namespace drive(s). This allows resources on those drives to be accessed as though they were ordinary variables (§5.2.6). In fact, an ordinary variable is stored on the file system provider drive Variable: (§3.1.5) and can be accessed by its ordinary name or its fully qualified namespace name.

Some namespace variable types are constrained implicitly (§5.3).

5.3 Constrained variables

By default, a variable may designate a value of any type. However, a variable may be *constrained* to designating values of a given type by specifying that type as a type literal before its name in an assignment or a parameter. For example,

PowerShell

```
[int]$i = 10    # constrains $i to designating ints only
$i = "Hello"    # error, no conversion to int
$i = "0x10"     # ok, conversion to int
$i = $true      # ok, conversion to int

function F ([int]$p1, [switch]$p2, [regex]$p3) { ... }
```

Any variable belonging to the namespace **Env:**, **Alias:**, or to the file system namespace (§2.3.2, §3.1) is constrained implicitly to the type `string`. Any variable belonging to the namespace **Function:** (§2.3.2, §3.1) is constrained implicitly to the type `scriptblock`.

6. Conversions

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A *type conversion* is performed when a value of one type is used in a context that requires a different type. If such a conversion happens automatically it is known as *implicit conversion*. (A common example of this is with some operators that need to convert one or more of the values designated by their operands.) Implicit conversion is permitted provided the sense of the source value is preserved, such as no loss of precision of a number when it is converted.

The cast operator (§7.2.9) allows for *explicit conversion*.

Conversions are discussed below, with supplementary information being provided as necessary in the description of each operator in §6.19.

Explicit conversion of a value to the type it already has causes no change to that value or its representation.

The rules for handing conversion when the value of an expression is being bound to a parameter are covered in §6.17.

6.1 Conversion to void

A value of any type can be discarded explicitly by casting it to type void. There is no result.

6.2 Conversion to bool

The rules for converting any value to type bool are as follows:

- A numeric or char value of zero is converted to False; a numeric or char value of non-zero is converted to True.
- A value of null type is converted to False.
- A string of length 0 is converted to False; a string of length > 0 is converted to True.
- A switch parameter with value `$true` is converted to True, and one with value `$false` is converted to False.
- All other non-null reference type values are converted to True.

If the type implements IList:

- If the object's Length > 2, the value is converted to True.
- If the object's Length is 1 and that first element is not itself an IList, then if that element's value is true, the value is converted to True.
- Otherwise, if the first element's Count >= 1, the value is converted to True.
- Otherwise, the value is converted to False.

6.3 Conversion to char

The rules for converting any value to type char are as follows:

- The conversion of a value of type bool, decimal, float, or double is in error.
- A value of null type is converted to the null (U+0000) character.
- An integer type value whose value can be represented in type char has that value; otherwise, the conversion is in error.
- The conversion of a string value having a length other than 1 is in error.
- A string value having a length 1 is converted to a char having that one character's value.
- A numeric type value whose value after rounding of any fractional part can be represented in the destination type has that rounded value; otherwise, the conversion is in error.
- For other reference type values, if the reference type supports such a conversion, that conversion is used; otherwise, the conversion is in error.

6.4 Conversion to integer

The rules for converting any value to type byte, int, or long are as follows:

- The bool value False is converted to zero; the bool value True is converted to 1.
- A char type value whose value can be represented in the destination type has that value; otherwise, the conversion is in error.
- A numeric type value whose value after rounding of any fractional part can be represented in the destination type has that rounded value; otherwise, the conversion is in error.
- A value of null type is converted to zero.
- A string that represents a number is converted as described in §6.16. If after truncation of the fractional part the result can be represented in the destination type the string is well formed and it has the destination type; otherwise, the conversion is in error. If the string does not represent a number, the conversion is in error.
- For other reference type values, if the reference type supports such a conversion, that conversion is used; otherwise, the conversion is in error.

6.5 Conversion to float and double

The rules for converting any value to type float or double are as follows:

- The bool value False is converted to zero; the bool value True is converted to 1.
- A char value is represented exactly.
- A numeric type value is represented exactly, if possible; however, for int, long, and decimal conversions to float, and for long and decimal conversions to double, some of the least significant bits of the integer value may be lost.
- A value of null type is converted to zero.
- A string that represents a number is converted as described in §6.16; otherwise, the conversion is in error.
- For other reference type values, if the reference type supports such a conversion, that conversion is used; otherwise, the conversion is in error.

6.6 Conversion to decimal

The rules for converting any value to type decimal are as follows:

- The bool value False is converted to zero; the bool value True is converted to 1.
- A char type value is represented exactly.
- A numeric type value is represented exactly; however, if that value is too large or too small to fit in the destination type, the conversion is in error.
- A value of null type is converted to zero.
- A string that represents a number is converted as described in §6.16; otherwise, the conversion is in error.
- For other reference type values, if the reference type supports such a conversion, that conversion is used; otherwise, the conversion is in error.
- The scale of the result of a successful conversion is such that the fractional part has no trailing zeros.

6.7 Conversion to object

The value of any type except the null type (4.1.2) can be converted to type object. The value retains its type and representation.

6.8 Conversion to string

The rules for converting any value to type string are as follows:

- The bool value `$false` is converted to "False"; the bool value `$true` is converted to "True".
- A char type value is converted to a 1-character string containing that char.
- A numeric type value is converted to a string having the form of a corresponding numeric literal. However, the result has no leading or trailing spaces, no leading plus sign, integers have base 10, and there is no type suffix. For a decimal conversion, the scale is preserved. For values of -∞, +∞, and NaN, the resulting strings are "-Infinity", "Infinity", and "NaN", respectively.
- A value of null type is converted to the empty string.
- For a 1-dimensional array, the result is a string containing the value of each element in that array, from start to end, converted to string, with elements being separated by the current Output Field Separator (§2.3.2.2). For an array having elements that are themselves arrays, only the top-level elements are converted. The string used to represent the value of an element that is an array, is implementation defined. For a multi-dimensional array, it is flattened (§9.12) and then treated as a 1-dimensional array.
- A value of null type is converted to the empty string.
- A scriptblock type value is converted to a string containing the text of that block without the delimiting { and } characters.
- For an enumeration type value, the result is a string containing the name of each enumeration constant encoded in that value, separated by commas.
- For other reference type values, if the reference type supports such a conversion, that conversion is used; otherwise, the conversion is in error.

The string used to represent the value of an element that is an array has the form `System.type[]`, `System.type[,]`, and so on. For other reference types, the method `ToString` is called. For other enumerable types, the source value is treated like a 1-dimensional array.

6.9 Conversion to array

The rules for converting any value to an array type are as follows:

- The target type may not be a multidimensional array.
- A value of null type is retained as is.
- For a scalar value other than `$null` or a value of type hashtable, a new 1-element array is created whose value is the scalar after conversion to the target element type.
- For a 1-dimensional array value, a new array of the target type is created, and each element is copied with conversion from the source array to the corresponding element in the target array.

- For a multi-dimensional array value, that array is first flattened (§9.12), and then treated as a 1-dimensional array value.
- A string value is converted to an array of char having the same length with successive characters from the string occupying corresponding positions in the array.

For other enumerable types, a new 1-element array is created whose value is the corresponding element after conversion to the target element type, if such a conversion exists. Otherwise, the conversion is in error.

6.10 Conversion to xml

The object is converted to type string and then into an XML Document object of type `xml`.

6.11 Conversion to regex

An expression that designates a value of type string may be converted to type `regex`.

6.12 Conversion to scriptblock

The rules for converting any value to type `scriptblock` are as follows:

- A string value is treated as the name of a command optionally following by arguments to a call to that command.

6.13 Conversion to enumeration types

The rules for converting any value to an enumeration type are as follows:

- A value of type string that contains one of the named values (with regard for case) for an enumeration type is converted to that named value.
- A value of type string that contains a comma-separated list of named values (with regard for case) for an enumeration type is converted to the bitwise-OR of all those named values.

6.14 Conversion to other reference types

The rules for converting any value to a reference type other than an array type or string are as follows:

- A value of null type is retained as is.
- Otherwise, the behavior is implementation defined.

A number of pieces of machinery come in to play here; these include the possible use of single argument constructors or default constructors if the value is a hashtable, implicit and explicit conversion operators, and Parse methods for the target type; the use of Convert.ConvertTo; and the ETS conversion mechanism.

6.15 Usual arithmetic conversions

If neither operand designates a value having numeric type, then

- If the left operand designates a value of type bool, the conversion is in error.
- Otherwise, all operands designating the value `$null` are converted to zero of type int and the process continues with the numeric conversions listed below.
- Otherwise, if the left operand designates a value of type char and the right operand designates a value of type bool, the conversion is in error.
- Otherwise, if the left operand designates a value of type string but does not represent a number (§6.16), the conversion is in error.
- Otherwise, if the right operand designates a value of type string but does not represent a number (§6.16), the conversion is in error.
- Otherwise, all operands designating values of type string are converted to numbers (§6.16), and the process continues with the numeric conversions listed below.
- Otherwise, the conversion is in error.

Numeric conversions:

- If one operand designates a value of type decimal, the value designated by the other operand is converted to that type, if necessary. The result has type decimal.
- Otherwise, if one operand designates a value of type double, the value designated by the other operand is converted to that type, if necessary. The result has type double.
- Otherwise, if one operand designates a value of type float, the values designated by both operands are converted to type double, if necessary. The result has type double.
- Otherwise, if one operand designates a value of type long, the value designated by the other operand value is converted to that type, if necessary. The result has the type first in the sequence long and double that can represent its value.
- Otherwise, the values designated by both operands are converted to type int, if necessary. The result has the first in the sequence int, long, double that can represent its value without truncation.

6.16 Conversion from string to numeric type

Depending on its contents, a string can be converted explicitly or implicitly to a numeric value. Specifically,

- An empty string is converted to the value zero.
- Leading and trailing spaces are ignored; however, a string may not consist of spaces only.
- A string containing only white space and/or line terminators is converted to the value zero.
- One leading + or - sign is permitted.
- An integer number may have a hexadecimal prefix (0x or 0X).
- An optionally signed exponent is permitted.
- Type suffixes and multipliers are not permitted.
- The case-distinct strings "-Infinity", "Infinity", and "NaN" are recognized as the values -∞, +∞, and NaN, respectively.

6.17 Conversion during parameter binding

For information about parameter binding see §8.14.

When the value of an expression is being bound to a parameter, there are extra conversion considerations, as described below:

- If the parameter type is switch (§4.2.5, §8.10.5) and the parameter has no argument, the value of the parameter in the called command is set to `$true`. If the parameter type is other than switch, a parameter having no argument is in error.
- If the parameter type is switch and the argument value is `$null`, the parameter value is set to `$false`.
- If the parameter type is object or is the same as the type of the argument, the argument's value is passed without conversion.
- If the parameter type is not object or scriptblock, an argument having type scriptblock is evaluated and its result is passed as the argument's value. (This is known as *delayed script block binding*.) If the parameter type is object or scriptblock, an argument having type scriptblock is passed as is.
- If the parameter type is a collection of type T2, and the argument is a scalar of type T1, that scalar is converted to a collection of type T2 containing one element. If necessary, the scalar value is converted to type T2 using the conversion rules of this section.
- If the parameter type is a scalar type other than object and the argument is a collection, the argument is in error.

- If the expected parameter type is a collection of type T2, and the argument is a collection of type T1, the argument is converted to a collection of type T2 having the same length as the argument collection. If necessary, the argument collection element values are converted to type T2 using the conversion rules of this section.
- If the steps above and the conversions specified earlier in this chapter do not suffice, the rules in §6.18 are applied. If those fail, the parameter binding fails.

6.18 .NET Conversion

For an implicit conversion, PowerShell's built-in conversions are tried first. If they cannot resolve the conversion, the .NET custom converters below are tried, in order, from top to bottom. If a conversion is found, but it throws an exception, the conversion has failed.

- **PSTypeConverter**: There are two ways of associating the implementation of the **PSTypeConverter** class with its target class: through the type configuration file (types.ps1xml) or by applying the `System.ComponentModel.TypeConverterAttribute` attribute to the target class. Refer to the PowerShell SDK documentation for more information.

- **TypeConverter**: This CLR type provides a unified way of converting types of values to other types, as well as for accessing standard values and sub-properties. The most common type of converter is one that converts to and from a text representation. The type converter for a class is bound to the class with a `System.ComponentModel.TypeConverterAttribute`. Unless this attribute is overridden, all classes that inherit from this class use the same type converter as the base class. Refer to the PowerShell SDK and the Microsoft .NET framework documentation for more information.

- **Parse Method**: If the source type is string and the destination type has a method called `Parse`, that method is called to perform the conversion.

- **Constructors**: If the destination type has a constructor taking a single argument whose type is that of the source type, that constructor is called to perform the conversion.

- **Implicit Cast Operator**: If the source type has an implicit cast operator that converts to the destination type, that operator is called to perform the conversion.

- **Explicit Cast Operator**: If the source type has an explicit cast operator that converts to the destination type, that operator is called to perform the conversion. If the destination type has an explicit cast operator that converts from the source type, that operator is called to perform the conversion.

- **IConvertable**: `System.Convert.ChangeType` is called to perform the conversion.

6.19 Conversion to ordered

The rules for converting any value to the pseudo-type ordered are as follows:

- If the value is a hash literal (§2.3.5.6), the result is an object with an implementation defined type that behaves like a hashtable and the order of the keys matches the order specified in the hash literal.
- Otherwise, the behavior is implementation defined.

Only hash literals (§2.3.5.6) can be converted to ordered. The result is an instance of `System.Collections.Specialized.OrderedDictionary`.

6.20 Conversion to pscustomobject

The rules for converting any value to the pseudo-type pscustomobject are as follows:

- A value of type hashtable is converted to a PowerShell object. Each key in the hashtable becomes a NoteProperty with the corresponding value.
- Otherwise, the behavior is implementation defined.

The conversion is always allowed but does not change the type of the value.

7. Expressions

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Syntax:

Syntax

```
expression:
    logical-expression
```

Description:

An *expression* is a sequence of operators and operands that designates a method, a function, a writable location, or a value; specifies the computation of a value; produces one or more side effects; or performs some combination thereof. For example,

- The literal 123 is an expression that designates the int value 123.
- The expression `1,2,3,4` designates the 4-element array object having the values shown.
- The expression `10.4 * $a` specifies a computation.
- The expression `$a++` produces a side effect.
- The expression `$a[$i--] = $b[++$j]` performs a combination of these things.

Except as specified for some operators, the order of evaluation of terms in an expression and the order in which side effects take place are both unspecified. Examples of unspecified behavior include the following: `$i++ + $i`, `$i + --$i`, and `$w[$j++] = $v[$j]`.

An implementation of PowerShell may provide support for user-defined types, and those types may have operations defined on them. All details of such types and operations are implementation defined.

A *top-level expression* is one that is not part of some larger expression. If a top-level expression contains a side-effect operator the value of that expression is not written to the pipeline; otherwise, it is. See §7.1.1 for a detailed discussion of this.

Ordinarily, an expression that designates a collection (§4) is enumerated into its constituent elements when the value of that expression is used. However, this is not the case when the expression is a cmdlet invocation. For example,

PowerShell

```
$x = 10,20,30
$a = $($x; 99)                      # $a.Length is 4

$x = New-Object 'int[]' 3
$a = $($x; 99)                      # equivalent, $a.Length is 4

$a = $(New-Object 'int[]' 3; 99)    # $a.Length is 2
```

In the first two uses of the `$(...)` operator, the expression designating the collection is the variable `$x`, which is enumerated resulting in three `int` values, plus the `int` 99. However, in the third case, the expression is a direct call to a cmdlet, so the result is not enumerated, and `$a` is an array of two elements, `int[3]` and `int`.

If an operation is not defined by PowerShell, the type of the value designated by the left operand is inspected to see if it has a corresponding `op_<operation>` method.

7.1 Primary expressions

Syntax:

Syntax

```
primary-expression:
    value
    member-access
    element-access
    invocation-expression
    post-increment-expression
    post-decrement-expression

value:
    parenthesized-expression
    sub-expression
    array-expression
    script-block-expression
    hash-literal-expression
    literal
    type-literal
    variable
```

7.1.1 Grouping parentheses

Syntax:

Tip

The `~opt~` notation in the syntax definitions indicates that the lexical entity is optional in the syntax.

Syntax

```
parenthesized-expression:
    ( new-lines~opt~ pipeline new-lines~opt~ )
```

Description:

A parenthesized expression is a *primary-expression* whose type and value are the same as those of the expression without the parentheses. If the expression designates a variable then the parenthesized expression designates that same variable. For example, `$x.m` and `($x).m` are equivalent.

Grouping parentheses may be used in an expression to document the default precedence and associativity within that expression. They can also be used to override that default precedence and associativity. For example,

PowerShell

```
4 + 6 * 2    # 16
4 + (6 * 2)  # 16 document default precedence
(4 + 6) * 2  # 20 override default precedence
```

Ordinarily, grouping parentheses at the top-most level are redundant. However, that is not always the case. Consider the following example:

PowerShell

```
2,4,6       # Length 3; values 2,4,6
(2,4),6     # Length 2; values [object[]],int
```

In the second case, the parentheses change the semantics, resulting in an array whose two elements are an array of 2 ints and the scalar int 6.

Here's another exception:

PowerShell

```
23.5/2.4          # pipeline gets 9.79166666666667
$a = 1234 * 3.5   # value not written to pipeline
$a                # pipeline gets 4319
```

In the first and third cases, the value of the result is written to the pipeline. However, although the expression in the second case is evaluated, the result is not written to the pipeline due to the presence of the side-effect operator = at the top level. (Removal of the `$a =` part allows the value to be written, as `*` is not a side-effect operator.)

To stop a value of any expression not containing top-level side effects from being written to the pipeline, discard it explicitly, as follows:

PowerShell

```
# None of these value are written to pipeline
[void](23.5/2.4)
[void]$a
$null = $a
$a > $null
```

To write to the pipeline the value of any expression containing top-level side effects, enclose that expression in parentheses, as follows:

PowerShell

```
($a = 1234 * 3.5) # pipeline gets 4319
```

As such, the grouping parentheses in this case are not redundant.

In the following example, we have variable substitution (§2.3.5.2) taking place in a string literal:

PowerShell

```
">$($a = -23)<"    # value not written to pipeline, get
><
">$(($a = -23))<"  # pipeline gets >-23<
```

In the first case, the parentheses represent a *sub-expression*'s delimiters *not* grouping parentheses, and as the top-level expression contains a side-effect operator, the expression's value is not written to the pipeline. Of course, the `>` and `<` characters are still written.) If grouping parenthesis are added -- as shown in the second case -- writing is enabled.

The following examples each contain top-level side-effect operators:

PowerShell

```
$a = $b = 0      # value not written to pipeline
$a = ($b = 0)    # value not written to pipeline
($a = ($b = 0))  # pipeline gets 0

++$a             # value not written to pipeline
(++$b)           # pipeline gets 1

$a--             # value not written to pipeline
($b--)           # pipeline gets 1
```

The use of grouping parentheses around an expression containing no top-level side effects makes those parentheses redundant. For example;

PowerShell

```
$a      # pipeline gets 0
($a)    # no side effect, so () redundant
```

Consider the following example that has two side effects, neither of which is at the top level:

PowerShell

```
12.6 + ($a = 10 - ++$b) # pipeline gets 21.6.
```

The result is written to the pipeline, as the top-level expression has no side effects.

7.1.2 Member access

Syntax:

Syntax

```
member-access: Note no whitespace is allowed after primary-expression.
    primary-expression . member-name
    primary-expression :: member-name
```

Description:

The operator `.` is used to select an instance member from an object, or a key from a `Hashtable`. The left operand must designate an object, and the right operand must designate an accessible instance member.

Either the right operand designates an accessible instance member within the type of the object designated by the left operand or, if the left operand designates an array, the right operand designates accessible instance members within each element of the array.

White space is not permitted before the `.` operator.

This operator is left associative.

The operator `::` is used to select a static member from a given type. The left operand must designate a type, and the right-hand operand must designate an accessible static member within that type.

White space is not permitted before the `::` operator.

This operator is left associative.

If the right-hand operand designates a writable location within the type of the object designated by the left operand, then the whole expression designates a writable location.

Examples:

PowerShell

```
$a = 10, 20, 30
$a.Length                    # get instance property

(10, 20, 30).Length

$property = "Length"
$a.$property                 # property name is a variable

$h1 = @{ FirstName = "James"; LastName = "Anderson"; IDNum = 123
}
$h1.FirstName                # designates the key FirstName
$h1.Keys                     # gets the collection of keys

[int]::MinValue              # get static property
[double]::PositiveInfinity   # get static property
$property = "MinValue"
[long]::$property            # property name is a variable

foreach ($t in [byte], [int], [long]) {
    $t::MaxValue             # get static property
}

$a = @{ID = 1 }, @{ID = 2 }, @{ID = 3 }
$a.ID                        # get ID from each element in the array
```

7.1.3 Invocation expressions

Syntax:

Syntax

```
invocation-expression: Note no whitespace is allowed after primary-
expression.
    primary-expression . member-name argument-list
    primary-expression :: member-name argument-list

argument-list:
    ( argument-expression-list~opt~ new-lines~opt~ )
```

Description:

An *invocation-expression* calls the method designated by *primary-expression.member-name* or *primary-expression*::*member-name*. The parentheses in *argument-list* contain a possibly empty, comma-separated list of expressions, which designate the *arguments* whose values are passed to the method. Before the method is called, the arguments are evaluated and converted according to the rules of §6, if necessary, to match the types expected by the method. The order of evaluation of *primary-expression.member-name*, *primary-expression*::*member-name*, and the arguments is unspecified.

This operator is left associative.

The type of the result of an *invocation-expression* is a *method designator* (§4.5.24).

Examples:

PowerShell

```
[math]::Sqrt(2.0)            # call method with argument 2.0
[char]::IsUpper("a")         # call method
$b = "abc#$%XYZabc"
$b.ToUpper()                 # call instance method

[math]::Sqrt(2)              # convert 2 to 2.0 and call method
[math]::Sqrt(2D)             # convert 2D to 2.0 and call method
[math]::Sqrt($true)          # convert $true to 1.0 and call method
[math]::Sqrt("20")           # convert "20" to 20 and call method

$a = [math]::Sqrt            # get method descriptor for Sqrt
$a.Invoke(2.0)               # call Sqrt via the descriptor
$a = [math]::("Sq"+"rt")     # get method descriptor for Sqrt
$a.Invoke(2.0)               # call Sqrt via the descriptor
$a = [char]::ToLower         # get method descriptor for ToLower
$a.Invoke("X")               # call ToLower via the descriptor
```

7.1.4 Element access

Syntax:

Syntax

```
element-access: Note no whitespace is allowed between primary-expression and
[.
    primary-expression [ new-lines~opt~ expression new-lines~opt~ ]
```

Description:

There must not be any white space between *primary-expression* and the left square bracket (`[`).

7.1.4.1 Subscripting an array

Description:

Arrays are discussed in detail in §9. If *expression* is a 1-dimensional array, see §7.1.4.5.

When *primary-expression* designates a 1-dimensional array *A*, the operator `[]` returns the element located at `A[0 + expression]` after the value of *expression* has been converted to `int`. The result has the element type of the array being subscripted. If *expression* is negative, `A[expression]` designates the element located at `A[A.Length + expression]`.

When *primary-expression* designates a 2-dimensional array *B*, the operator `[]` returns the element located at `B[0 + row,0 + column]` after the value of the *row* and *column* components of *expression* (which are specified as a comma-separated list) have been converted to `int`. The result has the element type of the array being subscripted. Unlike for a 1-dimensional array, negative positions have no special meaning.

When *primary-expression* designates an array of three or more dimensions, the rules for 2-dimensional arrays apply and the dimension positions are specified as a comma-separated list of values.

If a read access on a non-existing element is attempted, the result is `$null`. It is an error to write to a non-existing element.

For a multidimensional-array subscript expression, the order of evaluation of the dimension position expressions is unspecified. For example, given a 3-dimensional array `$a`, the behavior of `$a[$i++,$i,++$i]` is unspecified.

If *expression* is an array, see §7.1.4.5.

This operator is left associative.

Examples:

PowerShell

```
$a = [int[]](10,20,30) # [int[]], Length 3
$a[1] # returns int 20
$a[20] # no such position, returns $null
$a[-1] # returns int 30, i.e., $a[$a.Length-1]
$a[2] = 5 # changes int 30 to int 5
$a[20] = 5 # implementation-defined behavior

$a = New-Object 'double[,]' 3,2
$a[0,0] = 10.5 # changes 0.0 to 10.5
$a[0,0]++ # changes 10.5 to 10.6

$list = ("red",$true,10),20,(1.2, "yes")
$list[2][1] # returns string "yes"

$a = @{ A = 10 },@{ B = $true },@{ C = 123.45 }
$a[1]["B"] # $a[1] is a Hashtable, where B is a key

$a = "red","green"
$a[1][4] # returns string "n" from string in $a[1]
```

If a write access to a non-existing element is attempted, an **IndexOutOfRange** exception is raised.

7.1.4.2 Subscripting a string

Description:

When *primary-expression* designates a string *S*, the operator `[]` returns the character located in the zero-based position indicated by *expression*, as a char. If *expression* is greater than or equal to that string's length, the result is `$null`. If *expression* is negative, `S[expression]` designates the element located at `S[S.Length + expression]`.

Examples:

PowerShell

```
$s = "Hello"   # string, Length 5, positions 0-4
$c = $s[1]     # returns "e" as a string
$c = $s[20]    # no such position, returns $null
$c = $s[-1]    # returns "o", i.e., $s[$s.Length-1]
```

7.1.4.3 Subscripting a Hashtable

Description:

When *primary-expression* designates a Hashtable, the operator `[]` returns the value(s) associated with the key(s) designated by *expression*. The type of *expression* is not restricted.

When *expression* is a single key name, the result is the associated value and has that type, unless no such key exists, in which case, the result is `$null`. If `$null` is used as the key the behavior is implementation defined. If *expression* is an array of key names, see §7.1.4.5.

If *expression* is an array, see §7.1.4.5.

Examples:

PowerShell

```
$h1 = @{ FirstName = "James"; LastName = "Anderson"; IDNum = 123 }
$h1['FirstName']     # the value associated with key FirstName
$h1['BirthDate']     # no such key, returns $null

$h1 = @{ 10 = "James"; 20.5 = "Anderson"; $true = 123 }
$h1[10]              # returns value "James" using key 10
$h1[20.5]            # returns value "Anderson" using key 20.5
$h1[$true]           # returns value 123 using key $true
```

When *expression* is a single key name, if `$null` is used as the only value to subscript a Hashtable, a **NullArrayIndex** exception is raised.

7.1.4.4 Subscripting an XML document

Description:

When *primary-expression* designates an object of type xml, *expression* is converted to string, if necessary, and the operator `[]` returns the first child element having the name specified by *expression*. The type of *expression* must be string. The type of the result is implementation defined. The result can be subscripted to return its first child element. If no child element exists with the name specified by *expression*, the result is `$null`. The result does not designate a writable location.

Examples:

PowerShell

```
$x = [xml]@"
<Name>
<FirstName>Mary</FirstName>
<LastName>King</LastName>
</Name>
"@

$x['Name']                # refers to the element Name
$x['Name']['FirstName']   # refers to the element FirstName within Name
$x['FirstName']           # No such child element at the top level, result
is `$null`
```

The type of the result is `System.Xml.XmlElement` or `System.String`.

7.1.4.5 Generating array slices

When *primary-expression* designates an object of a type that is enumerable (§4) or a Hashtable, and *expression* is a 1-dimensional array, the result is an array slice (§9.9) containing the elements of *primary-expression* designated by the elements of *expression*.

In the case of a Hashtable, the array slice contains the associated values to the keys provided, unless no such key exists, in which case, the corresponding element is `$null`. If `$null` is used as any key name the behavior is implementation defined.

Examples:

PowerShell

```
$a = [int[]](30,40,50,60,70,80,90)
$a[1,3,5]                 # slice has Length 3, value 40,60,80
++$a[1,3,5][1]            # preincrement 60 in array 40,60,80
$a[,5]                    # slice with Length 1
$a[@()]                   # slice with Length 0
$a[-1..-3]                # slice with Length 0, value 90,80,70
$a = New-Object 'int[,]' 3,2
$a[0,0] = 10; $a[0,1] = 20; $a[1,0] = 30
$a[1,1] = 40; $a[2,0] = 50; $a[2,1] = 60
$a[(0,1),(1,0)]           # slice with Length 2, value 20,30, parens needed
$h1 = @{ FirstName = "James"; LastName = "Anderson"; IDNum = 123 }
$h1['FirstName']          # the value associated with key FirstName
$h1['BirthDate']          # no such key, returns $null
$h1['FirstName','IDNum']  # returns [object[]], Length 2 (James/123)
$h1['FirstName','xxx']    # returns [object[]], Length 2 (James/$null)
$h1[$null,'IDNum']        # returns [object[]], Length 1 (123)
```

Windows PowerShell: When *expression* is a collection of two or more key names, if `$null` is used as any key name that key is ignored and has no corresponding element in the resulting array.

7.1.5 Postfix increment and decrement operators

Syntax:

Syntax

```
post-increment-expression:
    primary-expression ++

post-decrement-expression:
    primary-expression dashdash

dashdash:
    --
```

Description:

The *primary-expression* must designate a writable location having a value of numeric type (§4) or the value `$null`. If the value designated by the operand is `$null`, that value is converted to type int and value zero before the operator is evaluated. The type of the value designated by *primary-expression* may change when the result is stored. See §7.11 for a discussion of type change via assignment.

The result produced by the postfix `++` operator is the value designated by the operand. After that result is obtained, the value designated by the operand is incremented by 1 of the appropriate type. The type of the result of expression `E++` is the same as for the result of the expression `E + 1` (§7.7).

The result produced by the postfix `--` operator is the value designated by the operand. After that result is obtained, the value designated by the operand is decremented by 1 of the appropriate type. The type of the result of expression `E--` is the same as for the result of the expression `E - 1` (§7.7).

These operators are left associative.

Examples:

PowerShell

```
$i = 0                  # $i = 0
$i++                    # $i is incremented by 1
```

```
$j = $i--             # $j takes on the value of $i before the decrement

$a = 1,2,3
$b = 9,8,7
$i = 0
$j = 1
$b[$j--] = $a[$i++]   # $b[1] takes on the value of $a[0], then $j is
                      # decremented, $i incremented

$i = 2147483647       # $i holds a value of type int
$i++                  # $i now holds a value of type double because
                      # 2147483648 is too big to fit in type int

[int]$k = 0           # $k is constrained to int
$k = [int]::MaxValue  # $k is set to 2147483647
$k++                  # 2147483648 is too big to fit, imp-def bahavior

$x = $null            # target is unconstrained, $null goes to [int]0
$x++                  # value treated as int, 0->1
```

7.1.6 $(...) operator

Syntax:

Syntax

```
sub-expression:
    $( new-lines~opt~ statement-list~opt~ new-lines~opt~ )
```

Description:

If *statement-list* is omitted, the result is `$null`. Otherwise, *statement-list* is evaluated. Any objects written to the pipeline as part of the evaluation are collected in an unconstrained 1-dimensional array, in order. If the array of collected objects is empty, the result is `$null`. If the array of collected objects contains a single element, the result is that element; otherwise, the result is the unconstrained 1-dimensional array of collected results.

Examples:

PowerShell

```
$j = 20
$($i = 10) # pipeline gets nothing
$(($i = 10)) # pipeline gets int 10
$($i = 10; $j) # pipeline gets int 20
$(($i = 10); $j) # pipeline gets [object[]](10,20)
$(($i = 10); ++$j) # pipeline gets int 10
```

```
$(($i = 10); (++$j)) # pipeline gets [object[]](10,22)
$($i = 10; ++$j) # pipeline gets nothing
$(2,4,6) # pipeline gets [object[]](2,4,6)
```

7.1.7 @(...) operator

Syntax:

Syntax

```
array-expression:
    @( new-lines~opt~ statement-list~opt~ new-lines~opt~ )
```

Description:

If *statement-list* is omitted, the result is an unconstrained 1-dimensional array of length zero. Otherwise, *statement-list* is evaluated, and any objects written to the pipeline as part of the evaluation are collected in an unconstrained 1-dimensional array, in order. The result is the (possibly empty) unconstrained 1-dimensional array.

Examples:

PowerShell

```
$j = 20
@($i = 10)              # 10 not written to pipeline, result is array of 0
@(($i = 10))            # pipeline gets 10, result is array of 1
@($i = 10; $j)          # 10 not written to pipeline, result is array of 1
@(($i = 10); $j)        # pipeline gets 10, result is array of 2
@(($i = 10); ++$j)      # pipeline gets 10, result is array of 1
@(($i = 10); (++$j))    # pipeline gets both values, result is array of 2
@($i = 10; ++$j)        # pipeline gets nothing, result is array of 0

$a = @(2,4,6)           # result is array of 3
@($a)                   # result is the same array of 3
@(@($a))                # result is the same array of 3
```

7.1.8 Script block expression

Syntax:

Syntax

```
script-block-expression:
    { new-lines~opt~ script-block new-lines~opt~ }
```

```
script-block:
    param-block~opt~ statement-terminators~opt~ script-block-body~opt~

script-block-body:
    named-block-list
    statement-list
```

Description:

param-block is described in §8.10.9. *named-block-list* is described in §8.10.7.

A script block is an unnamed block of statements that can be used as a single unit. Script blocks can be used to invoke a block of code as if it was a single command, or they can be assigned to variables that can be executed.

The *named-block-list* or *statement-list* is executed and the type and value(s) of the result are the type and value(s) of the results of those statement sets.

A *script-block-expression* has type scriptblock (§4.3.7).

If *param-block* is omitted, any arguments passed to the script block are available via `$args` (§8.10.1).

During parameter binding, a script block can be passed either as a script block object or as the result after the script block has been evaluated. See §6.17 for further information.

7.1.9 Hash literal expression

Syntax:

Syntax

```
hash-literal-expression:
    @{ new-lines~opt~ hash-literal-body~opt~ new-lines~opt~ }

hash-literal-body:
    hash-entry
    hash-literal-body statement-terminators hash-entry

hash-entry:
    key-expression = new-lines~opt~ statement

key-expression:
    simple-name
    unary-expression

statement-terminators:
    statement-terminator
    statement-terminators statement-terminator
```

```
statement-terminator:
    ;
    new-line-character
```

Description:

A *hash-literal-expression* is used to create a Hashtable (§10) of zero or more elements each of which is a key/value pair.

The key may have any type except the null type. The associated values may have any type, including the null type, and each of those values may be any expression that designates the desired value, including `$null`.

The ordering of the key/value pairs is not significant.

Examples:

PowerShell

```
$h1 = @{ FirstName = "James"; LastName = "Anderson"; IDNum = 123 }
$last = "Anderson"; $IDNum = 120
$h2 = @{ FirstName = "James"; LastName = $last; IDNum = $IDNum + 3 }
$h3 = @{ }
$h4 = @{ 10 = "James"; 20.5 = "Anderson"; $true = 123 }
```

which creates two Hashtables, `$h1` and `$h2`, each containing three key/value pairs, and a third, `$h3`, that is empty. Hashtable `$h4` has keys of various types.

7.1.10 Type literal expression

Syntax:

Syntax

```
type-literal:
    [ type-spec ]

type-spec:
    array-type-name new-lines~opt~ dimension~opt~ ]
    generic-type-name new-lines~opt~ generic-type-arguments ]
    type-name

dimension:
    ,
    dimension ,

generic-type-arguments:
```

```
    type-spec new-lines~opt~
    generic-type-arguments , new-lines~opt~ type-spec

array-type-name:
    type-name [

generic-type-name:
    type-name [
```

Description:

A *type-literal* is represented in an implementation by some unspecified *underlying type*. As a result, a type name is a synonym for its underlying type.

Type literals are used in a number of contexts:

- Specifying an explicit conversion (§6, §7.2.9)
- Creating a type-constrained array (§9.4)
- Accessing the static members of an object (§7.1.2)
- Specifying a type constraint on a variable (§5.3) or a function parameter (§8.10.2)

Examples:

Examples of type literals are `[int]`, `[object[]`, and `[int[,,]]`. A generic stack type (§4.4) that is specialized to hold strings might be written as `[Stack[string]]`, and a generic dictionary type that is specialized to hold `int` keys with associated string values might be written as `[Dictionary[int,string]]`.

The type of a *type-literal* is `System.Type`. The complete name for the type `Stack[string]` suggested above is `System.Collections.Generic.Stack[int]`. The complete name for the type `Dictionary[int,string]` suggested above is `System.Collections.Generic.Dictionary[int,string]`.

7.2 Unary operators

Syntax:

Syntax

```
unary-expression:
    primary-expression
    expression-with-unary-operator

expression-with-unary-operator:
    , new-lines~opt~ unary-expression
    -not new-lines~opt~ unary-expression
```

```
    ! new-lines~opt~ unary-expression
    -bnot new-lines~opt~ unary-expression
    + new-lines~opt~ unary-expression
    dash new-lines~opt~ unary-expression
    pre-increment-expression
    pre-decrement-expression
    cast-expression
    -split new-lines~opt~ unary-expression
    -join new-lines~opt~ unary-expression

dash:*
    - (U+002D)
    EnDash character (U+2013)
    EmDash character (U+2014)
    Horizontal bar character (U+2015)

pre-increment-expression:
    ++ new-lines~opt~ unary-expression

pre-decrement-expression:
    dashdash new-lines~opt~ unary-expression

cast-expression:
    type-literal unary-expression

dashdash:
    dash dash
```

7.2.1 Unary comma operator

Description:

This operator creates an unconstrained 1-dimensional array having one element, whose type and value are that of *unary-expression*.

This operator is right associative.

Examples:

PowerShell

```
$a = ,10         # create an unconstrained array of 1 element, $a[0],
                 # which has type int

$a = ,(10,"red") # create an unconstrained array of 1 element,
$a[0],
                 # which is an unconstrained array of 2 elements,
                 # $a[0][0] an int, and $a[0][1] a string

$a = ,,10        # create an unconstrained array of 1 element, which is
```

```
                # an unconstrained array of 1 element, which is an int
                # $a[0][0] is the int. Contrast this with @(@(10))
```

7.2.2 Logical NOT

Description:

The operator -not converts the value designated by *unary-expression* to type bool (§6.2), if necessary, and produces a result of that type. If *unary-expression*'s value is True, the result is False, and vice versa. The operator ! is an alternate spelling for -not.

This operator is right associative.

Examples:

PowerShell

```
-not $true          # False
-not -not $false    # False
-not 0              # True
-not 1.23           # False
!"xyz"              # False
```

7.2.3 Bitwise NOT

Description:

The operator -bnot converts the value designated by *unary-expression* to an integer type (§6.4), if necessary. If the converted value can be represented in type int then that is the result type. Else, if the converted value can be represented in type long then that is the result type. Otherwise, the expression is ill formed. The resulting value is the ones-complement of the converted value.

This operator is right associative.

Examples:

PowerShell

```
-bnot $true         # int with value 0xFFFFFFFE
-bnot 10            # int with value 0xFFFFFFF5
-bnot 2147483648.1  # long with value 0xFFFFFFFF7FFFFFFF
-bnot $null         # int with value 0xFFFFFFFF
-bnot "0xabc"       # int with value 0xFFFFF543
```

7.2.4 Unary plus

Description:

An expression of the form *+unary-expression* is treated as if it were written as `0 + unary-expression` (§7.7). The integer literal 0 has type `int`.

This operator is right associative.

Examples:

```
PowerShell

+123L          # type long, value 123
+0.12340D      # type decimal, value 0.12340
+"0xabc"       # type int, value 2748
```

7.2.5 Unary minus

Description:

An expression of the form *-unary-expression* is treated as if it were written as `0 - unary-expression` (§7.7). The integer literal 0 has type `int`.

This operator is right associative.

Examples:

-$true # type int, value -1 -123L # type long, value -123 -0.12340D # type decimal, value -0.12340

7.2.6 Prefix increment and decrement operators

Description:

The *unary-expression* must designate a writable location having a value of numeric type (§4) or the value `$null`. If the value designated by its *unary-expression* is `$null`, *unary-expression*'s value is converted to type int and value zero before the operator is evaluated.

> ⓘ **Note**
>
> The type of the value designated by *unary-expression* may change when the result is stored. See §7.11 for a discussion of type change via assignment.

For the prefix `++` operator, the value of *unary-expression* is incremented by 1 of the appropriate type. The result is the new value after incrementing has taken place. The expression `++E` is equivalent to `E += 1` (§7.11.2).

For the prefix `--` operator, the value of *unary-expression* is decremented by 1 of the appropriate type. The result is the new value after decrementing has taken place. The expression `--E` is equivalent to `E -= 1` (§7.11.2).

These operators are right associative.

Examples:

PowerShell

```
$i = 0                  # $i = 0
$++i                    # $i is incremented by 1
$j = --$i               # $i is decremented then $j takes on the value of $i

$a = 1,2,3
$b = 9,8,7
$i = 0;
$j = 1
$b[--$j] = $a[++$i]     # $j is # decremented, $i incremented, then $b[0]
                        # takes on the value of $a[1]

$i = 2147483647         # $i holds a value of type int
++$i                    # $i now holds a value of type double because
                        # 2147483648 is too big to fit in type int

[int]$k = 0             # $k is constrained to int
$k = [int]::MinValue    # $k is set to -2147483648
$--k                    # -2147483649 is too small to fit, imp-def behavior

$x = $null              # target is unconstrained, $null goes to [int]0
$--x                    # value treated as int, 0->-1
```

7.2.7 The unary -join operator

Description:

The unary `-join` operator produces a string that is the concatenation of the value of one or more objects designated by *unary-expression*. (A separator can be inserted by using the binary version of this operator (§7.8.4.4).)

unary-expression can be a scalar value or a collection.

Examples:

```PowerShell
-join (10, 20, 30)             # result is "102030"
-join (123, $false, 19.34e17)  # result is "123False1.934E+18"
-join 12345                    # result is "12345"
-join $null                    # result is ""
```

7.2.8 The unary -split operator

Description:

The unary `-split` operator splits one or more strings designated by *unary-expression*, returning their subparts in a constrained 1-dimensional array of string. It treats any contiguous group of white space characters as the delimiter between successive subparts. (An explicit delimiter string can be specified by using the binary version of this operator (§7.8.4.5).) This operator has two variants (§7.8).

The delimiter text is not included in the resulting strings. Leading and trailing white space in the input string is ignored. An input string that is empty or contains white space only results in an array of 1 string, which is empty.

unary-expression can designate a scalar value or an array of strings.

Examples:

```PowerShell
-split " red\`tblue\`ngreen " # 3 strings: "red", "blue", "green"
-split ("yes no", "up down") # 4 strings: "yes", "no", "up", "down"
-split " " # 1 (empty) string
```

7.2.9 Cast operator

Description:

This operator converts explicitly (§6) the value designated by *unary-expression* to the type designated by *type-literal*. If *type-literal* is other than void, the type of the result is the named type, and the value is the value after conversion. If *type-literal* is void, no object is written to the pipeline and there is no result.

When an expression of any type is cast to that same type, the resulting type and value is the *unary-expression*'s type and value.

This operator is right associative.

Examples:

PowerShell

```
[bool]-10        # a bool with value True
[int]-10.70D     # a decimal with value -10
[int]10.7        # an int with value 11
[long]"+2.3e+3"  # a long with value 2300
[char[]]"Hello"  # an array of 5 char with values H, e, l, l, and o.
```

7.3 Binary comma operator

Syntax:

Syntax

```
array-literal-expression:
    unary-expression
    unary-expression , new-lines~opt~ array-literal-expression
```

Description:

The binary comma operator creates a 1-dimensional array whose elements are the values designated by its operands, in lexical order. The array has unconstrained type.

Examples:

PowerShell

```
2,4,6                   # Length 3; values 2,4,6
(2,4),6                 # Length 2; values [object[]],int
(2,4,6),12,(2..4)       # Length 3; [object[]],int,[object[]]
2,4,6,"red",$null,$true  # Length 6
```

The addition of grouping parentheses to certain binary comma expressions does not document the default precedence; instead, it changes the result.

7.4 Range operator

Syntax:

Syntax

```
range-expression:
array-literal-expression
range-expression *..* new-lines~opt~
array-literal-expression
```

Description:

A *range-expression* creates an unconstrained 1-dimensional array whose elements are the values of the int sequence specified by the range bounds. The values designated by the operands are converted to int, if necessary (§6.4). The operand designating the lower value after conversion is the *lower bound*, while the operand designating the higher value after conversion is the *upper bound*. Both bounds may be the same, in which case, the resulting array has length 1. If the left operand designates the lower bound, the sequence is in ascending order. If the left operand designates the upper bound, the sequence is in descending order.

Conceptually, this operator is a shortcut for the corresponding binary comma operator sequence. For example, the range `5..8` can also be generated using `5,6,7,8`. However, if an ascending or descending sequence is needed without having an array, an implementation may avoid generating an actual array. For example, in `foreach ($i in 1..5) { ... }`, no array need be created.

A *range-expression* can be used to specify an array slice (§9.9).

Examples:

PowerShell

```
1..10        # ascending range 1..10
-500..-495   # descending range -500..-495
16..16       # sequence of 1

$x = 1.5
$x..5.40D    # ascending range 2..5

$true..3     # ascending range 1..3
-2..$null    # ascending range -2..0
"0xf".."0xa" # descending range 15..10
```

7.5 Format operator

Syntax:

Syntax

```
format-expression:
    range-expression
    format-expression format-operator new-lines~opt~ range-expression

format-operator:
    dash f

dash:
    - (U+002D)
    EnDash character (U+2013)
    EmDash character (U+2014)
    Horizontal bar character (U+2015)
```

Description:

A format-expression formats one or more values designated by *range-expression* according to a *format specification string* designated by *format-expression*. The positions of the values designated by *range-expression* are numbered starting at zero and increasing in lexical order. The result has type `string`.

A format specification string may contain zero or more format specifications each having the following form:

`{N [ ,M ][ : FormatString ]}`

N represents a (required) *range-expression* value position, *M* represents the (optional) minimum display width, and *FormatString* indicates the (optional) format. If the width of a formatted value exceeds the specified width, the width is increased accordingly. Values whose positions are not referenced in *FormatString* are ignored after being evaluated for any side effects. If *N* refers to a non-existent position, the behavior is implementation defined. Value of type `$null` and void are formatted as empty strings. Arrays are formatted as for *sub-expression* (§7.1.6). To include the characters "{" and "}" in a format specification without their being interpreted as format delimiters, write them as "{{" and "}}", respectively.

For a complete definition of format specifications, see the type `System.IFormattable` in Ecma Technical Report TR/84.

Examples:

PowerShell

```
`$i` = 10; $j = 12
"{2} <= {0} + {1}\`n" -f $i,$j,($i+$j)  # 22 <= 10 + 12
">{0,3}<" -f 5                          # > 5<
">{0,-3}<" -f 5                         # >5 <
">{0,3:000}<" -f 5                      # >005<
```

```
">{0,5:0.00}<" -f 5.0                    # > 5.00<
">{0:C}<" -f 1234567.888                 # >$1,234,567.89<
">{0:C}<" -f -1234.56                    # >($1,234.56)<
">{0,12:e2}<" -f 123.456e2               # > 1.23e+004<
">{0,-12:p}<" -f -0.252                  # >-25.20 % <
$format = ">{0:x8}<"
$format -f 123455                        # >0001e23f<
```

In a format specification if *N* refers to a non-existent position, a **FormatError** is raised.

7.6 Multiplicative operators

Syntax:

Syntax

```
multiplicative-expression:
    format-expression
    multiplicative-expression * new-lines~opt~ format-expression
    multiplicative-expression / new-lines~opt~ format-expression
    multiplicative-expression % new-lines~opt~ format-expression
```

7.6.1 Multiplication

Description:

The result of the multiplication operator `*` is the product of the values designated by the two operands after the usual arithmetic conversions (§6.15) have been applied.

This operator is left associative.

Examples:

PowerShell

```
12 * -10L      # long result -120
-10.300D * 12  # decimal result -123.600
10.6 * 12      # double result 127.2
12 * "0xabc"   # int result 32976
```

7.6.2 String replication

Description:

When the left operand designates a string the binary `*` operator creates a new string that contains the one designated by the left operand replicated the number of times designated by the value of the right operand as converted to integer type (§6.4).

This operator is left associative.

Examples:

```
PowerShell

"red" * "3"       # string replicated 3 times
"red" * 4         # string replicated 4 times
"red" * 0         # results in an empty string
"red" * 2.3450D   # string replicated twice
"red" * 2.7       # string replicated 3 times
```

7.6.3 Array replication

Description:

When the left operand designates an array the binary `*` operator creates a new unconstrained 1-dimensional array that contains the value designated by the left operand replicated the number of times designated by the value of the right operand as converted to integer type (§6.4). A replication count of zero results in an array of length 1. If the left operand designates a multidimensional array, it is flattened (§9.12) before being used.

This operator is left associative.

Examples:

```
PowerShell

$a = [int[]](10,20)              # [int[]], Length 2*1
$a * "3"                         # [object[]], Length 2*3
$a * 4                           # [object[]], Length 2*4
$a * 0                           # [object[]], Length 2*0
$a * 2.3450D                     # [object[]], Length 2*2
$a * 2.7                         # [object[]], Length 2*3
(New-Object 'float[,]' 2,3) * 2  # [object[]], Length 2*2
```

7.6.4 Division

Description:

The result of the division operator `/` is the quotient when the value designated by the left operand is divided by the value designated by the right operand after the usual arithmetic conversions (§6.15) have been applied.

If an attempt is made to perform integer or decimal division by zero, an implementation-defined terminating error is raised.

This operator is left associative.

Examples:

```PowerShell
10/-10      # int result -1
12/-10      # double result -1.2
12/-10D     # decimal result 1.2
12/10.6     # double result 1.13207547169811
12/"0xabc"  # double result 0.00436681222707424
```

If an attempt is made to perform integer or decimal division by zero, a **RuntimeException** exception is raised.

7.6.5 Remainder

Description:

The result of the remainder operator `%` is the remainder when the value designated by the left operand is divided by the value designated by the right operand after the usual arithmetic conversions (§6.15) have been applied.

If an attempt is made to perform integer or decimal division by zero, an implementation-defined terminating error is raised.

Examples:

```PowerShell
10 % 3          # int result 1
10.0 % 0.3      # double result 0.1
10.00D % "0x4"  # decimal result 2.00
```

If an attempt is made to perform integer or decimal division by zero, a **RuntimeException** exception is raised.

7.7 Additive operators

Syntax:

Syntax

```
additive-expression:
    multiplicative-expression
    additive-expression + new-lines~opt~ multiplicative-expression
    additive-expression dash new-lines~opt~ multiplicative-expression
```

7.7.1 Addition

Description:

The result of the addition operator `+` is the sum of the values designated by the two operands after the usual arithmetic conversions (§6.15) have been applied.

This operator is left associative.

Examples:

PowerShell

```
12 + -10L        # long result 2
-10.300D + 12    # decimal result 1.700
10.6 + 12        # double result 22.6
12 + "0xabc"     # int result 2760
```

7.7.2 String concatentaion

Description:

When the left operand designates a string the binary `+` operator creates a new string that contains the value designated by the left operand followed immediately by the value(s) designated by the right operand as converted to type string (§6.8).

This operator is left associative.

Examples:

PowerShell

```
"red" + "blue"       # "redblue"
"red" + "123"        # "red123"
```

```
"red" + 123          # "red123"
"red" + 123.456e+5   # "red12345600"
"red" + (20,30,40)   # "red20 30 40"
```

7.7.3 Array concatenation

Description:

When the left operand designates an array the binary `+` operator creates a new unconstrained 1-dimensional array that contains the elements designated by the left operand followed immediately by the value(s) designated by the right operand. Multidimensional arrays present in either operand are flattened (§9.12) before being used.

This operator is left associative.

Examples:

PowerShell

```
$a = [int[]](10,20)               # [int[]], Length 2
$a + "red"                        # [object[]], Length 3
$a + 12.5,$true                   # [object[]], Length 4
$a + (New-Object 'float[,]' 2,3)  # [object[]], Length 8
(New-Object 'float[,]' 2,3) + $a  # [object[]], Length 8
```

7.7.4 Hashtable concatenation

Description:

When both operands designate Hashtables the binary `+` operator creates a new Hashtable that contains the elements designated by the left operand followed immediately by the elements designated by the right operand.

If the Hashtables contain the same key, an implementation-defined terminating error is raised.

This operator is left associative.

Examples:

PowerShell

```
$h1 = @{ FirstName = "James"; LastName = "Anderson" }
$h2 = @{ Dept = "Personnel" }
```

```
$h3 = $h1 + $h2      # new Hashtable, Count = 3
```

If the Hashtables contain the same key, an exception of type **BadOperatorArgument** is raised.

7.7.5 Subtraction

Description:

The result of the subtraction operator `-` is the difference when the value designated by the right operand is subtracted from the value designated by the left operand after the usual arithmetic conversions (§6.15) have been applied.

This operator is left associative.

Examples:

PowerShell

```
12 - -10L      # long result 2c
-10.300D - 12  # decimal result -22.300
10.6 - 12      # double result -1.4
12 - "0xabc"   # int result -2736
```

7.8 Comparison operators

Syntax:

Syntax

```
comparison-operator: one of
    dash as           dash ccontains     dash ceq
    dash cge          dash cgt           dash cle
    dash clike        dash clt           dash cmatch
    dash cne          dash cnotcontains  dash cnotlike
    dash cnotmatch    dash contains      dash creplace
    dash csplit       dash eq            dash ge
    dash gt           dash icontains     dash ieq
    dash ige          dash igt           dash ile
    dash ilike        dash ilt           dash imatch
    dash in           dash ine           dash inotcontains
    dash inotlike     dash inotmatch     dash ireplace
    dash is           dash isnot         dash isplit
    dash join         dash le            dash like
    dash lt           dash match         dash ne
    dash notcontains  dash notin         dash notlike
    dash notmatch     dash replace       dash shl
```

```
    dash shr          dash split

dash:
    - (U+002D)
    EnDash character (U+2013)
    EmDash character (U+2014)
    Horizontal bar character (U+2015)
```

Description:

The type of the value designated by the left operand determines how the value designated by the right operand is converted (§6), if necessary, before the comparison is done.

Some *comparison-operator*s (written here as *-op*) have two variants, one that is case sensitive (*-cop*), and one that is not (*-iop*). The *-op* version is equivalent to *-iop*. Case sensitivity is meaningful only with comparisons of values of type string. In non-string comparison contexts, the two variants behave the same.

These operators are left associative.

7.8.1 Equality and relational operators

Description:

There are two *equality operators*: equality (`-eq`) and inequality (`-ne`); and four *relational operators*: less-than (`-lt`), less-than-or-equal-to (`-le`), greater-than (`-gt`), and greater-than-or-equal-to (`-ge`). Each of these has two variants (§7.8).

For two strings to compare equal, they must have the same length and contents, and letter case, if appropriate.

If the value designated by the left operand is not a collection, the result has type `bool`. Otherwise, the result is a possibly empty unconstrained 1-dimensional array containing the elements of the collection that test True when compared to the value designated by the right operand.

Examples:

PowerShell

```
10 -eq "010"           # True, int comparison
"010" -eq 10           # False, string comparison
"RED" -eq "Red"        # True, case-insensitive comparison
"RED" -ceq "Red"       # False, case-sensitive comparison
"ab" -lt "abc"         # True
```

```
10,20,30,20,10 -ne 20  # 10,30,10, Length 3
10,20,30,20,10 -eq 40  # Length 0
10,20,30,20,10 -ne 40  # 10,20,30,20,10, Length 5
10,20,30,20,10 -gt 25  # 30, Length 1
0,1,30 -ne $true       # 0,30, Length 2
0,"00" -eq "0"         # 0 (int), Length 1
```

7.8.2 Containment operators

Description:

There are four *containment operators*: contains (`-contains`), does-not-contain (`-notcontains`), in (`-in`) and not-in (`-notin`). Each of these has two variants (§7.8).

The containment operators return a result of type bool that indicates whether a value occurs (or does not occur) at least once in the elements of an array. With `-contains` and `-notcontains`, the value is designated by the right operand and the array is designated by the left operand. With -in and `-notin`, the operands are reversed. The value is designated by the left operand and the array is designated by the right operand.

For the purposes of these operators, if the array operand has a scalar value, the scalar value is treated as an array of one element.

Examples:

PowerShell

```
10,20,30,20,10 -contains 20     # True
10,20,30,20,10 -contains 42.9   # False
10,20,30 -contains "10"         # True
"010",20,30 -contains 10        # False
10,20,30,20,10 -notcontains 15  # True
"Red",20,30 -ccontains "RED"    # False
```

7.8.3 Type testing and conversion operators

Description:

The type operator `-is` tests whether the value designated by the left operand has the type, or is derived from a type that has the type, designated by the right operand. The right operand must designate a type or a value that can be converted to a type (such as a string that names a type). The type of the result is `bool`. The type operator `-isnot` returns the logical negation of the corresponding `-is` form.

The type operator `-as` attempts to convert the value designated by the left operand to the type designated by the right operand. The right operand must designate a type or a value that can be converted to a type (such as a string that names a type). If the conversion fails, `$null` is returned; otherwise, the converted value is returned and the return type of that result is the runtime type of the converted value.

Examples:

PowerShell

```
$a = 10            # value 10 has type int
$a -is [int]       # True

$t = [int]
$a -isnot $t       # False
$a -is "int"       # True
$a -isnot [double] # True

$x = [int[]](10,20)
$x -is [int[]]     # True

$a = "abcd"        # string is derived from object
$a -is [object]    # True

$x = [double]
foreach ($t in [int],$x,[decimal],"string") {
    $b = (10.60D -as $t) * 2  # results in int 22, double 21.2
}                             # decimal 21.20, and string "10.6010.60"
```

7.8.4 Pattern matching and text manipulation operators

7.8.4.1 The -like and -notlike operators

Description:

If the left operand does not designate a collection, the result has type `bool`. Otherwise, the result is a possibly empty unconstrained 1-dimensional array containing the elements of the collection that test True when compared to the value designated by the right operand. The right operand may designate a string that contains wildcard expressions (§3.15). These operators have two variants (§7.8).

Examples:

PowerShell

```
"Hello" -like "h*"                    # True, starts with h
"Hello" -clike "h*"                   # False, does not start with lowercase
h
"Hello" -like "*l*"                   # True, has an l in it somewhere
"Hello" -like "??l"                   # False, no length match

"-abc" -like "[-xz]*"                 # True, - is not a range separator
"#$%\^&" -notlike "*[A-Za-z]"         # True, does not end with alphabetic
character
"He" -like "h[aeiou]?*"               # False, need at least 3 characters
"When" -like "*[?]"                   # False, ? is not a wildcard character
"When?" -like "*[?]"                  # True, ? is not a wildcard character

"abc","abbcde","abcgh" -like "abc*"   # object[2], values
"abc" and "abcgh"
```

7.8.4.2 The -match and -notmatch operators

Description:

If the left operand does not designate a collection, the result has type `bool` and if that result is `$true`, the elements of the Hashtable `$matches` are set to the strings that match (or do-not-match) the value designated by the right operand. Otherwise, the result is a possibly empty unconstrained 1-dimensional array containing the elements of the collection that test True when compared to the value designated by the right operand, and `$matches` is not set. The right operand may designate a string that contains regular expressions (§3.16), in which case, it is referred to as a *pattern*. These operators have two variants (§7.8).

These operators support submatches (§7.8.4.6).

Examples:

PowerShell

```
"Hello" -match ".l"                   # True, $matches key/value is 0/"el"
"Hello" -match '\^h.*o$'              # True, $matches key/value is
0/"Hello"
"Hello" -cmatch '\^h.*o$'             # False, $matches not set
"abc\^ef" -match ".\\\^e"             # True, $matches key/value is
0/"c\^e"

"abc" -notmatch "[A-Za-z]"            # False
"abc" -match "[\^A-Za-z]"             # False
"He" -match "h[aeiou]."               # False, need at least 3 characters
"abc","abbcde","abcgh" -match "abc.*" # Length is 2, values "abc", "abcgh"
```

7.8.4.3 The -replace operator

Description:

The `-replace` operator allows text replacement in one or more strings designated by the left operand using the values designated by the right operand. This operator has two variants (§7.8). The right operand has one of the following forms:

- The string to be located, which may contain regular expressions (§3.16). In this case, the replacement string is implicitly "".
- An array of 2 objects containing the string to be located, followed by the replacement string.

If the left operand designates a string, the result has type string. If the left operand designates a 1-dimensional array of string, the result is an unconstrained 1-dimensional array, whose length is the same as for left operand's array, containing the input strings after replacement has completed.

This operator supports submatches (§7.8.4.6).

Examples:

PowerShell

```
"Analogous","an apple" -replace "a","*"      # "*n*logous","*n *pple"
"Analogous" -creplace "[aeiou]","?"          # "An?l?g??s"
"Analogous","an apple" -replace '\^a',"%%A"  # "%%Analogous","%%An apple"
"Analogous" -replace "[aeiou]",'$&$&'        # "AAnaaloogoouus"
```

7.8.4.4 The binary -join operator

Description:

The binary `-join` operator produces a string that is the concatenation of the value of one or more objects designated by the left operand after having been converted to string (§6.7), if necessary. The string designated by the right operand is used to separate the (possibly empty) values in the resulting string.

The left operand can be a scalar value or a collection.

Examples:

PowerShell

```
(10, 20, 30) -join "\|"    # result is "10\|20\|30"
12345 -join ","            # result is "12345", no separator needed
($null,$null) -join "<->"  # result is "<->", two zero-length values
```

7.8.4.5 The binary -split operator

Description:

The binary `-split` operator splits one or more strings designated by the left operand, returning their subparts in a constrained 1-dimensional array of string. This operator has two variants (§7.8). The left operand can designate a scalar value or an array of strings. The right operand has one of the following forms:

- A *delimiter string*
- An array of 2 objects containing a delimiter string followed by a numeric *split count*
- An array of 3 objects containing a delimiter string, a numeric split count, and an *options string*
- A script block
- An array of 2 objects containing a script block followed by a numeric split count

The delimiter string may contain regular expressions (§3.16). It is used to locate subparts with the input strings. The delimiter is not included in the resulting strings. If the left operand designates an empty string, that results in an empty string element. If the delimiter string is an empty string, it is found at every character position in the input strings.

By default, all subparts of the input strings are placed into the result as separate elements; however, the split count can be used to modify this behavior. If that count is negative, zero, or greater than or equal to the number of subparts in an input string, each subpart goes into a separate element. If that count is less than the number of subparts in the input string, there are count elements in the result, with the final element containing all of the subparts beyond the first **count - 1** subparts.

An options string contains zero or more *option names* with each adjacent pair separated by a comma. Leading, trailing, and embedded white space is ignored. Option names may be in any order and are case-sensitive.

If an options string contains the option name **SimpleMatch**, it may also contain the option name **IgnoreCase**. If an options string contains the option name **RegexMatch** or it does not contain either **RegexMatch** or **SimpleMatch**, it may contain any option name except **SimpleMatch**. However, it must not contain both **Multiline** and **Singleline**.

Here is the set of option names:

Option	Description
CultureInvariant	Ignores cultural differences in language when evaluating the delimiter.
ExplicitCapture	Ignores non-named match groups so that only explicit capture groups are returned in the result list.
IgnoreCase	Force case-insensitive matching, even if `-csplit` is used.
IgnorePatternWhitespace	Ignores unescaped white space and comments marked with the number sign (#).
Multiline	This mode recognizes the start and end of lines and strings. The default mode is **Singleline**.
RegexMatch	Use regular expression matching to evaluate the delimiter. This is the default.
SimpleMatch	Use simple string comparison when evaluating the delimiter.
Singleline	This mode recognizes only the start and end of strings. It is the default mode.

The script block (§7.1.8) specifies the rules for determining the delimiter, and must evaluate to type bool.

Examples:

PowerShell

```
"one,forty two,," -split ","              # 5 strings: "one" "forty two" ""
""

"abc","de" -split ""                      # 9 strings: "" "a" "b" "c" "" ""
"d" "e" ""

"ab,cd","1,5,7,8" -split ",", 2           # 4 strings: "ab" "cd" "1" "5,7,8"

"10X20x30" -csplit "X", 0, "SimpleMatch"  # 2 strings: "10" "20x30"

"analogous" -split "[AEIOU]", 0, "RegexMatch, IgnoreCase"
                                          # 6 strings: "" "n" "l" "g" "" "s"

"analogous" -split { $_ -eq "a" -or $_ -eq "o" }, 4
                                          # 4 strings: "" "n" "l" "gous"
```

7.8.4.6 Submatches

The pattern being matched by `-match`, `-notmatch`, and `-replace` may contain subparts (called *submatches*) delimited by parentheses. Consider the following example:

```
"red" -match "red"
```

The result is `$true` and key 0 of `$matches` contains "red", that part of the string designated by the left operand that exactly matched the pattern designated by the right operand.

In the following example, the whole pattern is a submatch:

```
"red" -match "(red)"
```

As before, key 0 contains "red"; however, key 1 also contains "red", which is that part of the string designated by the left operand that exactly matched the submatch.

Consider the following, more complex, pattern:

```
"red" -match "((r)e)(d)"
```

This pattern allows submatches of "r", "re", "d", or "red".

Again, key 0 contains "red". Key 1 contains "re", key 2 contains "r", and key 3 contains "d". The key/value pairs are in matching order from left-to-right in the pattern, with longer string matches preceding shorter ones.

In the case of `-replace`, the replacement text can access the submatches via names of the form `$n`, where the first match is `$1`, the second is `$3`, and so on. For example,

PowerShell

```
"Monday morning" -replace '(Monday|Tuesday)
(morning|afternoon|evening)','the $2 of $1'
```

The resulting string is "the morning of Monday".

Instead of having keys in `$matches` be zero-based indexes, submatches can be named using the form `?<*name*>`. For example, `"((r)e)(d)"` can be written with three named submatches, m1, m2, and m3, as follows: `"(?<m1>(?<m2>r)e)(?<m3>d)"`.

7.8.5 Shift operators

Description:

The shift left (`-shl`) operator and shift right (`-shr`) operator convert the value designed by the left operand to an integer type and the value designated by the right operand to int, if necessary, using the usual arithmetic conversions (§6.15).

The shift left operator shifts the left operand left by a number of bits computed as described below. The low-order empty bit positions are set to zero.

The shift right operator shifts the left operand right by a number of bits computed as described below. The low-order bits of the left operand are discarded, the remaining bits shifted right. When the left operand is a signed value, the high-order empty bit positions are set to zero if the left operand is non-negative and set to one if the left operand is negative. When the left operand is an unsigned value, the high-order empty bit positions are set to zero.

When the left operand has type int, the shift count is given by the low-order five bits of the right operand. When the right operand has type long, the shift count is given by the low-order six bits of the right operand.

Examples:

PowerShell

```
0x0408 -shl 1             # int with value 0x0810
0x0408 -shr 3             # int with value 0x0081
0x100000000 -shr 0xfff81  # long with value 0x80000000
```

7.9 Bitwise operators

Syntax:

Syntax

```
bitwise-expression:
    comparison-expression
    bitwise-expression -band new-lines~opt~ comparison-expression
    bitwise-expression -bor new-lines~opt~ comparison-expression
    bitwise-expression -bxor new-lines~opt~ comparison-expression
```

Description:

The bitwise AND operator `-band`, the bitwise OR operator `-bor`, and the bitwise XOR operator -bxor convert the values designated by their operands to integer types, if necessary, using the usual arithmetic conversions (§6.15). After conversion, if both values have type int that is the type of the result. Otherwise, if both values have type long, that

is the type of the result. If one value has type int and the other has type long, the type of the result is long. Otherwise, the expression is ill formed. The result is the bitwise AND, bitwise OR, or bitwise XOR, respectively, of the possibly converted operand values.

These operators are left associative. They are commutative if neither operand contains a side effect.

Examples:

PowerShell

```
0x0F0F -band 0xFE    # int with value 0xE
0x0F0F -band 0xFEL   # long with value 0xE
0x0F0F -band 14.6    # long with value 0xF

0x0F0F -bor 0xFE     # int with value 0xFFF
0x0F0F -bor 0xFEL    # long with value 0xFFF
0x0F0F -bor 14.40D   # long with value 0xF0F

0x0F0F -bxor 0xFE    # int with value 0xFF1
0x0F0F -bxor 0xFEL   # long with value 0xFF1
0x0F0F -bxor 14.40D  # long with value 0xF01
0x0F0F -bxor 14.6    # long with value 0xF00
```

7.10 Logical operators

Syntax:

Syntax

```
logical-expression:
    bitwise-expression
    logical-expression -and new-lines~opt~ bitwise-expression
    logical-expression -or new-lines~opt~ bitwise-expression
    logical-expression -xor new-lines~opt~ bitwise-expression
```

Description:

The logical AND operator `-and` converts the values designated by its operands to `bool`, if necessary (§6.2). The result is the logical AND of the possibly converted operand values, and has type `bool`. If the left operand evaluates to False the right operand is not evaluated.

The logical OR operator `-or` converts the values designated by its operands to `bool`, if necessary (§6.2). The result is the logical OR of the possibly converted operand values,

and has type `bool`. If the left operand evaluates to True the right operand is not evaluated.

The logical XOR operator `-xor` converts the values designated by its operands to `bool` (§6.2). The result is the logical XOR of the possibly converted operand values, and has type `bool`.

These operators are left associative.

Examples:

PowerShell

```
$j = 10
$k = 20
($j -gt 5) -and (++$k -lt 15)   # True -and False -> False
($j -gt 5) -and ($k -le 21)     # True -and True -> True
($j++ -gt 5) -and ($j -le 10)   # True -and False -> False
($j -eq 5) -and (++$k -gt 15)   # False -and True -> False

$j = 10
$k = 20
($j++ -gt 5) -or (++$k -lt 15)  # True -or False -> True
($j -eq 10) -or ($k -gt 15)     # False -or True -> True
($j -eq 10) -or (++$k -le 20)   # False -or False -> False

$j = 10
$k = 20
($j++ -gt 5) -xor (++$k -lt 15) # True -xor False -> True
($j -eq 10) -xor ($k -gt 15)    # False -xor True -> True
($j -gt 10) -xor (++$k -le 25)  # True -xor True -> False
```

7.11 Assignment operators

Syntax:

Syntax

```
assignment-expression:
    expression assignment-operator statement

assignment-operator: *one of
    =   dash =   +=   *=   /=   %=
```

Description:

An assignment operator stores a value in the writable location designated by *expression*. For a discussion of *assignment-operator* `=` see §7.11.1. For a discussion of all other *assignment-operator*s see §7.11.2.

An assignment expression has the value designated by *expression* after the assignment has taken place; however, that assignment expression does not itself designate a writable location. If *expression* is type-constrained (§5.3), the type used in that constraint is the type of the result; otherwise, the type of the result is the type after the usual arithmetic conversions (§6.15) have been applied.

This operator is right associative.

7.11.1 Simple assignment

Description:

In *simple assignment* (`=`), the value designated by *statement* replaces the value stored in the writable location designated by *expression*. However, if *expression* designates a non-existent key in a Hashtable, that key is added to the Hashtable with an associated value of the value designated by *statement*.

As shown by the grammar, *expression* may designate a comma-separated list of writable locations. This is known as *multiple assignment*. *statement* designates a list of one or more comma-separated values. The commas in either operand list are part of the multiple-assignment syntax and do *not* represent the binary comma operator. Values are taken from the list designated by *statement*, in lexical order, and stored in the corresponding writable location designated by *expression*. If the list designated by *statement* has fewer values than there are *expression* writable locations, the excess locations take on the value `$null`. If the list designated by *statement* has more values than there are *expression* writable locations, all but the right-most *expression* location take on the corresponding *statement* value and the right-most *expression* location becomes an unconstrained 1-dimensional array with all the remaining *statement* values as elements.

For statements that have values (§8.1.2), *statement* can be a statement.

Examples:

PowerShell

```
$a = 20; $b = $a + 12L              # $b has type long, value 22
$hypot = [Math]::Sqrt(3*3 + 4*4)    # type double, value 5
$a = $b = $c = 10.20D               # all have type decimal, value 10.20
$a = (10,20,30),(1,2)               # type [object[]], Length 2
```

```
[int]$x = 10.6                      # type int, value 11
[long]$x = "0xabc"                  # type long, value 0xabc
$a = [float]                        # value type literal [float]
$i,$j,$k = 10,"red",$true           # $i is 10, $j is "red", $k is True
$i,$j = 10,"red",$true              # $i is 10, $j is [object[]], Length 2
$i,$j = (10,"red"),$true            # $i is [object[]], Length 2, $j is True
$i,$j,$k = 10                       # $i is 10, $j is $null, $k is $null

$h = @{}
[int] $h.Lower, [int] $h.Upper = -split "10 100"

$h1 = @{ FirstName = "James"; LastName = "Anderson"; IDNum = 123 }
$h1.Dept = "Finance"                # adds element Finance
$h1["City"] = "New York"            # adds element City

[int]$Variable:v = 123.456          # v takes on the value 123
${E:output.txt} = "a"               # write text to the given file
$Env:MyPath = "x:\data\file.txt"    # define the environment variable
$Function:F = { param ($a, $b) "Hello there, $a, $b" }
F 10 "red"                          # define and invoke a function
function Demo { "Hi there from inside Demo" }
$Alias:A = "Demo"                   # create alias for function Demo
A                                   # invoke function Demo via the alias
```

7.11.2 Compound assignment

Description:

A *compound assignment* has the form `E1 op= E2`, and is equivalent to the simple assignment expression `E1 = E1 op (E2)` except that in the compound assignment case the expression *E1* is evaluated only once. If *expression* is type-constrained (§5.3), the type used in that constraint is the type of the result; otherwise, the type of the result is determined by *op*. For `*=`, see §7.6.1, §7.6.2, §7.6.3; for `/=`, see §7.6.4; for `%=`, see §7.6.5; for `+=`, see §7.7.1, §7.7.2, §7.7.3; for `-=`, see §7.7.5.

> ⓘ **Note**
>
> An operand designating an unconstrained value of numeric type may have its type changed by an assignment operator when the result is stored.

Examples:

PowerShell

```
$a = 1234; $a *= (3 + 2)  # type is int, value is 1234 * (3 + 2)
$b = 10,20,30             # $b[1] has type int, value 20
$b[1] /= 6                # $b[1] has type double, value 3.33...
```

```
$i = 0
$b = 10,20,30
$b[++$i] += 2             # side effect evaluated only once

[int]$Variable:v = 10     # v takes on the value 10
$Variable:v -= 3          # 3 is subtracted from v

${E:output.txt} = "a"     # write text to the given file
${E:output.txt} += "b"    # append text to the file giving ab
${E:output.txt} *= 4      # replicate ab 4 times giving abababab
```

7.12 Redirection operators

Syntax:

Syntax

```
pipeline:
    assignment-expression
    expression redirections~opt~ pipeline-tail~opt~
    command verbatim-command-argument~opt~ pipeline-tail~opt~

redirections:
    redirection
    redirections redirection

redirection:
    merging-redirection-operator
    file-redirection-operator redirected-file-name

redirected-file-name:
    command-argument
    primary-expression

file-redirection-operator: one of
    >   >>   2>   2>>   3>   3>>   4>   4>>
    5>  5>>  6>   6>>   >    >>    <

merging-redirection-operator: one of
    >&1   2>&1   3>&1   4>&1   5>&1   6>&1
    >&2   1>&2   3>&2   4>&2   5>&2   6>&2
```

Description:

The redirection operator `>` takes the standard output from the pipeline and redirects it to the location designated by *redirected-file-name*, overwriting that location's current contents.

The redirection operator `>>` takes the standard output from the pipeline and redirects it to the location designated by *redirected-file-name*, appending to that location's current contents, if any. If that location does not exist, it is created.

The redirection operator with the form `n>` takes the output of stream *n* from the pipeline and redirects it to the location designated by *redirected-file-name*, overwriting that location's current contents.

The redirection operator with the form `n>>` takes the output of stream *n* from the pipeline and redirects it to the location designated by *redirected-file-name*, appending to that location's current contents, if any. If that location does not exist, it is created.

The redirection operator with the form `m>&n` writes output from stream *m* to the same location as stream *n*.

The following are the valid streams:

Stream	Description
1	Standard output stream
2	Error output stream
3	Warning output stream
4	Verbose output stream
5	Debug output stream
*	Standard output, error output, warning output, verbose output, and debug output streams

The redirection operators `1>&2`, `6>`, `6>>` and `<` are reserved for future use.

If on output the value of *redirected-file-name* is `$null`, the output is discarded.

Ordinarily, the value of an expression containing a top-level side effect is not written to the pipeline unless that expression is enclosed in a pair of parentheses. However, if such an expression is the left operand of an operator that redirects standard output, the value is written.

Examples:

PowerShell

```
$i = 200                        # pipeline gets nothing
$i                              # pipeline gets result
```

```
$i > output1.txt               # result redirected to named file
++$i >> output1.txt            # result appended to named file
type file1.txt 2> error1.txt   # error output redirected to named file
type file2.txt 2>> error1.txt  # error output appended to named file
dir -Verbose 4> verbose1.txt   # verbose output redirected to named file

# Send all output to output2.txt
dir -Verbose -Debug -WarningAction Continue *> output2.txt

# error output redirected to named file, verbose output redirected
# to the same location as error output
dir -Verbose 4>&2 2> error2.txt
```

8. Statements

Article • 05/16/2022

8.1 Statement blocks and lists

Syntax:

> **Tip**
>
> The `~opt~` notation in the syntax definitions indicates that the lexical entity is optional in the syntax.

Syntax

```
statement-block:
    new-lines~opt~ { statement-list~opt~ new-lines~opt~ }

statement-list:
    statement
    statement-list statement

statement:
    if-statement
    label~opt~ labeled-statement
    function-statement
    flow-control-statement statement-terminator
    trap-statement
    try-statement
    data-statement
    inlinescript-statement
    parallel-statement
    sequence-statement
    pipeline statement-terminator

statement-terminator:
    ;
    new-line-character
```

Description:

A *statement* specifies some sort of action that is to be performed. Unless indicated otherwise within this clause, statements are executed in lexical order.

A *statement-block* allows a set of statements to be grouped into a single syntactic unit.

8.1.1 Labeled statements

Syntax:

Syntax

```
labeled-statement:
    switch-statement
    foreach-statement
    for-statement
    while-statement
    do-statement
```

Description:

An iteration statement (§8.4) or a switch statement (§8.6) may optionally be preceded immediately by one statement label, *label*. A statement label is used as the optional target of a break (§8.5.1) or continue (§8.5.2) statement. However, a label does not alter the flow of control.

White space is not permitted between the colon (`:`) and the token that follows it.

Examples:

PowerShell

```
:go_here while ($j -le 100) {
    # ...
}

:labelA
for ($i = 1; $i -le 5; ++$i) {
    :labelB
    for ($j = 1; $j -le 3; ++$j) {
        :labelC
        for ($k = 1; $k -le 2; ++$k) {
            # ...
        }
    }
}
```

8.1.2 Statement values

The value of a statement is the cumulative set of values that it writes to the pipeline. If the statement writes a single scalar value, that is the value of the statement. If the statement writes multiple values, the value of the statement is that set of values stored

in elements of an unconstrained 1-dimensional array, in the order in which they were written. Consider the following example:

```
$v = for ($i = 10; $i -le 5; ++$i) { }
```

There are no iterations of the loop and nothing is written to the pipeline. The value of the statement is `$null`.

```
$v = for ($i = 1; $i -le 5; ++$i) { }
```

Although the loop iterates five times nothing is written to the pipeline. The value of the statement is $null.

```
$v = for ($i = 1; $i -le 5; ++$i) { $i }
```

The loop iterates five times each time writing to the pipeline the `int` value `$i`. The value of the statement is `object[]` of Length 5.

```
$v = for ($i = 1; $i -le 5; ) { ++$i }
```

Although the loop iterates five times nothing is written to the pipeline. The value of the statement is `$null`.

```
$v = for ($i = 1; $i -le 5; ) { (++$i) }
```

The loop iterates five times with each value being written to the pipeline. The value of the statement is `object[]` of Length 5.

```
$i = 1; $v = while ($i++ -lt 2) { $i }
```

The loop iterates once. The value of the statement is the `int` with value 2.

Here are some other examples:

PowerShell

```powershell
# if $count is not currently defined then define it with int value 10
$count = if ($count -eq $null) { 10 } else { $count }

$i = 1
$v = while ($i -le 5) {
    $i                  # $i is written to the pipeline
    if ($i -band 1) {

        "odd"           # conditionally written to the pipeline

    }
```

```
    ++$i                # not written to the pipeline

}
# $v is object[], Length 8, value 1,"odd",2,3,"odd",4,5,"odd"
```

8.2 Pipeline statements

Syntax:

Syntax

```
pipeline:
    assignment-expression
    expression redirections~opt~ pipeline-tail~opt~
    command verbatim-command-argument~opt~ pipeline-tail~opt~

assignment-expression:
    expression assignment-operator statement

pipeline-tail:
    | new-lines~opt~ command
    | new-lines~opt~ command pipeline-tail

command:
    command-name command-elements~opt~
    command-invocation-operator command-module~opt~ command-name-expr
command-elements~opt~

command-invocation-operator: one of
    &   .

command-module:
    primary-expression

command-name:
    generic-token
    generic-token-with-subexpr

generic-token-with-subexpr:
    No whitespace is allowed between ) and command-name.
    generic-token-with-subexpr-start statement-list~opt~ )

command-namecommand-name-expr:
    command-name

primary-expressioncommand-elements:
    command-element
    command-elements command-element

command-element:
    command-parameter
    command-argument
```

```
    redirection

command-argument:
    command-name-expr

verbatim-command-argument:
    --% verbatim-command-argument-chars
```

Description:

redirections is discussed in §7.12; *assignment-expression* is discussed in §7.11; and the *command-invocation-operator* dot (`.`) is discussed in §3.5.5. For a discussion of argument-to-parameter mapping in command invocations, see §8.14.

The first command in a *pipeline* is an expression or a command invocation. Typically, a command invocation begins with a *command-name*, which is usually a bare identifier. *command-elements* represents the argument list to the command. A newline or n unescaped semicolon terminates a pipeline.

A command invocation consists of the command's name followed by zero or more arguments. The rules governing arguments are as follows:

- An argument that is not an expression, but which contains arbitrary text without unescaped white space, is treated as though it were double quoted. Letter case is preserved.
- Variable substitution and sub-expression expansion (§2.3.5.2) takes place inside *expandable-string-literal*s and *expandable-here-string-literal*s.
- Text inside quotes allows leading, trailing, and embedded white space to be included in the argument's value. [*Note*: The presence of whitespace in a quoted argument does not turn a single argument into multiple arguments. *end note*]
- Putting parentheses around an argument causes that expression to be evaluated with the result being passed instead of the text of the original expression.
- To pass an argument that looks like a switch parameter (§2.3.4) but is not intended as such, enclose that argument in quotes.
- When specifying an argument that matches a parameter having the `[switch]` type constraint (§8.10.5), the presence of the argument name on its own causes that parameter to be set to `$true`. However, the parameter's value can be set explicitly by appending a suffix to the argument. For example, given a type constrained parameter *p*, an argument of `-p:$true` sets p to True, while `-p:$false` sets p to False.

- An argument of `--` indicates that all arguments following it are to be passed in their actual form as though double quotes were placed around them.
- An argument of `--%` indicates that all arguments following it are to be passed with minimal parsing and processing. This argument is called the verbatim parameter. Arguments after the verbatim parameter are not PowerShell expressions even if they are syntactically valid PowerShell expressions.

If the command type is Application, the parameter `--%` is not passed to the command. The arguments after `--%` have any environment variables (strings surrounded by `%`) expanded. For example:

PowerShell

```
echoargs.exe --% "%path%" # %path% is replaced with the value $env:path
```

The order of evaluation of arguments is unspecified.

For information about parameter binding see §8.14. For information about name lookup see §3.8.

Once argument processing has been completed, the command is invoked. If the invoked command terminates normally (§8.5.4), control reverts to the point in the script or function immediately following the command invocation. For a description of the behavior on abnormal termination see `break` (§8.5.1), `continue` (§8.5.2), `throw` (§8.5.3), `exit` (§8.5.5), `try` (§8.7), and `trap` (§8.8).

Ordinarily, a command is invoked by using its name followed by any arguments. However, the command-invocation operator, &, can be used. If the command name contains unescaped white space, it must be quoted and invoked with this operator. As a script block has no name, it too must be invoked with this operator. For example, the following invocations of a command call `Get-Factorial` are equivalent:

PowerShell

```
Get-Factorial 5
& Get-Factorial 5
& "Get-Factorial" 5
```

Direct and indirect recursive function calls are permitted. For example,

PowerShell

```
function Get-Power([int]$x, [int]$y) {
    if ($y -gt 0) { return $x * (Get-Power $x (--$y)) }
    else { return 1 }
}
```

Examples:

PowerShell

```
New-Object 'int[,]' 3,2
New-Object -ArgumentList 3,2 -TypeName 'int[,]'

dir e:\PowerShell\Scripts\*statement*.ps1 | Foreach-Object {$_.Length}

dir e:\PowerShell\Scripts\*.ps1 | Select-String -List "catch" | Format-Table
path,linenumber -AutoSize
```

8.3 The if statement

Syntax:

Syntax

```
if-statement:
    if new-lines~opt~ ( new-lines~opt~ pipeline new-lines~opt~ ) statement-
block
        elseif-clauses~opt~ else-clause~opt~

elseif-clauses:
    elseif-clause
    elseif-clauses elseif-clause

elseif-clause:
    new-lines~opt~ elseif new-lines~opt~ ( new-lines~opt~ pipeline new-
lines~opt~ ) statement-block

else-clause:
    new-lines~opt~ else statement-block
```

Description:

The *pipeline* controlling expressions must have type bool or be implicitly convertible to that type. The *else-clause* is optional. There may be zero or more *elseif-clause*s.

If the top-level *pipeline* tests True, then its *statement-block* is executed and execution of the statement terminates. Otherwise, if an *elseif-clause* is present, if its *pipeline* tests

True, then its *statement-block* is executed and execution of the statement terminates. Otherwise, if an *else-clause* is present, its *statement-block* is executed.

Examples:

PowerShell

```
$grade = 92
if ($grade -ge 90) { "Grade A" }
elseif ($grade -ge 80) { "Grade B" }
elseif ($grade -ge 70) { "Grade C" }
elseif ($grade -ge 60) { "Grade D" }
else { "Grade F" }
```

8.4 Iteration statements

8.4.1 The while statement

Syntax:

Syntax

```
while-statement:
    while new-lines~opt~ ( new-lines~opt~ while-condition new-lines~opt~ )
statement-block

while-condition:
    new-lines~opt~ pipeline
```

Description:

The controlling expression *while-condition* must have type bool or be implicitly convertible to that type. The loop body, which consists of *statement-block*, is executed repeatedly until the controlling expression tests False. The controlling expression is evaluated before each execution of the loop body.

Examples:

PowerShell

```
$i = 1
while ($i -le 5) {                      # loop 5 times
    "{0,1}`t{1,2}" -f $i, ($i*$i)
    ++$i
}
```

8.4.2 The do statement

Syntax:

Syntax

```
do-statement:
    do statement-block new-lines~opt~ while new-lines~opt~ ( while-condition
new-lines~opt~ )
    do statement-block new-lines~opt~ until new-lines~opt~ ( while-condition
new-lines~opt~ )

while-condition:
    new-lines~opt~ pipeline
```

Description:

The controlling expression *while-condition* must have type bool or be implicitly convertible to that type. In the while form, the loop body, which consists of *statement-block*, is executed repeatedly while the controlling expression tests True. In the until form, the loop body is executed repeatedly until the controlling expression tests True. The controlling expression is evaluated after each execution of the loop body.

Examples:

PowerShell

```
$i = 1
do {
    "{0,1}`t{1,2}" -f $i, ($i * $i)
}
while (++$i -le 5)                # loop 5 times

$i = 1
do {
    "{0,1}`t{1,2}" -f $i, ($i * $i)
}
until (++$i -gt 5)                # loop 5 times
```

8.4.3 The for statement

Syntax:

Syntax

```
for-statement:
    for new-lines~opt~ (
```

```
        new-lines~opt~ for-initializer~opt~ statement-terminator
        new-lines~opt~ for-condition~opt~ statement-terminator
        new-lines~opt~ for-iterator~opt~
        new-lines~opt~ ) statement-block

    for new-lines~opt~ (
        new-lines~opt~ for-initializer~opt~ statement-terminator
        new-lines~opt~ for-condition~opt~
        new-lines~opt~ ) statement-block

    for new-lines~opt~ (
        new-lines~opt~ for-initializer~opt~
        new-lines~opt~ ) statement-block

for-initializer:
    pipeline

for-condition:
    pipeline

for-iterator:
    pipeline
```

Description:

The controlling expression *for-condition* must have type bool or be implicitly convertible to that type. The loop body, which consists of *statement-block*, is executed repeatedly while the controlling expression tests True. The controlling expression is evaluated before each execution of the loop body.

Expression *for-initializer* is evaluated before the first evaluation of the controlling expression. Expression *for-initializer* is evaluated for its side effects only; any value it produces is discarded and is not written to the pipeline.

Expression *for-iterator* is evaluated after each execution of the loop body. Expression *for-iterator* is evaluated for its side effects only; any value it produces is discarded and is not written to the pipeline.

If expression *for-condition* is omitted, the controlling expression tests True.

Examples:

PowerShell

```powershell
for ($i = 5; $i -ge 1; --$i) { # loop 5 times
    "{0,1}`t{1,2}" -f $i, ($i * $i)
}

$i = 5
for (; $i -ge 1; ) { # equivalent behavior
```

```
    "{0,1}`t{1,2}" -f $i, ($i * $i)
    --$i
}
```

8.4.4 The foreach statement

Syntax:

Syntax

```
foreach-statement:
    foreach new-lines~opt~ foreach-parameter~opt~ new-lines~opt~
        ( new-lines~opt~ variable new-lines~opt~ *in* new-lines~opt~
pipeline
        new-lines~opt~ ) statement-block

foreach-parameter:
    -parallel
```

Description:

The loop body, which consists of *statement-block*, is executed for each element designated by the variable *variable* in the collection designated by *pipeline*. The scope of *variable* is not limited to the foreach statement. As such, it retains its final value after the loop body has finished executing. If *pipeline* designates a scalar (excluding the value $null) instead of a collection, that scalar is treated as a collection of one element. If *pipeline* designates the value `$null`, *pipeline* is treated as a collection of zero elements.

If the *foreach-parameter* `-parallel` is specified, the behavior is implementation defined.

The *foreach-parameter* `-parallel` is only allowed in a workflow (§8.10.2).

Every foreach statement has its own enumerator, `$foreach` (§2.3.2.2, §4.5.16), which exists only while that loop is executing.

The objects produced by *pipeline* are collected before *statement-block* begins to execute. However, with the ForEach-Object cmdlet, *statement-block* is executed on each object as it is produced.

Examples:

PowerShell

```
$a = 10, 53, 16, -43
foreach ($e in $a) {
    ...
```

```
}
$e # the int value -43

foreach ($e in -5..5) {
    ...
}

foreach ($t in [byte], [int], [long]) {
    $t::MaxValue # get static property
}

foreach ($f in Get-ChildItem *.txt) {
    ...
}

$h1 = @{ FirstName = "James"; LastName = "Anderson"; IDNum = 123 }
foreach ($e in $h1.Keys) {
    "Key is " + $e + ", Value is " + $h1[$e]
}
```

8.5 Flow control statements

Syntax:

Syntax

```
flow-control-statement:
    break label-expression~opt~
    continue label-expression~opt~
    throw pipeline~opt~
    return pipeline~opt~
    exit pipeline~opt~

label-expression:
    simple-name
    unary-expression
```

Description:

A flow-control statement causes an unconditional transfer of control to some other location.

8.5.1 The break statement

Description:

A break statement with a *label-expression* is referred to as a *labeled break statement*. A break statement without a *label-expression* is referred to as an *unlabeled break*

statement.

Outside a trap statement, an unlabeled break statement directly within an iteration statement (§8.4) terminates execution of that smallest enclosing iteration statement. An unlabeled break statement directly within a switch statement (§8.6) terminates pattern matching for the current switch's *switch-condition*. See (§8.8) for details of using break from within a trap statement.

An iteration statement or a switch statement may optionally be preceded immediately by one statement label (§8.1.1).Such a statement label may be used as the target of a labeled break statement, in which case, that statement terminates execution of the targeted enclosing iteration statement.

A labeled break need not be resolved in any local scope; the search for a matching label may continue up the calling stack even across script and function-call boundaries. If no matching label is found, the current command invocation is terminated.

The name of the label designated by *label-expression* need not have a constant value.

If *label-expression* is a *unary-expression*, it is converted to a string.

Examples:

PowerShell

```
$i = 1
while ($true) { # infinite loop
    if ($i * $i -gt 100) {
        break # break out of current while loop
    }
    ++$i
}

$lab = "go_here"
:go_here
for ($i = 1; ; ++$i) {
    if ($i * $i -gt 50) {
        break $lab # use a string value as target
    }
}

:labelA
for ($i = 1; $i -le 2; $i++) {

    :labelB
    for ($j = 1; $j -le 2; $j++) {

        :labelC
        for ($k = 1; $k -le 3; $k++) {
            if (...) { break labelA }
```

```
        }
    }
}
```

8.5.2 The continue statement

Description:

A `continue` statement with a *label-expression* is referred to as a *labeled continue statement*. A continue statement without a *label-expression* is referred to as an *unlabeled continue statement*.

The use of `continue` from within a trap statement is discussed in §8.8.

An unlabeled `continue` statement within a loop terminates execution of the current loop and transfers control to the closing brace of the smallest enclosing iteration statement (§8.4). An unlabeled `continue` statement within a switch terminates execution of the current `switch` iteration and transfers control to the smallest enclosing `switch`'s *switch-condition* (§8.6).

An iteration statement or a `switch` statement (§8.6) may optionally be preceded immediately by one statement label (§8.1.1). Such a statement label may be used as the target of an enclosed labeled `continue` statement, in which case, that statement terminates execution of the current loop or `switch` iteration, and transfers control to the targeted enclosing iteration or `switch` statement label.

A labeled `continue` need not be resolved in any local scope; the search for a matching label may `continue` up the calling stack even across script and function-call boundaries. If no matching label is found, the current command invocation is terminated.

The name of the label designated by *label-expression* need not have a constant value.

If *label-expression* is a *unary-expression*, it is converted to a string.

Examples:

PowerShell

```
$i = 1
while (...) {
    ...
    if (...) {
        continue # start next iteration of current loop
    }
    ...
```

```
}

$lab = "go_here"
:go_here
for (...; ...; ...) {
    if (...) {
        continue $lab # start next iteration of labeled loop
    }
}

:labelA
for ($i = 1; $i -le 2; $i++) {

    :labelB
    for ($j = 1; $j -le 2; $j++) {

        :labelC
        for ($k = 1; $k -le 3; $k++) {
            if (...) { continue labelB }
        }
    }
}
```

8.5.3 The throw statement

Description:

An exception is a way of handling a system- or application-level error condition. The throw statement raises an exception. (See §8.7 for a discussion of exception handling.)

If *pipeline* is omitted and the throw statement is not in a *catch-clause*, the behavior is implementation defined. If *pipeline* is present and the throw statement is in a *catch-clause*, the exception that was caught by that *catch-clause* is re-thrown after any *finally-clause* associated with the *catch-clause* is executed.

If *pipeline* is present, the type of the exception thrown is implementation defined.

When an exception is thrown, control is transferred to the first catch clause in an enclosing try statement that can handle the exception. The location at which the exception is thrown initially is called the *throw point*. Once an exception is thrown the steps described in §8.7 are followed repeatedly until a catch clause that matches the exception is found or none can be found.

Examples:

PowerShell

```
throw
throw 100
throw "No such record in file"
```

If *pipeline* is omitted and the throw statement is not from within a *catch-clause*, the text "ScriptHalted" is written to the pipeline, and the type of the exception raised is `System.Management.Automation.RuntimeException`.

If *pipeline* is present, the exception raised is wrapped in an object of type `System.Management.Automation.RuntimeException`, which includes information about the exception as a `System.Management.Automation.ErrorRecord` object (accessible via `$_`).

Example 1: `throw 123` results in an exception of type **RuntimeException**. From within the catch block, `$_.TargetObject` contains the object wrapped inside, in this case, a `System.Int32` with value 123.

Example 2: `throw "xxx"` results in an exception of type **RuntimeException**. From within the catch block, `$_.TargetObject` contains the object wrapped inside, in this case, a `System.String` with value "xxx".

Example 3: `throw 10,20` results in an exception of type **RuntimeException**. From within the catch block, `$_.TargetObject` contains the object wrapped inside, in this case, a `System.Object[]`, an unconstrained array of two elements with the `System`.Int32` values 10 and 20.

8.5.4 The return statement

Description:

The `return` statement writes to the pipeline the value(s) designated by *pipeline*, if any, and returns control to the function or script's caller. A function or script may have zero or more `return` statements.

If execution reaches the closing brace of a function an implied `return` without *pipeline* is assumed.

The `return` statement is a bit of "syntactic sugar" to allow programmers to express themselves as they can in other languages; however, the value returned from a function or script is actually all of the values written to the pipeline by that function or script plus any value(s) specified by *pipeline*. If only a scalar value is written to the pipeline, its type is the type of the value returned; otherwise, the return type is an unconstrained 1-dimensional array containing all the values written to the pipeline.

Examples:

```PowerShell
function Get-Factorial ($v) {
    if ($v -eq 1) {
        return 1 # return is not optional
    }

    return $v * (Get-Factorial ($v - 1)) # return is optional
}
```

The caller to `Get-Factorial` gets back an `int`.

```PowerShell
function Test {
    "text1" # "text1" is written to the pipeline
    # ...
    "text2" # "text2" is written to the pipeline
    # ...
    return 123 # 123 is written to the pipeline
}
```

The caller to `Test` gets back an unconstrained 1-dimensional array of three elements.

8.5.5 The exit statement

Description:

The exit statement terminates the current script and returns control and an *exit code* to the host environment or the calling script. If *pipeline* is provided, the value it designates is converted to int, if necessary. If no such conversion exists, or if *pipeline* is omitted, the int value zero is returned.

Examples:

```PowerShell
exit $count # terminate the script with some accumulated count
```

8.6 The switch statement

Syntax:

Syntax

```
switch-statement:
    switch new-lines~opt~ switch-parameters~opt~ switch-condition switch-
body

switch-parameters:
    switch-parameter
    switch-parameters switch-parameter

switch-parameter:
    -regex
    -wildcard
    -exact
    -casesensitive
    -parallel

switch-condition:
    ( new-lines~opt~ pipeline new-lines~opt~ )
    -file new-lines~opt~ switch-filename

switch-filename:
    command-argument
    primary-expression

switch-body:
    new-lines~opt~ { new-lines~opt~ switch-clauses }

switch-clauses:
    switch-clause
    switch-clauses switch-clause

switch-clause:
    switch-clause-condition statement-block statement-terimators~opt~

switch-clause-condition:
    command-argument
    primary-expression
```

Description:

If *switch-condition* designates a single value, control is passed to one or more matching pattern statement blocks. If no patterns match, some default action can be taken.

A switch must contain one or more *switch-clause*s, each starting with a pattern (a *non-default switch clause*), or the keyword `default` (a *default switch clause*). A switch must contain zero or one `default` switch clauses, and zero or more non-default switch clauses. Switch clauses may be written in any order.

Multiple patterns may have the same value. A pattern need not be a literal, and a switch may have patterns with different types.

If the value of *switch-condition* matches a pattern value, that pattern's *statement-block* is executed. If multiple pattern values match the value of *switch-condition*, each matching pattern's *statement-block* is executed, in lexical order, unless any of those *statement-block*s contains a `break` statement (§8.5.1).

If the value of *switch-condition* does not match any pattern value, if a `default` switch clause exists, its *statement-block* is executed; otherwise, pattern matching for that *switch-condition* is terminated.

Switches may be nested, with each switch having its own set of switch clauses. In such instances, a switch clause belongs to the innermost switch currently in scope.

On entry to each *statement-block*, `$_` is automatically assigned the value of the *switch-condition* that caused control to go to that *statement-block*. `$_` is also available in that *statement-block*'s *switch-clause-condition*.

Matching of non-strings is done by testing for equality (§7.8.1).

If the matching involves strings, by default, the comparison is case-insensitive. The presence of the *switch-parameter* `-casesensitive` makes the comparison case-sensitive.

A pattern may contain wildcard characters (§3.15), in which case, wildcard string comparisons are performed, but only if the *switch-parameter* -wildcard is present. By default, the comparison is case-insensitive.

A pattern may contain a regular expression (§3.16), in which case, regular expression string comparisons are performed, but only if the *switch-parameter* `-regex` is present. By default, the comparison is case-insensitive. If `-regex` is present and a pattern is matched, `$matches` is defined in the *switch-clause statement-block* for that pattern.

A *switch-parameter* may be abbreviated; any distinct leading part of a parameter may be used. For example, `-regex`, `-rege`, `-reg`, `-re`, and `-r` are equivalent.

If conflicting *switch-parameter*s are specified, the lexically final one prevails. The presence of `-exact` disables `-regex` and `-wildcard`; it has no affect on `-case`, however.

If the *switch-parameter* `-parallel` is specified, the behavior is implementation defined.

The *switch-parameter* `-parallel` is only allowed in a workflow (§8.10.2).

If a pattern is a *script-block-expression*, that block is evaluated and the result is converted to bool, if necessary. If the result has the value `$true`, the corresponding *statement-block* is executed; otherwise, it is not.

If *switch-condition* designates multiple values, the switch is applied to each value in lexical order using the rules described above for a *switch-condition* that designates a single value. Every switch statement has its own enumerator, `$switch` (§2.3.2.2, §4.5.16), which exists only while that switch is executing.

A switch statement may have a label, and it may contain labeled and unlabeled break (§8.5.1) and continue (§8.5.2) statements.

If *switch-condition* is `-file` *switch-filename*, instead of iterating over the values in an expression, the switch iterates over the values in the file designated by *switch-filename*.The file is read a line at a time with each line comprising a value. Line terminator characters are not included in the values.

Examples:

PowerShell

```
$s = "ABC def`nghi`tjkl`fmno @#$"
$charCount = 0; $pageCount = 0; $lineCount = 0; $otherCount = 0
for ($i = 0; $i -lt $s.Length; ++$i) {
    ++$charCount
    switch ($s[$i]) {
        "`n" { ++$lineCount }
        "`f" { ++$pageCount }
        "`t" { }
        " " { }
        default { ++$otherCount }
    }
}

switch -wildcard ("abc") {
    a* { "a*, $_" }
    ?B? { "?B? , $_" }
    default { "default, $_" }
}

switch -regex -casesensitive ("abc") {
    ^a* { "a*" }
    ^A* { "A*" }
}

switch (0, 1, 19, 20, 21) {
    { $_ -lt 20 } { "-lt 20" }
    { $_ -band 1 } { "Odd" }
    { $_ -eq 19 } { "-eq 19" }
    default { "default" }
}
```

8.7 The try/finally statement

Syntax:

Syntax

```
try-statement:
    try statement-block catch-clauses
    try statement-block finally-clause
    try statement-block catch-clauses finally-clause

catch-clauses:
    catch-clause
    catch-clauses catch-clause

catch-clause:
    new-lines~opt~ catch catch-type-list~opt~
    statement-block

catch-type-list:
    new-lines~opt~ type-literal
    catch-type-list new-lines~opt~ , new-lines~opt~

type-literalfinally-clause:
    new-lines~opt~ finally statement-block
```

Description:

The try statement provides a mechanism for catching exceptions that occur during execution of a block. The try statement also provides the ability to specify a block of code that is always executed when control leaves the try statement. The process of raising an exception via the throw statement is described in §8.5.3.

A *try block* is the *statement-block* associated with the try statement. A *catch block* is the *statement-block* associated with a *catch-clause*. A *finally block* is the *statement-block* associated with a *finally-clause*.

A *catch-clause* without a *catch-type-list* is called a *general catch clause*.

Each *catch-clause* is an *exception handler*, and a *catch-clause* whose *catch-type-list* contains the type of the raised exception is a *matching catch clause*. A general catch clause matches all exception types.

Although *catch-clauses* and *finally-clause* are optional, at least one of them must be present.

The processing of a thrown exception consists of evaluating the following steps repeatedly until a catch clause that matches the exception is found.

- In the current scope, each try statement that encloses the throw point is examined. For each try statement *S*, starting with the innermost try statement and ending with the outermost try statement, the following steps are evaluated:
  - If the `try` block of *S* encloses the throw point and if *S* has one or more catch clauses, the catch clauses are examined in lexical order to locate a suitable handler for the exception. The first catch clause that specifies the exception type or a base type of the exception type is considered a match. A general catch clause is considered a match for any exception type. If a matching catch clause is located, the exception processing is completed by transferring control to the block of that catch clause. Within a matching catch clause, the variable `$_` contains a description of the current exception.
  - Otherwise, if the `try` block or a `catch` block of *S* encloses the throw point and if *S* has a `finally` block, control is transferred to the finally block. If the `finally` block throws another exception, processing of the current exception is terminated. Otherwise, when control reaches the end of the `finally` block, processing of the current exception is continued.
- If an exception handler was not located in the current scope, the steps above are then repeated for the enclosing scope with a throw point corresponding to the statement from which the current scope was invoked.
- If the exception processing ends up terminating all scopes, indicating that no handler exists for the exception, then the behavior is unspecified.

To prevent unreachable catch clauses in a try block, a catch clause may not specify an exception type that is equal to or derived from a type that was specified in an earlier catch clause within that same try block.

The statements of a `finally` block are always executed when control leaves a `try` statement. This is true whether the control transfer occurs as a result of normal execution, as a result of executing a `break`, `continue`, or `return` statement, or as a result of an exception being thrown out of the `try` statement.

If an exception is thrown during execution of a `finally` block, the exception is thrown out to the next enclosing `try` statement. If another exception was in the process of being handled, that exception is lost. The process of generating an exception is further discussed in the description of the `throw` statement.

`try` statements can co-exist with `trap` statements; see §8.8 for details.

Examples:

PowerShell

```
$a = new-object 'int[]' 10
$i = 20 # out-of-bounds subscript

while ($true) {
    try {
        $a[$i] = 10
        "Assignment completed without error"
        break
    }

    catch [IndexOutOfRangeException] {
        "Handling out-of-bounds index, >$_<`n"
        $i = 5
    }

    catch {
        "Caught unexpected exception"
    }

    finally {
        # ...
    }
}
```

Each exception thrown is raised as a `System.Management.Automation.RuntimeException`. If there are type-specific *catch-clause*s in the `try` block, the **InnerException** property of the exception is inspected to try and find a match, such as with the type `System.IndexOutOfRangeException` above.

8.8 The trap statement

Syntax:

Syntax

```
trap-statement:
    *trap* new-lines~opt~ type-literal~opt~ new-lines~opt~ statement-block
```

Description:

A `trap` statement with and without *type-literal* is analogous to a `catch` block (§8.7) with and without *catch-type-list*, respectively, except that a `trap` statement can trap only one type at a time.

Multiple `trap` statements can be defined in the same *statement-block*, and their order of definition is irrelevant. If two `trap` statements with the same *type-literal* are defined in the same scope, the lexically first one is used to process an exception of matching type.

Unlike a `catch` block, a `trap` statement matches an exception type exactly; no derived type matching is performed.

When an exception occurs, if no matching `trap` statement is present in the current scope, a matching trap statement is searched for in the enclosing scope, which may involve looking in the calling script, function, or filter, and then in its caller, and so on. If the lookup ends up terminating all scopes, indicating that no handler exists for the exception, then the behavior is unspecified.

A `trap` statement's *statement-body* only executes to process the corresponding exception; otherwise, execution passes over it.

If a `trap`'s *statement-body* exits normally, by default, an error object is written to the error stream, the exception is considered handled, and execution continues with the statement immediately following the one in the scope containing the `trap` statement that made the exception visible. The cause of the exception might be in a command called by the command containing the `trap` statement.

If the final statement executed in a `trap`'s *statement-body* is continue (§8.5.2), the writing of the error object to the error stream is suppressed, and execution continues with the statement immediately following the one in the scope containing the trap statement that made the exception visible. If the final statement executed in a `trap`'s *statement-body* is break (§8.5.1), the writing of the error object to the error stream is suppressed, and the exception is re-thrown.

Within a `trap` statement the variable `$_` contains a description of the current error.

Consider the case in which an exception raised from within a `try` block does not have a matching `catch` block, but a matching `trap` statement exists at a higher block level. After the `try` block's finally clause is executed, the `trap` statement gets control even if any parent scope has a matching `catch` block. If a `trap` statement is defined within the `try` block itself, and that `try` block has a matching `catch` block, the `trap` statement gets control.

Examples:

In the following example, the error object is written and execution continues with the statement immediately following the one that caused the trap; that is, "Done" is written to the pipeline.

PowerShell

```
$j = 0; $v = 10/$j; "Done"
trap { $j = 2 }
```

In the following example, the writing of the error object is suppressed and execution continues with the statement immediately following the one that caused the trap; that is, "Done" is written to the pipeline.

PowerShell

```
$j = 0; $v = 10/$j; "Done"
trap { $j = 2; continue }
```

In the following example, the writing of the error object is suppressed and the exception is re-thrown.

PowerShell

```
$j = 0; $v = 10/$j; "Done"
trap { $j = 2; break }
```

In the following example, the trap and exception-generating statements are in the same scope. After the exception is caught and handled, execution resumes with writing 1 to the pipeline.

PowerShell

```
&{trap{}; throw '\...'; 1}
```

In the following example, the trap and exception-generating statements are in different scopes. After the exception is caught and handled, execution resumes with writing 2 (not 1) to the pipeline.

PowerShell

```
trap{} &{throw '\...'; 1}; 2
```

8.9 The data statement

Syntax:

```
```

Syntax

```
data-statement:
    data new-lines~opt~ data-name data-commands-allowed~opt~ statement-block

data-name:
    simple-name

data-commands-allowed:
    new-lines~opt~ -supportedcommand data-commands-list

data-commands-list:
    new-lines~opt~ data-command
    data-commands-list , new-lines~opt~ data-command

data-command:
    command-name-expr
```

Description:

A data statement creates a *data section*, keeping that section's data separate from the code. This separation supports facilities like separate string resource files for text, such as error messages and Help strings. It also helps support internationalization by making it easier to isolate, locate, and process strings that will be translated into different languages.

A script or function can have zero or more data sections.

The *statement-block* of a data section is limited to containing the following PowerShell features only:

- All operators except `-match`
- The `if` statement
- The following automatic variables: `$PsCulture`, `$PsUICulture`, `$true`, `$false`, and `$null`.
- Comments
- Pipelines
- Statements separated by semicolons (`;`)
- Literals
- Calls to the ConvertFrom-StringData cmdlet
- Any other cmdlets identified via the **supportedcommand** parameter

If the `ConvertFrom-StringData` cmdlet is used, the key/value pairs can be expressed using any form of string literal. However, *expandable-string-literal*s and *expandable-here-string-literal*s must not contain any variable substitutions or sub-expression expansions.

Examples:

The **SupportedCommand** parameter indicates that the given cmdlets or functions generate data only. For example, the following data section includes a user-written cmdlet, `ConvertTo-XML`, which formats data in an XML file:

```PowerShell
data -supportedCommand ConvertTo-XML {
    Format-XML -strings string1, string2, string3
}
```

Consider the following example, in which the data section contains a `ConvertFrom-StringData` command that converts the strings into a hash table, whose value is assigned to `$messages`.

```PowerShell
$messages = data {
    ConvertFrom-StringData -stringdata @'
    Greeting = Hello
    Yes = yes
    No = no
'@
}
```

The keys and values of the hash table are accessed using `$messages.Greeting`, `$messages.Yes`, and `$messages.No`, respectively.

Now, this can be saved as an English-language resource. German- and Spanish-language resources can be created in separate files, with the following data sections:

```PowerShell
$messages = data {
    ConvertFrom-StringData -stringdata @"
    Greeting = Guten Tag
    Yes = ja
    No = nein
"@
}

$messagesS = data {
    ConvertFrom-StringData -stringdata @"
    Greeting = Buenos días
    Yes = sí
    No = no
```

```
"@
}
```

If *dataname* is present, it names the variable (without using a leading `$`) into which the value of the data statement is to be stored. Specifically, `$name = data { ... }` is equivalent to `data name { ... }`.

8.10 Function definitions

Syntax:

Syntax

```
function-statement:
    function new-lines~opt~ function-name function-parameter-
declaration~opt~ { script-block }
    filter new-lines~opt~ function-name function-parameter-declaration~opt~
{ script-block }
    workflow new-lines~opt~ function-name function-parameter-
declaration~opt~ { script-block }

function-name:
    command-argument

command-argument:
    command-name-expr

function-parameter-declaration:
    new-lines~opt~ ( parameter-list new-lines~opt~ )

parameter-list:
    script-parameter
    parameter-list new-lines~opt~ , script-parameter

script-parameter:
    new-lines~opt~ attribute-list~opt~ new-lines~opt~ variable script-
parameter-default~opt~

script-block:
    param-block~opt~ statement-terminators~opt~ script-block-body~opt~

param-block:
    new-lines~opt~ attribute-list~opt~ new-lines~opt~ param new-lines~opt~
        ( parameter-list~opt~ new-lines~opt~ )

parameter-list:
    script-parameter
    parameter-list new-lines~opt~ , script-parameter

script-parameter-default:
```

```
    new-lines~opt~ = new-lines~opt~ expression

script-block-body:
    named-block-list
    statement-list

named-block-list:
    named-block
    named-block-list named-block

named-block:
    block-name statement-block statement-terminators~opt~

block-name: one of
    dynamicparam   begin   process   end
```

Description:

A *function definition* specifies the name of the function, filter, or workflow being defined and the names of its parameters, if any. It also contains zero or more statements that are executed to achieve that function's purpose.

Each function is an instance of the class `System.Management.Automation.FunctionInfo`.

8.10.1 Filter functions

Whereas an ordinary function runs once in a pipeline and accesses the input collection via `$input`, a *filter* is a special kind of function that executes once for each object in the input collection. The object currently being processed is available via the variable `$_`.

A filter with no named blocks (§8.10.7) is equivalent to a function with a process block, but without any begin block or end block.

Consider the following filter function definition and calls:

PowerShell

```
filter Get-Square2 { # make the function a filter
    $_ * $_ # access current object from the collection
}

-3..3 | Get-Square2 # collection has 7 elements
6, 10, -3 | Get-Square2 # collection has 3 elements
```

Each filter is an instance of the class `System.Management.Automation.FilterInfo` (§4.5.11).

8.10.2 Workflow functions

A workflow function is like an ordinary function with implementation defined semantics. A workflow function is translated to a sequence of Windows Workflow Foundation activities and executed in the Windows Workflow Foundation engine.

8.10.3 Argument processing

Consider the following definition for a function called `Get-Power`:

PowerShell

```
function Get-Power ([long]$base, [int]$exponent) {
    $result = 1
    for ($i = 1; $i -le $exponent; ++$i) {
        $result *= $base
    }
    return $result
}
```

This function has two parameters, `$base` and `$exponent`. It also contains a set of statements that, for non-negative exponent values, computes `$base^$exponent^` and returns the result to `Get-Power`'s caller.

When a script, function, or filter begins execution, each parameter is initialized to its corresponding argument's value. If there is no corresponding argument and a default value (§8.10.4) is supplied, that value is used; otherwise, the value `$null` is used. As such, each parameter is a new variable just as if it was initialized by assignment at the start of the *script-block*.

If a *script-parameter* contains a type constraint (such as `[long]` and `[int]` above), the value of the corresponding argument is converted to that type, if necessary; otherwise, no conversion occurs.

When a script, function, or filter begins execution, variable `$args` is defined inside it as an unconstrained 1-dimensional array, which contains all arguments not bound by name or position, in lexical order.

Consider the following function definition and calls:

PowerShell

```
function F ($a, $b, $c, $d) { ... }

F -b 3 -d 5 2 4       # $a is 2, $b is 3, $c is 4, $d is 5, $args Length 0
```

```
F -a 2 -d 3 4 5       # $a is 2, $b is 4, $c is 5, $d is 3, $args Length 0
F 2 3 4 5 -c 7 -a 1   # $a is 1, $b is 2, $c is 7, $d is 3, $args Length 2
```

For more information about parameter binding see §8.14.

8.10.4 Parameter initializers

The declaration of a parameter *p* may contain an initializer, in which case, that initializer's value is used to initialize *p* provided *p* is not bound to any arguments in the call.

Consider the following function definition and calls:

PowerShell

```
function Find-Str ([string]$str, [int]$start_pos = 0) { ... }

Find-Str "abcabc" # 2nd argument omitted, 0 used for $start_pos
Find-Str "abcabc" 2 # 2nd argument present, so it is used for $start_pos
```

8.10.5 The [switch] type constraint

When a switch parameter is passed, the corresponding parameter in the command must be constrained by the type switch. Type switch has two values, True and False.

Consider the following function definition and calls:

PowerShell

```
function Process ([switch]$trace, $p1, $p2) { ... }

Process 10 20               # $trace is False, $p1 is 10, $p2 is 20
Process 10 -trace 20        # $trace is True, $p1 is 10, $p2 is 20
Process 10 20 -trace        # $trace is True, $p1 is 10, $p2 is 20
Process 10 20 -trace:$false # $trace is False, $p1 is 10, $p2 is 20
Process 10 20 -trace:$true  # $trace is True, $p1 is 10, $p2 is 20
```

8.10.6 Pipelines and functions

When a script, function, or filter is used in a pipeline, a collection of values is delivered to that script or function. The script, function, or filter gets access to that collection via the enumerator $input (§2.3.2.2, §4.5.16), which is defined on entry to that script, function, or filter.

Consider the following function definition and calls:

PowerShell

```
function Get-Square1 {
    foreach ($i in $input) {   # iterate over the collection
        $i * $i
    }
}

-3..3 | Get-Square1            # collection has 7 elements
6, 10, -3 | Get-Square1        # collection has 3 elements
```

8.10.7 Named blocks

The statements within a *script-block* can belong to one large unnamed block, or they can be distributed into one or more named blocks. Named blocks allow custom processing of collections coming from pipelines; named blocks can be defined in any order.

The statements in a *begin block* (i.e.; one marked with the keyword begin) are executed once, before the first pipeline object is delivered.

The statements in a *process block* (i.e.; one marked with the keyword process) are executed for each pipeline object delivered. (`$_` provides access to the current object being processed from the input collection coming from the pipeline.) This means that if a collection of zero elements is sent via the pipeline, the process block is not executed at all. However, if the script or function is called outside a pipeline context, this block is executed exactly once, and `$_` is set to `$null`, as there is no current collection object.

The statements in an *end block* (i.e.; one marked with the keyword end) are executed once, after the last pipeline object has been delivered.

8.10.8 dynamicParam block

The subsections of §8.10 thus far deal with *static parameters*, which are defined as part of the source code. It is also possible to define *dynamic parameters* via a *dynamicParam block*, another form of named block (§8.10.7), which is marked with the keyword `dynamicParam`. Much of this machinery is implementation defined.

Dynamic parameters are parameters of a cmdlet, function, filter, or script that are available under certain conditions only. One such case is the **Encoding** parameter of the `Set-Item` cmdlet.

In the *statement-block*, use an if statement to specify the conditions under which the parameter is available in the function. Use the New-Object cmdlet to create an object of an implementation-defined type to represent the parameter, and specify its name. Also, use `New-Object` to create an object of a different implementation-defined type to represent the implementation-defined attributes of the parameter.

The following example shows a function with standard parameters called Name and Path, and an optional dynamic parameter named **DP1**. The **DP1** parameter is in the PSet1 parameter set and has a type of `Int32`. The **DP1** parameter is available in the Sample function only when the value of the Path parameter contains "HKLM:", indicating that it is being used in the `HKEY_LOCAL_MACHINE` registry drive.

PowerShell

```
function Sample {
    Param ([String]$Name, [String]$Path)
    DynamicParam {
        if ($path -match "*HKLM*:") {
            $dynParam1 = New-Object
System.Management.Automation.RuntimeDefinedParameter("dp1", [Int32],
$attributeCollection)

            $attributes = New-Object
System.Management.Automation.ParameterAttribute
            $attributes.ParameterSetName = 'pset1'
            $attributes.Mandatory = $false

            $attributeCollection = New-Object -Type
System.Collections.ObjectModel.Collection``1[System.Attribute]
            $attributeCollection.Add($attributes)

            $paramDictionary = New-Object
System.Management.Automation.RuntimeDefinedParameterDictionary
            $paramDictionary.Add("dp1", $dynParam1)
            return $paramDictionary
        }
    }
}
```

The type used to create an object to represent a dynamic parameter is `System.Management.Automation.RuntimeDefinedParameter`.

The type used to create an object to represent the attributes of the parameter is `System.Management.Automation.ParameterAttribute`.

The implementation-defined attributes of the parameter include **Mandatory**, **Position**, and **ValueFromPipeline**.

8.10.9 param block

A *param-block* provides an alternate way of declaring parameters. For example, the following sets of parameter declarations are equivalent:

PowerShell

```
function FindStr1 ([string]$str, [int]$start_pos = 0) { ... }
function FindStr2 {
    param ([string]$str, [int]$start_pos = 0) ...
}
```

A *param-block* allows an *attribute-list* on the *param-block* whereas a *function-parameter-declaration* does not.

A script may have a *param-block* but not a *function-parameter-declaration*. A function or filter definition may have a *function-parameter-declaration* or a *param-block*, but not both.

Consider the following example:

PowerShell

```
param ( [Parameter(Mandatory = $true, ValueFromPipeline=$true)]
        [string[]] $ComputerName )
```

The one parameter, `$ComputerName`, has type `string[]`, it is required, and it takes input from the pipeline.

See §12.3.7 for a discussion of the **Parameter** attribute and for more examples.

8.11 The parallel statement

Syntax:

Syntax

```
parallel-statement:
    *parallel* statement-block
```

The parallel statement contains zero or more statements that are executed in an implementation defined manner.

A parallel statement is only allowed in a workflow (§8.10.2).

8.12 The sequence statement

Syntax:

Syntax

```
sequence-statement:
    *sequence* statement-block
```

The sequence statement contains zero or more statements that are executed in an implementation defined manner.

A sequence statement is only allowed in a workflow (§8.10.2).

8.13 The inlinescript statement

Syntax:

Syntax

```
inlinescript-statement:
    inlinescript statement-block
```

The inlinescript statement contains zero or more statements that are executed in an implementation defined manner.

A inlinescript statement is only allowed in a workflow (§8.10.2).

8.14 Parameter binding

When a script, function, filter, or cmdlet is invoked, each argument can be bound to the corresponding parameter by position, with the first parameter having position zero.

Consider the following definition fragment for a function called `Get-Power`, and the calls to it:

PowerShell

```
function Get-Power ([long]$base, [int]$exponent) { ... }

Get-Power 5 3       # argument 5 is bound to parameter $base in position 0
                    # argument 3 is bound to parameter $exponent in position
1
                    # no conversion is needed, and the result is 5 to the
```

```
power 3

Get-Power 4.7 3.2   # double argument 4.7 is rounded to int 5, double
argument
                    # 3.2 is rounded to int 3, and result is 5 to the power
3

Get-Power 5         # $exponent has value $null, which is converted to int 0

Get-Power           # both parameters have value $null, which is converted
to int 0
```

When a script, function, filter, or cmdlet is invoked, an argument can be bound to the corresponding parameter by name. This is done by using a *parameter with argument*, which is an argument that is the parameter's name with a leading dash (-), followed by the associated value for that argument. The parameter name used can have any case-insensitive spelling and can use any prefix that uniquely designates the corresponding parameter. When choosing parameter names, avoid using the names of the common parameters.

Consider the following calls to function `Get-Power`:

PowerShell

```
Get-Power -base 5 -exponent 3   # -base designates $base, so 5 is
                                # bound to that, exponent designates
                                # $exponent, so 3 is bound to that

Get-Power -Exp 3 -BAs 5         # $base takes on 5 and $exponent takes on 3

Get-Power -e 3 -b 5             # $base takes on 5 and $exponent takes on 3
```

On the other hand, calls to the following function

PowerShell

```
function Get-Hypot ([double]$side1, [double]$side2) {
    return [Math]::Sqrt($side1 * $side1 + $side2 * $side2)
}
```

must use parameters `-side1` and `-side2`, as there is no prefix that uniquely designates the parameter.

The same parameter name cannot be used multiple times with or without different associated argument values.

Parameters can have attributes (§12). For information about the individual attributes see the sections within §12.3. For information about parameter sets see §12.3.7.

A script, function, filter, or cmdlet can receive arguments via the invocation command line, from the pipeline, or from both. Here are the steps, in order, for resolving parameter binding:

1. Bind all named parameters, then
2. Bind positional parameters, then
3. Bind from the pipeline by value (§12.3.7) with exact match, then
4. Bind from the pipeline by value (§12.3.7) with conversion, then
5. Bind from the pipeline by name (§12.3.7) with exact match, then
6. Bind from the pipeline by name (§12.3.7) with conversion

Several of these steps involve conversion, as described in §6. However, the set of conversions used in binding is not exactly the same as that used in language conversions. Specifically,

- Although the value `$null` can be cast to bool, `$null` cannot be bound to `bool`.
- When the value `$null` is passed to a switch parameter for a cmdlet, it is treated as if `$true` was passed. However, when passed to a switch parameter for a function, it is treated as if `$false` was passed.
- Parameters of type bool or switch can only bind to numeric or bool arguments.
- If the parameter type is not a collection, but the argument is some sort of collection, no conversion is attempted unless the parameter type is object or PsObject. (The main point of this restriction is to disallow converting a collection to a string parameter.) Otherwise, the usual conversions are attempted.

If the parameter type is `IList` or `ICollection<T>`, only those conversions via Constructor, op_Implicit, and op_Explicit are attempted. If no such conversions exist, a special conversion for parameters of "collection" type is used, which includes `IList`, `ICollection<T>`, and arrays.

Positional parameters prefer to be bound without type conversion, if possible. For example,

PowerShell

```
function Test {
    [CmdletBinding(DefaultParameterSetname = "SetB")]
    param([Parameter(Position = 0, ParameterSetname = "SetA")]
        [decimal]$dec,
        [Parameter(Position = 0, ParameterSetname = "SetB")]
        [int]$in
```

```
    )
    $PsCmdlet.ParameterSetName
}

Test 42d   # outputs "SetA"
Test 42    # outputs "SetB"
```

9. Arrays

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9.1 Introduction

PowerShell supports arrays of one or more dimensions with each dimension having zero or more *elements*. Within a dimension, elements are numbered in ascending integer order starting at zero. Any individual element can be accessed via the array subscript operator `[]` (§7.1.4). The number of dimensions in an array is called its *rank*.

An element can contain a value of any type including an array type. An array having one or more elements whose values are of any array type is called a *jagged array*. A *multidimensional array* has multiple dimensions, in which case, the number of elements in each row of a dimension is the same. An element of a jagged array may contain a multidimensional array, and vice versa.

Multidimensional arrays are stored in row-major order. The number of elements in an array is called that array's *length*, which is fixed when the array is created. As such, the elements in a 1-dimensional array *A* having length *N* can be accessed (i.e., *subscripted*) using the expressions `A[0], A[1], ..., A[N-1]`. The elements in a 2-dimensional array *B* having *M* rows, with each row having *N* columns, can be accessed using the expressions `B[0,0], B[0,1], ..., B[0,N-1], B[1,0], B[1,1], ..., B[1,N-1], ..., B[M-1,0], B[M-1,1], ..., B[M-1,N-1]`. And so on for arrays with three or more dimensions.

By default, an array is *polymorphic*; i.e., its elements do not need to all have the same type. For example,

PowerShell

```
$items = 10,"blue",12.54e3,16.30D # 1-D array of length 4
$items[1] = -2.345
$items[2] = "green"

$a = New-Object 'object[,]' 2,2 # 2-D array of length 4
$a[0,0] = 10
$a[0,1] = $false
$a[1,0] = "red"
$a[1,1] = $null
```

A 1-dimensional array has type `type[]`, a 2-dimensional array has type `type[,]`, a 3-dimensional array has type `type[,,]`, and so on, where *type* is object for an unconstrained type array, or the constrained type for a constrained array (§9.4).

All array types are derived from the type Array (§4.3.2).

9.2 Array creation

An array is created via an *array creation expression*, which has the following forms: unary comma operator (§7.2.1) ,*array-expression* (§7.1.7), binary comma operator (§7.3), range operator (§7.4), or New-Object cmdlet.

Here are some examples of array creation and usage:

PowerShell

```
$values = 10, 20, 30
for ($i = 0; $i -lt $values.Length; ++$i) {
    "`$values[$i] = $($values[$i])"
}

$x = , 10                           # x refers to an array of length 1
$x = @(10)                          # x refers to an array of length 1
$x = @()                            # x refers to an array of length 0

$a = New-Object 'object[,]' 2, 2    # create a 2x2 array of anything
$a[0, 0] = 10                       # set to an int value
$a[0, 1] = $false                   # set to a boolean value
$a[1, 0] = "red"                    # set to a string value
$a[1, 1] = 10.50D                   # set to a decimal value
foreach ($e in $a) {                # enumerate over the whole array
    $e
}
```

The following is written to the pipeline:

Output

```
$values[0] = 10
$values[1] = 20
$values[2] = 30

10
False
red
10.50
```

The default initial value of any element not explicitly initialized is the default value for that element's type (that is, `$false`, zero, or `$null`).

9.3 Array concatenation

Arrays of arbitrary type and length can be concatenated via the `+` and `+=` operators, both of which result in the creation of a new unconstrained 1-dimensional array. The existing arrays are unchanged. See §7.7.3 for more information, and §9.4 for a discussion of adding to an array of constrained type.

9.4 Constraining element types

A 1-dimensional array can be created so that it is type-constrained by prefixing the array-creation expression with an array type cast. For example,

PowerShell

```
$a = [int[]](1,2,3,4)   # constrained to int
$a[1] = "abc"           # implementation-defined behavior
$a += 1.23              # new array is unconstrained
```

The syntax for creating a multidimensional array requires the specification of a type, and that type becomes the constraint type for that array. However, by specifying type `object[]`, there really is no constraint as a value of any type can be assigned to an element of an array of that type.

Concatenating two arrays (§7.7.3) always results in a new array that is unconstrained even if both arrays are constrained by the same type. For example,

PowerShell

```
$a = [int[]](1,2,3)    # constrained to int
$b = [int[]](10,20)    # constrained to int
$c = $a + $b           # constraint not preserved
$c = [int[]]($a + $b)  # result explicitly constrained to int
```

9.5 Arrays as reference types

As array types are reference types, a variable designating an array can be made to refer to any array of any rank, length, and element type. For example,

PowerShell

```
$a = 10,20                    # $a refers to an array of length 2
$a = 10,20,30                 # $a refers to a different array, of length 3
```

```
$a = "red",10.6                # $a refers to a different array, of length 2
$a = New-Object 'int[,]' 2,3   # $a refers to an array of rank 2
```

Assignment of an array involves a shallow copy; that is, the variable assigned to refers to the same array, no copy of the array is made. For example,

PowerShell

```
$a = 10,20,30
">$a<"
$b = $a          # make $b refer to the same array as $a
">$b<"

$a[0] = 6        # change value of [0] via $a
">$a<"
">$b<"           # change is reflected in $b

$b += 40         # make $b refer to a new array
$a[0] = 8        # change value of [0] via $a
">$a<"
">$b<"           # change is not reflected in $b
```

The following is written to the pipeline:

Output

```
>10 20 30<
>10 20 30<
>6 20 30<
>6 20 30<
>8 20 30<
>6 20 30 40<
```

9.6 Arrays as array elements

Any element of an array can itself be an array. For example,

PowerShell

```
$colors = "red", "blue", "green"
$list = $colors, (,7), (1.2, "yes") # parens in (,7) are redundant; they
                                    # are intended to aid readability
"`$list refers to an array of length $($list.Length)"
">$($list[1][0])<"
">$($list[2][1])<"
```

The following is written to the pipeline:

Output

```
$list refers to an array of length 3
>7<
>yes<
```

`$list[1]` refers to an array of 1 element, the integer 7, which is accessed via `$list[1][0]`, as shown. Compare this with the following subtly different case:

PowerShell

```
$list = $colors, 7, (1.2, "yes") # 7 has no prefix comma
">$($list[1])<"
```

Here, `$list[1]` refers to a scalar, the integer 7, which is accessed via `$list[1]`.

Consider the following example,

PowerShell

```
$x = [string[]]("red","green")
$y = 12.5, $true, "blue"
$a = New-Object 'object[,]' 2,2
$a[0,0] = $x                # element is an array of 2 strings
$a[0,1] = 20                # element is an int
$a[1,0] = $y                # element is an array of 3 objects
$a[1,1] = [int[]](92,93)    # element is an array of 2 ints
```

9.7 Negative subscripting

This is discussed in §7.1.4.1.

9.8 Bounds checking

This is discussed in §7.1.4.1.

9.9 Array slices

An *array slice* is an unconstrained 1-dimensional array whose elements are copies of zero or more elements from a collection. An array slice is created via the subscript operator `[]` (§7.1.4.5).

9.10 Copying an array

A contiguous set of elements can be copied from one array to another using the method `[Array]::Copy`. For example,

PowerShell

```
$a = [int[]](10,20,30)
$b = [int[]](0,1,2,3,4,5)
[Array]::Copy($a, $b, 2)        # $a[0]->$b[0],
$a[1]->$b[1]
[Array]::Copy($a, 1, $b, 3, 2)  # $a[1]->$b[3],
$a[2]->$b[4]
```

9.11 Enumerating over an array

Although it is possible to loop through an array accessing each of its elements via the subscript operator, we can enumerate over that array's elements using the foreach statement. For a multidimensional array, the elements are processed in row-major order. For example,

PowerShell

```
$a = 10, 53, 16, -43
foreach ($elem in $a) {
    # do something with element via $elem
}

foreach ($elem in -5..5) {
    # do something with element via $elem
}

$a = New-Object 'int[,]' 3, 2
foreach ($elem in $a) {
    # do something with element via $elem
}
```

9.12 Multidimensional array flattening

Some operations on a multidimensional array (such as replication (§7.6.3) and concatenation (§7.7.3)) require that array to be *flattened*; that is, to be turned into a 1-dimensional array of unconstrained type. The resulting array takes on all the elements in row-major order.

Consider the following example:

PowerShell

```
$a = "red",$true
$b = (New-Object 'int[,]' 2,2)
$b[0,0] = 10
$b[0,1] = 20
$b[1,0] = 30
$b[1,1] = 40
$c = $a + $b
```

The array designated by `$c` contains the elements "red", `$true`, 10, 20, 30, and 40.

10. Hashtables

Article • 07/29/2021

Syntax:

> **Tip**
>
> The `~opt~` notation in the syntax definitions indicates that the lexical entity is optional in the syntax.

Syntax

```
hash-literal-expression:
    @{ new-lines~opt~ hash-literal-body~opt~ new-lines~opt~ }

hash-literal-body:
    hash-entry
    hash-literal-body statement-terminators hash-entry

hash-entry:
    key-expression = new-lines~opt~ statement

key-expression:
    simple-name
    unary-expression

statement-terminator:
    ;
    new-line-character
```

10.1 Introduction

The type Hashtable represents a collection of *key/value pair* objects that supports efficient retrieval of a value when indexed by the key. Each key/value pair is an *element*, which is stored in some implementation-defined object type.

An element's key cannot be the null value. There are no restrictions on the type of a key or value. Duplicate keys are not supported.

Given a key/value pair object, the key and associated value can be obtained by using the instance properties Key and Value, respectively.

Given one or more keys, the corresponding value(s) can be accessed via the Hashtable subscript operator `[]` (§7.1.4.3).

All Hashtables have type `Hashtable` (§4.3.3).

The order of the keys in the collection returned by Keys is unspecified; however, it is the same order as the associated values in the collection returned by Values.

Here are some examples involving Hashtables:

```PowerShell
$h1 = @{ FirstName = "James"; LastName = "Anderson"; IDNum = 123 }
$h1.FirstName # designates the key FirstName
$h1["LastName"] # designates the associated value for key LastName
$h1.Keys # gets the collection of keys
```

`Hashtable` elements are stored in an object of type **DictionaryEntry**, and the collections returned by Keys and Values have type **ICollection**.

10.2 Hashtable creation

A `Hashtable` is created via a hash literal (§7.1.9) or the New-Object cmdlet. It can be created with zero or more elements. The Count property returns the current element count.

10.3 Adding and removing Hashtable elements

An element can be added to a `Hashtable` by assigning (§7.11.1) a value to a non-existent key name or to a subscript (§7.1.4.3) that uses a non-existent key name. Removal of an element requires the use of the Remove method. For example,

```PowerShell
$h1 = @{ FirstName = "James"; LastName = "Anderson"; IDNum = 123 }
$h1.Dept = "Finance" # adds element Finance
$h1["Salaried"] = $false # adds element Salaried
$h1.Remove("Salaried") # removes element Salaried
```

10.4 Hashtable concatenation

Hashtables can be concatenated via the `+` and `+=` operators, both of which result in the creation of a new `Hashtable`. The existing Hashtables are unchanged. See §7.7.4 for more information.

10.5 Hashtables as reference types

As `Hashtable` is a reference type, assignment of a `Hashtable` involves a shallow copy; that is, the variable assigned to refers to the same `Hashtable`; no copy of the `Hashtable` is made. For example,

PowerShell

```
$h1 = @{ FirstName = "James"; LastName = "Anderson"; IDNum = 123 }
$h2 = $h1
$h1.FirstName = "John" # change key's value in $h1
$h2.FirstName # change is reflected in $h2
```

10.6 Enumerating over a Hashtable

To process every pair in a `Hashtable`, use the **Keys** property to retrieve the list of keys as an array, and then enumerate over the elements of that array getting the associated value via the **Value** property or a subscript, as follows

PowerShell

```
$h1 = @{ FirstName = "James"; LastName = "Anderson"; IDNum = 123}
foreach ($e in $h1.Keys) {
   "Key is " + $e + ", Value is " + $h1[$e]
}
```

11. Modules

Article • 09/23/2022

11.1 Introduction

As stated in §3.14, a module is a self-contained reusable unit that allows PowerShell code to be partitioned, organized, and abstracted. A module can contain one or more *module members*, which are commands (such as cmdlets and functions) and items (such as variables and aliases). The names of these members can be kept private to the module or they may be *exported* to the session into which the module is *imported*.

There are three different *module types*: manifest, script, and binary. A *manifest module* is a file that contains information about a module, and controls certain aspects of that module's use. A *script module* is a PowerShell script file with a file extension of `.psm1` instead of `.ps1`. A *binary module* contains class types that define cmdlets and providers. Unlike script modules, binary modules are written in compiled languages. Binary modules are not covered by this specification.

A binary module is a .NET assembly (i.e.; a DLL) that was compiled against the PowerShell libraries.

Modules may *nest*; that is, one module may import another module. A module that has associated nested modules is a *root module*.

When a PowerShell session is created, by default, no modules are imported.

When modules are imported, the search path used to locate them is defined by the environment variable **PSModulePath**.

The following cmdlets deal with modules:

- Get-Module: Identifies the modules that have been, or can be imported
- Import-Module: Adds one or more modules to the current session (see §11.4)
- Export-ModuleMember: Identifies the module members that are to be exported
- Remove-Module: Removes one or more modules from the current session (see §11.5)
- New-Module: Creates a dynamic module (see §11.7)

11.2 Writing a script module

A script module is a script file. Consider the following script module:

PowerShell

```
function Convert-CentigradeToFahrenheit ([double]$tempC) {
    return ($tempC * (9.0 / 5.0)) + 32.0
}
New-Alias c2f Convert-CentigradeToFahrenheit

function Convert-FahrenheitToCentigrade ([double]$tempF) {
    return ($tempF - 32.0) * (5.0 / 9.0)
}
New-Alias f2c Convert-FahrenheitToCentigrade

Export-ModuleMember -Function Convert-CentigradeToFahrenheit
Export-ModuleMember -Function Convert-FahrenheitToCentigrade
Export-ModuleMember -Alias c2f, f2c
```

This module contains two functions, each of which has an alias. By default, all function names, and only function names are exported. However, once the cmdlet `Export-ModuleMember` has been used to export anything, then only those things exported explicitly will be exported. A series of commands and items can be exported in one call or a number of calls to this cmdlet; such calls are cumulative for the current session.

11.3 Installing a script module

A script module is defined in a script file, and modules can be stored in any directory. The environment variable PSModulePath points to a set of directories to be searched when module-related cmdlets look for modules whose names do not include a fully qualified path. Additional lookup paths can be provided; for example,

`$Env:PSModulepath = $Env:PSModulepath + ";<additional-path>"`

Any additional paths added affect the current session only.

Alternatively, a fully qualified path can be specified when a module is imported.

11.4 Importing a script module

Before the resources in a module can be used, that module must be imported into the current session, using the cmdlet `Import-Module`. `Import-Module` can restrict the resources that it actually imports.

When a module is imported, its script file is executed. That process can be configured by defining one or more parameters in the script file, and passing in corresponding arguments via the ArgumentList parameter of `Import-Module`.

Consider the following script that uses these functions and aliases defined in §11.2:

`Import-Module` "E:\Scripts\Modules\PSTest_Temperature" -Verbose

PowerShell

```
"0 degrees C is " + (Convert-CentigradeToFahrenheit 0) + " degrees F"
"100 degrees C is " + (c2f 100) + " degrees F"
"32 degrees F is " + (Convert-FahrenheitToCentigrade 32) + " degrees C"
"212 degrees F is " + (f2c 212) + " degrees C"
```

Importing a module causes a name conflict when commands or items in the module have the same names as commands or items in the session. A name conflict results in a name being hidden or replaced. The Prefix parameter of `Import-Module` can be used to avoid naming conflicts. Also, the **Alias**, **Cmdlet**, **Function**, and **Variable** parameters can limit the selection of commands to be imported, thereby reducing the chances of name conflict.

Even if a command is hidden, it can be run by qualifying its name with the name of the module in which it originated. For example, `& M\F 100` invokes the function *F* in module *M*, and passes it the argument 100.

When the session includes commands of the same kind with the same name, such as two cmdlets with the same name, by default it runs the most recently added command.

See §3.5.6 for a discussion of scope as it relates to modules.

11.5 Removing a script module

One or more modules can be removed from a session via the cmdlet `Remove-Module`.

Removing a module does not uninstall the module.

In a script module, it is possible to specify code that is to be executed prior to that module's removal, as follows:

`$MyInvocation.MyCommand.ScriptBlock.Module.OnRemove = { *on-removal-code* }`

11.6 Module manifests

As stated in §11.1, a manifest module is a file that contains information about a module, and controls certain aspects of that module's use.

A module need not have a corresponding manifest, but if it does, that manifest has the same name as the module it describes, but with a `.psd1` file extension.

A manifest contains a limited subset of PowerShell script, which returns a Hashtable containing a set of keys. These keys and their values specify the *manifest elements* for that module. That is, they describe the contents and attributes of the module, define any prerequisites, and determine how the components are processed.

Essentially, a manifest is a data file; however, it can contain references to data types, the if statement, and the arithmetic and comparison operators. (Assignments, function definitions and loops are not permitted.) A manifest also has read access to environment variables and it can contain calls to the cmdlet `Join-Path`, so paths can be constructed.

> ⓘ **Note**
>
> Editor's Note: The original document contains a list of keys allowed in a module manifest file. That list is outdated and incomplete. For a complete list of keys in a module manifest, see **New-ModuleManifest**.

The only key that is required is **ModuleVersion**.

Here is an example of a simple manifest:

PowerShell

```
@{
ModuleVersion = '1.0'
Author = 'John Doe'
RequiredModules = @()
FunctionsToExport = 'Set*','Get*','Process*'
}
```

The key **GUID** has a `string` value. This specifies a Globally Unique IDentifier (GUID) for the module. The **GUID** can be used to distinguish among modules having the same name. To create a new GUID, call the method `[guid]::NewGuid()`.

11.7 Dynamic modules

A *dynamic module* is a module that is created in memory at runtime by the cmdlet `New-Module`; it is not loaded from disk. Consider the following example:

PowerShell

```
$sb = {
    function Convert-CentigradeToFahrenheit ([double]$tempC) {
        return ($tempC * (9.0 / 5.0)) + 32.0
    }

    New-Alias c2f Convert-CentigradeToFahrenheit

    function Convert-FahrenheitToCentigrade ([double]$tempF) {
        return ($tempF - 32.0) * (5.0 / 9.0)
    }

    New-Alias f2c Convert-FahrenheitToCentigrade

    Export-ModuleMember -Function Convert-CentigradeToFahrenheit
    Export-ModuleMember -Function Convert-FahrenheitToCentigrade
    Export-ModuleMember -Alias c2f, f2c
}

New-Module -Name MyDynMod -ScriptBlock $sb
Convert-CentigradeToFahrenheit 100
c2f 100
```

The script block `$sb` defines the contents of the module, in this case, two functions and two aliases to those functions. As with an on-disk module, only functions are exported by default, so `Export-ModuleMember` cmdlets calls exist to export both the functions and the aliases.

Once `New-Module` runs, the four names exported are available for use in the session, as is shown by the calls to the `Convert-CentigradeToFahrenheit` and c2f.

Like all modules, the members of dynamic modules run in a private module scope that is a child of the global scope. `Get-Module` cannot get a dynamic module, but `Get-Command` can get the exported members.

To make a dynamic module available to `Get-Module`, pipe a `New-Module` command to `Import-Module`, or pipe the module object that `New-Module` returns, to `Import-Module`. This action adds the dynamic module to the `Get-Module` list, but it does not save the module to disk or make it persistent.

11.8 Closures

A dynamic module can be used to create a *closure*, a function with attached data. Consider the following example:

PowerShell

```
function Get-NextID ([int]$startValue = 1) {
    $nextID = $startValue
    {
        ($script:nextID++)
    }.GetNewClosure()
}

$v1 = Get-NextID      # get a scriptblock with $startValue of 0
& $v1                 # invoke Get-NextID getting back 1
& $v1                 # invoke Get-NextID getting back 2

$v2 = Get-NextID 100  # get a scriptblock with $startValue of 100
& $v2                 # invoke Get-NextID getting back 100
& $v2                 # invoke Get-NextID getting back 101
```

The intent here is that `Get-NextID` return the next ID in a sequence whose start value can be specified. However, multiple sequences must be supported, each with its own `$startValue` and `$nextID` context. This is achieved by the call to the method `[scriptblock]::GetNewClosure` (§4.3.7).

Each time a new closure is created by `GetNewClosure`, a new dynamic module is created, and the variables in the caller's scope (in this case, the script block containing the increment) are copied into this new module. To ensure that the nextId defined inside the parent function (but outside the script block) is incremented, the explicit script: scope prefix is needed.

Of course, the script block need not be a named function; for example:

PowerShell

```
$v3 = & {      # get a scriptblock with $startValue of 200
    param ([int]$startValue = 1)
    $nextID = $startValue
    {
        ($script:nextID++)
    }.GetNewClosure()
} 200

& $v3          # invoke script getting back 200
& $v3          # invoke script getting back 201
```

12. Attributes

Article • 07/29/2021

An *attribute* object associates predefined system information with a *target element*, which can be a param block or a parameter (§8.10). Each attribute object has an *attribute type*.

Information provided by an attribute is also known as *metadata*. Metadata can be examined by the command or the execution environment to control how the command processes data or before run time by external tools to control how the command itself is processed or maintained.

Multiple attributes can be applied to the same target element.

12.1 Attribute specification

> **Tip**
>
> The `~opt~` notation in the syntax definitions indicates that the lexical entity is optional in the syntax.

Syntax

```
attribute-list:
    attribute
    attribute-list new-lines~opt~ attribute

attribute:
    [ new-lines~opt~ attribute-name ( attribute-arguments new-lines~opt~ )
new-lines~opt~ ]
    type-literal

attribute-name:
    type-spec

attribute-arguments:
    attribute-argument
    attribute-argument new-lines~opt~ ,
    attribute-arguments

attribute-argument:
    new-lines~opt~ expression
    new-lines~opt~ simple-name
    new-lines~opt~ simple-name = new-lines~opt~ expression
```

An attribute consists of an *attribute-name* and an optional list of positional and named arguments. The positional arguments (if any) precede the named arguments. A named argument consists of a *simple-name*, optionally followed by an equal sign and followed by an *expression*. If the expression is omitted, the value `$true` is assumed.

The *attribute-name* is a reserved attribute type (§12.3) or some implementation-defined attribute type.

12.2 Attribute instances

An attribute instance is an object of an attribute type. The instance represents an attribute at run-time.

To create an object of some attribute type *A*, use the notation `A()`. An attribute is declared by enclosing its instance inside `[]`, as in `[A()]`. Some attribute types have positional and named parameters (§8.14), just like functions and cmdlets. For example,

```
[A(10,IgnoreCase=$true)]
```

shows an instance of type *A* being created using a positional parameter whose argument value is 10, and a named parameter, **IgnoreCase**, whose argument value is `$true`.

12.3 Reserved attributes

The attributes described in the following sections can be used to augment or modify the behavior of PowerShell functions, filters, scripts, and cmdlets.

12.3.1 The Alias attribute

This attribute is used in a *script-parameter* to specify an alternate name for a parameter. A parameter may have multiple aliases, and each alias name must be unique within a *parameter-list*. One possible use is to have different names for a parameter in different parameter sets (see **ParameterSetName**).

The attribute argument has type string[].

Consider a function call `Test1` that has the following param block, and which is called as shown:

```
PowerShell
```

```
param (
    [Parameter(Mandatory = $true)]
    [Alias("CN")]
    [Alias("name", "system")]
    [string[]] $ComputerName
)

Test1 "Mars", "Saturn"                # pass argument by position
Test1 -ComputerName "Mars", "Saturn"  # pass argument by name
Test1 -CN "Mars", "Saturn"            # pass argument using first alias
Test1 -name "Mars", "Saturn"          # pass argument using second alias
Test1 -sys "Mars", "Saturn"           # pass argument using third alias
```

Consider a function call `Test2` that has the following param block, and which is called as shown:

PowerShell

```
param (
    [Parameter(Mandatory = $true, ValueFromPipelineByPropertyName = $true)]
    [Alias('PSPath')]
    [string] $LiteralPath
)

Get-ChildItem "E:\*.txt" | Test2 -LiteralPath { $_ ; "`n`t";
    $_.FullName + ".bak" }
Get-ChildItem "E:\*.txt" | Test2
```

Cmdlet `Get-ChildItem` (alias `Dir`) adds to the object it returns a new **NoteProperty** of type `string`, called **PSPath**.

12.3.2 The AllowEmptyCollection attribute

This attribute is used in a *script-parameter* to allow an empty collection as the argument of a mandatory parameter.

Consider a function call `Test` that has the following param block, and which is called as shown:

PowerShell

```
param (
    [parameter(Mandatory = $true)]
    [AllowEmptyCollection()]
    [string[]] $ComputerName
)
```

```
Test "Red", "Green" # $computerName has Length 2
Test "Red" # $computerName has Length 1
Test -comp @() # $computerName has Length 0
```

12.3.3 The AllowEmptyString attribute

This attribute is used in a *script-parameter* to allow an empty string as the argument of a mandatory parameter.

Consider a function call `Test` that has the following param block, and which is called as shown:

PowerShell

```
param (
    [parameter(Mandatory = $true)]
    [AllowEmptyString()]
    [string] $ComputerName
)

Test "Red" # $computerName is "Red"
Test "" # empty string is permitted
Test -comp "" # empty string is permitted
```

12.3.4 The AllowNull attribute

This attribute is used in a *script-parameter* to allow $null as the argument of a mandatory parameter for which no implicit conversion is available.

Consider a function call Test that has the following param block, and which is called as shown:

PowerShell

```
param (
    [parameter(Mandatory = $true)]
    [AllowNull()]
    [int[]] $Values
)

Test 10, 20, 30     # $values has Length 3, values 10, 20, 30
Test 10, $null, 30  # $values has Length 3, values 10, 0, 30
Test -val $null     # $values has value $null
```

Note that the second case above does not need this attribute; there is already an implicit conversion from `$null` to int.

12.3.5 The CmdletBinding attribute

This attribute is used in the *attribute-list* of *param-block* of a function to indicate that function acts similar to a cmdlet. Specifically, it allows functions to access a number of methods and properties through the $PsCmdlet variable by using begin, process, and end named blocks (§8.10.7).

When this attribute is present, positional arguments that have no matching positional parameters cause parameter binding to fail and $args is not defined. (Without this attribute $args would take on any unmatched positional argument values.)

The following arguments are used to define the characteristics of the parameter:

Parameter Name	Purpose
SupportsShouldProcess (named)	Type: bool; Default value: $false Specifies whether the function supports calls to the ShouldProcess method, which is used to prompt the user for feedback before the function makes a change to the system. A value of $true indicates that it does. A value of $false indicates that it doesn't.
ConfirmImpact (named)	Type: string; Default value: "Medium" Specifies the impact level of the action performed. The call to the ShouldProcess method displays a confirmation prompt only when the ConfirmImpact argument is greater than or equal to the value of the $ConfirmPreference preference variable. The possible values of this argument are: None: Suppress all requests for confirmation. Low: The action performed has a low risk of losing data. Medium: The action performed has a medium risk of losing data. High: The action performed has a high risk of losing data. The value of $ConfirmPreference can be set so that only cmdlets with an equal or higher impact level can request confirmation before they perform their operation. For example, if $ConfirmPreference is set to Medium, cmdlets with a Medium or High impact level can request confirmation. Requests from cmdlets with a low impact level are suppressed.

Parameter Name	Purpose
DefaultParameterSetName (named)	Type: string; Default value: "__AllParameterSets" Specifies the parameter set to use if that cannot be determined from the arguments. See the named argument ParameterSetName in the attribute Parameter ([§12.3.7][§12.3.7]).
PositionalBinding (named)	Type: bool; Default value: $true Specifies whether positional binding is supported or not. The value of this argument is ignored if any parameters specify non-default values for either the named argument Position or the named argument ParameterSetName in the attribute Parameter ([§12.3.7][§12.3.7]). Otherwise, if the argument is $false then no parameters are positional, otherwise parameters are assigned a position based on the order the parameters are specified.

Here's is an example of the framework for using this attribute:

PowerShell

```
[CmdletBinding(SupportsShouldProcess = $true, ConfirmImpact = "Low")]
param ( ... )

begin { ... }
Get-process { ... }
end { ... }
```

12.3.6 The OutputType attribute

This attribute is used in the *attribute-list* of *param-block* to specify the types returned. The following arguments are used to define the characteristics of the parameter:

Parameter Name	Purpose
Type (position 0)	Type: string[] or array of type literals A list of the types of the values that are returned.
ParameterSetName (named)	Type: string[] Specifies the parameter sets that return the types indicated by the corresponding elements of the Type parameter.

Here are several examples of this attribute's use:

PowerShell

```
[OutputType([int])] param ( ... )
[OutputType("double")] param ( ... )
[OutputType("string","string")] param ( ... )
```

12.3.7 The Parameter attribute

This attribute is used in a *script-parameter*. The following named arguments are used to define the characteristics of the parameter:

Parameter	Purpose
HelpMessage (named)	Type: string This argument specifies a message that is intended to contain a short description of the parameter. This message is used in an implementation-defined manner when the function or cmdlet is run yet a mandatory parameter having a HelpMessage does not have a corresponding argument. The following example shows a parameter declaration that provides a description of the parameter. param ([Parameter(Mandatory = $true, HelpMessage = "An array of computer names.")] [string[]] $ComputerName) Windows PowerShell: If a required parameter is not provided the runtime prompts the user for a parameter value. The prompt dialog box includes the HelpMessage text.
Mandatory (named)	Type: bool; Default value: $false This argument specifies whether the parameter is required within the given parameter set (see ParameterSetName argument below). A value of $true indicates that it is. A value of $false indicates that it isn't. param ([Parameter(Mandatory = $true)] [string[]] $ComputerName) Windows PowerShell: If a required parameter is not provided the runtime prompts the user for a parameter value. The prompt dialog box includes the HelpMessage text, if any.
ParameterSetName (named)	Type: string; Default value: "__AllParameterSets" It is possible to write a single function or cmdlet that can perform different actions for different scenarios. It does this

Parameter	Purpose
	by exposing different groups of parameters depending on the action it wants to take. Such parameter groupings are called *parameter sets*. The argument ParameterSetName specifies the parameter set to which a parameter belongs. This behavior means that each parameter set must have one unique parameter that is not a member of any other parameter set. For parameters that belong to multiple parameter sets, add a Parameter attribute for each parameter set. This allows the parameter to be defined differently for each parameter set. A parameter set that contains multiple positional parameters must define unique positions for each parameter. No two positional parameters can specify the same position. If no parameter set is specified for a parameter, the parameter belongs to all parameter sets. When multiple parameter sets are defined, the named argument DefaultParameterSetName of the attribute CmdletBinding ([§12.3.5][§12.3.5]) is used to specify the default parameter set. The runtime uses the default parameter set if it cannot determine the parameter set to use based on the information provided by the command, or raises an exception if no default parameter set has been specified. The following example shows a function Test with a parameter declaration of two parameters that belong to two different parameter sets, and a third parameter that belongs to both sets: param ([Parameter(Mandatory = $true, ParameterSetName = "Computer")] [string[]] $ComputerName, [Parameter(Mandatory = $true, ParameterSetName = "User")] [string[]] $UserName, [Parameter(Mandatory = $true, ParameterSetName = "Computer")] [Parameter(ParameterSetName = "User")] [int] $SharedParam = 5)

Parameter	Purpose

	if ($PsCmdlet.ParameterSetName -eq "Computer")
	{
	# handle "Computer" parameter set
	}
	
	elseif ($PsCmdlet.ParameterSetName -eq "User")
	{
	# handle "User" parameter set
	}
	...
	}
	
	Test -ComputerName "Mars","Venus" -SharedParam 10
	Test -UserName "Mary","Jack"
	Test -UserName "Mary","Jack" -SharedParam 20

Position (named)	Type: int This argument specifies the position of the parameter in the argument list. If this argument is not specified, the parameter name or its alias must be specified explicitly when the parameter is set. If none of the parameters of a function has positions, positions are assigned to each parameter based on the order in which they are received. The following example shows the declaration of a parameter whose value must be specified as the first argument when the function is called. param ([Parameter(Position = 0)] [string[]] $ComputerName)

Parameter	Purpose
ValueFromPipeline (named)	Type: bool; Default value: $false This argument specifies whether the parameter accepts input from a pipeline object. A value of $true indicates that it does. A value of $false indicates that it does not. Specify $true if the function or cmdlet accesses the complete object, not just a property of the object. Only one parameter in a parameter set can declare ValueFromPipeline as $true. The following example shows the parameter declaration of a mandatory parameter, $ComputerName, that accepts the input object that is passed to the function from the pipeline. param ([Parameter(Mandatory = $true, ValueFromPipeline=$true)] [string[]] $ComputerName) For an example of using this parameter in conjunction with the Alias attribute see [§12.3.1][§12.3.1].
ValueFromPipelineByPropertyName (named)	Type: bool; Default value: $false This argument specifies whether the parameter takes its value from a property of a pipeline object that has either the same name or the same alias as this parameter. A value of $true indicates that it does. A value of $false indicates that it does not. Specify $true if the following conditions are true: the parameter accesses a property of the piped object, and the property has the same name as the parameter, or the property has the same alias as the parameter. A parameter having ValueFromPipelineByPropertyName set to $true need not have a parameter in the same set with ValueFromPipeline set to $true. If a function has a parameter $ComputerName, and the piped object has a ComputerName property, the value of the ComputerName property is assigned to the $ComputerName parameter of the function: param ([parameter(Mandatory = $true, ValueFromPipelineByPropertyName = $true)] [string[]] $ComputerName)

Parameter	Purpose

	Multiple parameters in a parameter set can define the ValueFromPipelineByPropertyName as $true. Although, a single input object cannot be bound to multiple parameters, different properties in that input object may be bound to different parameters.
	
	When binding a parameter with a property of an input object, the runtime environment first looks for a property with the same name as the parameter. If such a property does not exist, the runtime environment looks for aliases to that parameter, in their declaration order, picking the first such alias for which a property exists.
	
	function Process-Date
	{
	param(
	[Parameter(ValueFromPipelineByPropertyName=$true)]
	[int]$Year,
	
	[Parameter(ValueFromPipelineByPropertyName=$true)]
	[int]$Month,
	
	[Parameter(ValueFromPipelineByPropertyName=$true)]
	[int]$Day
	)
	
	process { ... }
	}
	
	Get-Date | Process-Date

ValueFromRemainingArguments (named)	Type: bool; Default value: $false This argument specifies whether the parameter accepts all of the remaining arguments that are not bound to the parameters of the function. A value of $true indicates that it does. A value of $false indicates that it does not. The following example shows a parameter $others that accepts all the remaining arguments of the input object that is passed to the function Test: param ([parameter(Mandatory = $true)][int] $p1, [parameter(Mandatory = $true)][int] $p2, [parameter(ValueFromRemainingArguments = $true)] [string[]] $others) Test 10 20 # $others has Length 0 Test 10 20 30 40 # $others has Length 2, value 30,40

An implementation may define other attributes as well.

The following attributes are provided as well:

- **HelpMessageBaseName**: Specifies the location where resource identifiers reside. For example, this parameter could specify a resource assembly that contains Help messages that are to be localized.
- **HelpMessageResourceId**: Specifies the resource identifier for a Help message.

12.3.8 The PSDefaultValue attribute

This attribute is used in a *script-parameter* to provide additional information about the parameter. The attribute is used in an implementation defined manner. The following arguments are used to define the characteristics of the parameter:

Parameter Name	Purpose
Help (named)	Type: string This argument specifies a message that is intended to contain a short description of the default value of a parameter. This message is used in an implementation-defined manner. Windows PowerShell: The message is used as part of the description of the parameter for the help topic displayed by the [Get-Help] (xref:Microsoft.PowerShell.Core.Get-Help) cmdlet.
Value (named)	Type: object This argument specifies a value that is intended to be the default value of a parameter. The value is used in an implementation-defined manner. Windows PowerShell: The value is used as part of the description of the parameter for the help topic displayed by the [Get-Help](xref:Microsoft.PowerShell.Core.Get-Help)cmdlet when the Help property is not specified.

12.3.9 The SupportsWildcards attribute

This attribute is used in a *script-parameter* to provide additional information about the parameter. The attribute is used in an implementation defined manner.

This attribute is used as part of the description of the parameter for the help topic displayed by the Get-Help cmdlet.

12.3.10 The ValidateCount attribute

This attribute is used in a *script-parameter* to specify the minimum and maximum number of argument values that the parameter can accept. The following arguments are used to define the characteristics of the parameter:

Parameter Name	Purpose
MinLength (position 0)	Type: int This argument specifies the minimum number of argument values allowed.
MaxLength (position 1)	Type: int This argument specifies the maximum number of argument values allowed.

In the absence of this attribute, the parameter's corresponding argument value list can be of any length.

Consider a function call Test that has the following param block, and which is called as shown:

PowerShell

```
param (
    [ValidateCount(2, 5)]
    [int[]] $Values
)

Temp 10, 20, 30
Temp 10                          # too few argument values
Temp 10, 20, 30, 40, 50, 60      # too many argument values

[ValidateCount(3, 4)]$Array = 1..3
$Array = 10                      # too few argument values
$Array = 1..100                  # too many argument values
```

12.3.11 The ValidateLength attribute

This attribute is used in a *script-parameter* or *variable* to specify the minimum and maximum length of the parameter's argument, which must have type string. The following arguments are used to define the characteristics of the parameter:

Parameter Name	Purpose

Parameter Name	Purpose
MinLength (position 0)	Type: int This argument specifies the minimum number of characters allowed.
MaxLength (position 1)	Type: int This argument specifies the maximum number of characters allowed.

In the absence of this attribute, the parameter's corresponding argument can be of any length.

Consider a function call Test that has the following param block, and which is called as shown:

PowerShell

```
param ( [parameter(Mandatory = $true)]
[ValidateLength(3,6)]
[string[]] $ComputerName )

Test "Thor","Mars"     # length is ok
Test "Io","Mars"       # "Io" is too short
Test "Thor","Jupiter"  # "Jupiter" is too long
```

12.3.12 The ValidateNotNull attribute

This attribute is used in a *script-parameter* or *variable* to specify that the argument of the parameter cannot be `$null` or be a collection containing a null-valued element.

Consider a function call `Test` that has the following param block, and which is called as `shown:

PowerShell

```
param (
    [ValidateNotNull()]
    [string[]] $Names
)

Test "Jack", "Jill"     # ok
Test "Jane", $null      # $null array element value not allowed
Test $null              # null array not allowed

[ValidateNotNull()]$Name = "Jack" # ok
$Name = $null           # null value not allowed
```

12.3.13 The ValidateNotNullOrEmpty attribute

This attribute is used in a *script-parameter* or *variable* to specify that the argument if the parameter cannot be $null, an empty string, or an empty array, or be a collection containing a $null-valued or empty string element.

Consider a function call `Test` that has the following param block, and which is called as shown:

PowerShell

```
param (
    [ValidateNotNullOrEmpty()]
    [string[]] $Names
)

Test "Jack", "Jill"    # ok
Test "Mary", ""        # empty string not allowed
Test "Jane", $null     # $null array element value not allowed
Test $null             # null array not allowed
Test @()               # empty array not allowed

[ValidateNotNullOrEmpty()]$Name = "Jack" # ok
$Name = ""             # empty string not allowed
$Name = $null          # null value not allowed
```

12.3.14 The ValidatePattern attribute

This attribute is used in a *script-parameter* or *variable* to specify a regular expression for matching the pattern of the parameter's argument. The following arguments are used to define the characteristics of the parameter:

Parameter Name	Purpose
RegexString (position 0)	Type: String A regular expression that is used to validate the parameter's argument
Options (named)	Type: Regular-Expression-Option See [§4.2.6.4][§4.2.6.4] for the allowed values.

If the argument is a collection, each element in the collection must match the pattern.

Consider a function call `Test` that has the following param block, and which is called as shown:

PowerShell

```
param (
    [ValidatePattern('\^[A-Z][1-5][0-9]$')]
    [string] $Code,

    [ValidatePattern('\^(0x|0X)([A-F]|[a-f]|[0-9])([A-F]|[a-f]|[0-9])$')]
    [string] $HexNum,

    [ValidatePattern('\^[+|-]?[1-9]$')]
    [int] $Minimum
)

Test -c A12 # matches pattern
Test -c A63 # does not match pattern

Test -h 0x4f # matches pattern
Test -h "0XB2" # matches pattern
Test -h 0xK3 # does not match pattern

Test -m -4 # matches pattern
Test -m "+7" # matches pattern
Test -m -12 # matches pattern, but is too long

[ValidatePattern('\^[a-z][a-z0-9]\*$')]$ident = "abc"
$ident = "123" # does not match pattern
```

12.3.15 The ValidateRange attribute

This attribute is used in a *script-parameter* or *variable* to specify the minimum and maximum values of the parameter's argument. The following arguments are used to define the characteristics of the parameter:

Parameter Name	Purpose
MinRange (position 0)	Type: object This argument specifies the minimum value allowed.
MaxRange (position 1)	Type: object This argument specifies the maximum value allowed.

In the absence of this attribute, there is no range restriction.

Consider a function call `Test1` that has the following param block, and which is called as shown:

PowerShell

```
param (
    [parameter(Mandatory = $true)]
    [ValidateRange(1, 10)]
    [int] $StartValue
)

Test1 2
Test1 -st 7
Test1 -3 # value is too small
Test1 12 # value is too large
```

Consider a function call Test2 that has the following param block and calls:

PowerShell

```
param (
    [parameter(Mandatory = $true)]
    [ValidateRange("b", "f")]
    [string] $Name
)

Test2 "Bravo" # ok
Test2 "Alpha" # value compares less than the minimum
Test2 "Hotel" # value compares greater than the maximum
```

Consider a function call `Test3` that has the following param block, and which is called as shown:

PowerShell

```
param (
    [parameter(Mandatory = $true)]
    [ValidateRange(0.002, 0.003)]
    [double] $Distance
)

Test3 0.002
Test3 0.0019    # value is too small
Test3 "0.005"   # value is too large

[ValidateRange(13, 19)]$teenager = 15
$teenager = 20  # value is too large
```

12.3.16 The ValidateScript attribute

This attribute is used in a *script-parameter* or *variable* to specify a script that is to be used to validate the parameter's argument.

The argument in position 1 is a *script-block-expression*.

Consider a function call `Test` that has the following param block, and which is called as shown:

PowerShell

```
param (
    [Parameter(Mandatory = $true)]
    [ValidateScript( { ($_ -ge 1 -and $_ -le 3) -or ($_ -ge 20) })]
    [int] $Count
)

Test 2 # ok, valid value
Test 25 # ok, valid value
Test 5 # invalid value
Test 0 # invalid value

[ValidateScript({$_.Length --gt 7})]$password = "password" # ok
$password = "abc123" # invalid value
```

12.3.17 The ValidateSet attribute

This attribute is used in a *script-parameter* or *variable* to specify a set of valid values for the argument of the parameter. The following arguments are used to define the characteristics of the parameter:

Parameter Name	Purpose
ValidValues (position 0)	Type: string[] The set of valid values.
IgnoreCase (named)	Type: bool; Default value: $true Specifies whether case should be ignored for parameters of type string.

If the parameter has an array type, every element of the corresponding argument array must match an element of the value set.

Consider a function call `Test` that has the following param block, and which is called as shown:

PowerShell

```
param ( [ValidateSet("Red", "Green", "Blue")]
    [string] $Color,
```

```
    [ValidateSet("up", "down", "left", "right", IgnoreCase =
        $false)]
    [string] $Direction

)

Test -col "RED"    # case is ignored, is a member of the set
Test -col "white"  # case is ignored, is not a member of the set

Test -dir "up"     # case is not ignored, is a member of the set
Test -dir "Up"     # case is not ignored, is not a member of the set

[ValidateSet(("Red", "Green", "Blue")]$color = "RED" # ok, case is ignored
$color = "Purple"  # case is ignored, is not a member of the set
```

13. Cmdlets

Article • 07/29/2021

A cmdlet is a single-feature command that manipulates objects in PowerShell. Cmdlets can be recognized by their name format, a verb and noun separated by a dash (`-`), such as `Get-Help`, `Get-Process`, and `Start-Service`. A *verb pattern* is a verb expressed using wildcards, as in `W*`. A *noun pattern* is a noun expressed using wildcards, as in *event*.

Cmdlets should be simple and be designed to be used in combination with other cmdlets. For example, **Get** cmdlets should only retrieve data, **Set** cmdlets should only establish or change data, **Format** cmdlets should only format data, and **Out** cmdlets should only direct the output to a specified destination.

For each cmdlet, provide a help file that can be accessed by typing:

```
get-help *cmdlet-name* -detailed
```

The detailed view of the cmdlet help file should include a description of the cmdlet, the command syntax, descriptions of the parameters, and an example that demonstrate the use of that cmdlet.

Cmdlets are used similarly to operating system commands and utilities. PowerShell commands are not case-sensitive.

> ⓘ **Note**
>
> Editor's note: The original document contains a list of cmdlet with descriptions, syntax diagrams, parameter definitions, and examples. This information is incomplete and out dated. For current information about cmdlet, consult the **Reference** section of the **PowerShell documentation**.

13.1 Common parameters

The *common parameters* are a set of cmdlet parameters that can be used with any cmdlet. They are implemented by the PowerShell runtime environment itself, not by the cmdlet developer, and they are automatically available to any cmdlet or function that uses the **Parameter** attribute (§12.3.7) or **CmdletBinding** attribute (§12.3.5).

Although the common parameters are accepted by any cmdlet, they might not have any semantics for that cmdlet. For example, if a cmdlet does not generate any verbose output, using the **Verbose** common parameter has no effect.

Several common parameters override system defaults or preferences that can be set via preference variables (§2.3.2.3). Unlike the preference variables, the common parameters affect only the commands in which they are used.

> ⓘ **Note**
>
> Editor's note: The original document contains a list of the Common Parameters. This information is incomplete and out dated. For current information see **about_CommonParameters**.

A. Comment-Based Help

Article • 07/29/2021

PowerShell provides a mechanism for programmers to document their scripts using special comment directives. Comments using such syntax are called *help comments*. The cmdlet Get-Help generates documentation from these directives.

A.1 Introduction

A help comment contains a *help directive* of the form *.name* followed on one or more subsequent lines by the help content text. The help comment can be made up of a series of *single-line-comment*s or a *delimited-comment* (§2.2.3). The set of comments comprising the documentation for a single entity is called a *help topic*.

For example,

PowerShell

```
# <help-directive-1>
# <help-content-1>
...

# <help-directive-n>
# <help-content-n>
```

or

PowerShell

```
<#
<help-directive-1>
<help-content-1>
...

<help-directive-n>
<help-content-n>
#>
```

All of the lines in a help topic must be contiguous. If a help topic follows a comment that is not part of that topic, there must be at least one blank line between the two.

The directives can appear in any order, and some of the directives may appear multiple times.

Directive names are not case-sensitive.

When documenting a function, help topics may appear in one of three locations:

- Immediately before the function definition with no more than one blank line between the last line of the function help and the line containing the function statement.
- Inside the function's body immediately following the opening curly bracket.
- Inside the function's body immediately preceding the closing curly bracket.

When documenting a script file, help topics may appear in one of two locations:

- At the beginning of the script file, optionally preceded by comments and blank lines only. If the first item in the script after the help is a function definition, there must be at least two blank lines between the end of the script help and that function declaration. Otherwise, the help will be interpreted as applying to the function instead of the script file.
- At the end of the script file.

A.2 Help directives

A.2.1 .DESCRIPTION

Syntax:

Syntax

```
.DESCRIPTION
```

Description:

This directive allows for a detailed description of the function or script. (The `.SYNOPSIS` directive (§A.2.11) is intended for a brief description.) This directive can be used only once in each topic.

Examples:

PowerShell

```
<#
.DESCRIPTION
Computes Base to the power Exponent. Supports non-negative integer
powers only.
#>
```

A.2.2 .EXAMPLE

Syntax:

```
Syntax
.EXAMPLE
```

Description:

This directive allows an example of command usage to be shown.

If this directive occurs multiple times, each associated help content block is displayed as a separate example.

Examples:

```powershell
<#
.EXAMPLE
Get-Power 3 4
81

.EXAMPLE
Get-Power -Base 3 -Exponent 4
81
#>
```

A.2.3 .EXTERNALHELP

Syntax:

```
Syntax
.EXTERNALHELP <XMLHelpFilePath>
```

Description:

This directive specifies the path to an XML-based help file for the script or function.

Although comment-based help is easier to implement, XML-based Help is required if more precise control is needed over help content or if help topics are to be translated

into multiple languages. The details of XML-based help are not defined by this specification.

Examples:

```PowerShell
<#
.ExternalHelp C:\MyScripts\Update-Month-Help.xml
#>
```

A.2.4 .FORWARDHELPCATEGORY

Syntax:

```Syntax
.FORWARDHELPCATEGORY <Category>
```

Description:

Specifies the help category of the item in **ForwardHelpTargetName** (§A.2.5). Valid values are **Alias**, **All**, **Cmdlet**, **ExternalScript**, **FAQ**, **Filter**, **Function**, **General**, **Glossary**, **HelpFile**, **Provider**, and **ScriptCommand**. Use this directive to avoid conflicts when there are commands with the same name.

Examples:

See §A.2.5.

A.2.5 .FORWARDHELPTARGETNAME

Syntax:

```Syntax
.FORWARDHELPTARGETNAME <Command-Name>
```

Description:

Redirects to the help topic specified by `<Command-Name>`.

Examples:

PowerShell

```
function Help {
<#
.FORWARDHELPTARGETNAME Get-Help
.FORWARDHELPCATEGORY Cmdlet
#>
    ...
}
```

The command `Get-Help help` is treated as if it were `Get-Help Get-Help` instead.

A.2.6 .INPUTS

Syntax:

Syntax

```
.INPUTS
```

Description:

The pipeline can be used to pipe one or more objects to a script or function. This directive is used to describe such objects and their types.

If this directive occurs multiple times, each associated help content block is collected in the one documentation entry, in the directives' lexical order.

Examples:

PowerShell

```
<#
.INPUTS
None. You cannot pipe objects to Get-Power.

.INPUTS
For the Value parameter, one or more objects of any kind can be written
to the pipeline. However, the object is converted to a string before it
is added to the item.
#>
function Process-Thing {
    param ( ...
        [Parameter(ValueFromPipeline=$true)]
        [object[]]$Value,
        ...
    )
```

```
    ...
}
```

A.2.7 .LINK

Syntax:

```
Syntax

.LINK
```

Description:

This directive specifies the name of a related topic.

If this directive occurs multiple times, each associated help content block is collected in the one documentation entry, in the directives' lexical order.

The Link directive content can also include a URI to an online version of the same help topic. The online version is opens when Get-Help is invoked with the Online parameter. The URI must begin with "http" or "https".

Examples:

```
PowerShell

<#
.LINK
Online version: http://www.acmecorp.com/widget.html

.LINK
Set-ProcedureName
#>
```

A.2.8 .NOTES

Syntax:

```
Syntax

.NOTES
```

Description:

This directive allows additional information about the function or script to be provided. This directive can be used only once in each topic.

Examples:

PowerShell

```
<#
.Notes
*arbitrary text goes here*
#>
```

A.2.9 .OUTPUTS

Syntax:

Syntax

```
.OUTPUTS
```

Description:

This directive is used to describe the objects output by a command.

If this directive occurs multiple times, each associated help content block is collected in the one documentation entry, in the directives' lexical order.

Examples:

PowerShell

```
<#
.OUTPUTS
double - Get-Power returns Base to the power Exponent.

.OUTPUTS
None unless the -PassThru switch parameter is used.
#>
```

A.2.10 .PARAMETER

Syntax:

Syntax

```
.PARAMETER <Parameter-Name>
```

Description:

This directive allows for a detailed description of the given parameter. This directive can be used once for each parameter. Parameter directives can appear in any order in the comment block; however, the order in which their corresponding parameters are actually defined in the source determines the order in which the parameters and their descriptions appear in the resulting documentation.

An alternate format involves placing a parameter description comment immediately before the declaration of the corresponding parameter variable's name. If the source contains both a parameter description comment and a Parameter directive, the description associated with the Parameter directive is used.

Examples:

PowerShell

```powershell
<#
.PARAMETER Base
The integer value to be raised to the Exponent-th power.

.PARAMETER Exponent
The integer exponent to which Base is to be raised.
#>

function Get-Power {
    param ([long]$Base, [int]$Exponent)
    ...
}

function Get-Power {
    param ([long]
        # The integer value to be raised to the Exponent-th power.
        $Base,
        [int]
        # The integer exponent to which Base is to be raised.
        $Exponent
    )
    ...
}
```

A.2.11 .SYNOPSIS

Syntax:

```
```

PowerShell

```
.SYNOPSIS
```

Description:

This directive allows for a brief description of the function or script. (The `.DESCRIPTION` directive (§A.2.1) is intended for a detailed description.) This directive can be used only once in each topic.

Examples:

PowerShell

```
<#
.SYNOPSIS
Computes Base to the power Exponent.
#>
```

B. Grammar

Article • 05/22/2021

This appendix contains summaries of the lexical and syntactic grammars found in the main document.

> **Tip**
>
> The `~opt~` notation in the syntax definitions indicates that the lexical entity is optional in the syntax.

B.1 Lexical grammar

Syntax

```
input:
    input-elements~opt~ signature-block~opt~

input-elements:
    input-element
    input-elements input-element

input-element:
    whitespace
    comment
    token

signature-block:
    signature-begin signature signature-end

signature-begin:
    new-line-character # SIG # Begin signature block new-line-character

signature:
    base64 encoded signature blob in multiple single-line-comments

signature-end:
    new-line-character # SIG # End signature block new-line-character
```

B.1.1 Line terminators

Syntax

```
new-line-character:
    Carriage return character (U+000D)
    Line feed character (U+000A)
    Carriage return character (U+000D) followed by line feed character
(U+000A)

new-lines:
    new-line-character
    new-lines new-line-character
```

B.1.2 Comments

Syntax

```
comment:
    single-line-comment
    requires-comment
    delimited-comment

single-line-comment:
    # input-characters~opt~

input-characters:
    input-character
    input-characters input-character

input-character:
    Any Unicode character except a new-line-character

requires-comment:
    #requires whitespace command-arguments

dash:
    - (U+002D)
    EnDash character (U+2013)
    EmDash character (U+2014)
    Horizontal bar character (U+2015)

dashdash:
    dash dash

delimited-comment:
    <# delimited-comment-text~opt~ hashes >

delimited-comment-text:
    delimited-comment-section
    delimited-comment-text delimited-comment-section

delimited-comment-section:
    >
    hashes~opt~ not-greater-than-or-hash
```

```
hashes:
    #
    hashes #

not-greater-than-or-hash:
    Any Unicode character except > or #
```

B.1.3 White space

Syntax

```
whitespace:
    Any character with Unicode class Zs, Zl, or Zp
    Horizontal tab character (U+0009)
    Vertical tab character (U+000B)
    Form feed character (U+000C)
    ` (The backtick character U+0060) followed by new-line-character
```

B.1.4 Tokens

Syntax

```
token:
    keyword
    variable
    command
    command-parameter
    command-argument-token
    integer-literal
    real-literal
    string-literal
    type-literal
    operator-or-punctuator
```

B.1.5 Keywords

Syntax

```
keyword: one of
    begin          break          catch       class
    continue       data           define      do
    dynamicparam   else           elseif      end
    exit           filter         finally     for
    foreach        from           function    if
    in             inlinescript   parallel    param
    process        return         switch      throw
```

```
    trap            try             until       using
    var             while           workflow
```

B.1.6 Variables

Syntax

```
variable:
    $$
    $?
    $^
    $   variable-scope~opt~  variable-characters
    @   variable-scope~opt~  variable-characters
    braced-variable


braced-variable:
    ${   variable-scope~opt~   braced-variable-characters   }

variable-scope:
    global:
    local:
    private:
    script:
    using:
    workflow:
    variable-namespace

variable-namespace:
    variable-characters   :

variable-characters:
    variable-character
    variable-characters   variable-character

variable-character:
    A Unicode character of classes Lu, Ll, Lt, Lm, Lo, or Nd
    _   (The underscore character U+005F)
    ?

braced-variable-characters:
    braced-variable-character
    braced-variable-characters   braced-variable-character

braced-variable-character:
    Any Unicode character except
        }   (The closing curly brace character U+007D)
        `   (The backtick character U+0060)
    escaped-character

escaped-character:
    `   (The backtick character U+0060) followed by any Unicode character
```

B.1.7 Commands

Syntax

```
generic-token:
    generic-token-parts

generic-token-parts:
    generic-token-part
    generic-token-parts generic-token-part

generic-token-part:
    expandable-string-literal
    verbatim-here-string-literal
    variable
    generic-token-char

generic-token-char:
    Any Unicode character except
        {   }   (   )   ;   ,   |   &   $
        ` (The backtick character U+0060)
        double-quote-character
        single-quote-character
        whitespace
        new-line-character
        escaped-character

generic-token-with-subexpr-start:
    generic-token-parts $(
```

B.1.8 Parameters

Syntax

```
command-parameter:
    dash first-parameter-char parameter-chars colon~opt~

first-parameter-char:
    A Unicode character of classes Lu, Ll, Lt, Lm, or Lo
    _ (The underscore character U+005F)
    ?

parameter-chars:
    parameter-char
    parameter-chars parameter-char

parameter-char:
    Any Unicode character except
        { } ( ) ; , | & . [
```

```
        colon
        whitespace
        new-line-character

colon:
    : (The colon character U+003A)

verbatim-command-argument-chars:
    verbatim-command-argument-part
    verbatim-command-argument-chars verbatim-command-argument-part

verbatim-command-argument-part:
    verbatim-command-string
    & non-ampersand-character
    Any Unicode character except
        |
        new-line-character

non-ampersand-character:
    Any Unicode character except &

verbatim-command-string:
    double-quote-character non-double-quote-chars
    double-quote-character

non-double-quote-chars:
    non-double-quote-char
    non-double-quote-chars non-double-quote-char

non-double-quote-char:
    Any Unicode character except
        double-quote-character
```

B.1.9 Literals

Syntax

```
literal:
    integer-literal
    real-literal
    string-literal
```

B.1.9.1 Integer Literals

Syntax

```
integer-literal:
    decimal-integer-literal
    hexadecimal-integer-literal
```

```
decimal-integer-literal:
    decimal-digits numeric-type-suffix~opt~ numeric-multiplier~opt~

decimal-digits:
    decimal-digit
    decimal-digit decimal-digits

decimal-digit: one of
    0  1  2  3  4  5  6  7  8  9

numeric-type-suffix:
    long-type-suffix
    decimal-type-suffix

hexadecimal-integer-literal:
    0x hexadecimal-digits long-type-suffix~opt~
    numeric-multiplier~opt~

hexadecimal-digits:
    hexadecimal-digit
    hexadecimal-digit decimal-digits

hexadecimal-digit: one of
    0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f

long-type-suffix:
    l

numeric-multiplier: one of
    kb mb gb tb pb
```

B.1.9.2 Real Literals

Syntax

```
real-literal:
    decimal-digits . decimal-digits exponent-part~opt~ decimal-type-
suffix~opt~ numeric-multiplier~opt~
    . decimal-digits exponent-part~opt~ decimal-type-suffix~opt~ numeric-
multiplier~opt~
    decimal-digits exponent-part decimal-type-suffix~opt~ numeric-
multiplier~opt~

exponent-part:
    e sign~opt~  decimal-digits

sign: one of
    +
    dash

decimal-type-suffix:
```

```
    d
    l
```

B.1.9.3 String Literals

Syntax

```
string-literal:
    expandable-string-literal
    expandable-here-string-literal
    verbatim-string-literal
    verbatim-here-string-literal

expandable-string-literal:
    double-quote-character expandable-string-characters~opt~  dollars~opt~
double-quote-character

double-quote-character:
    " (U+0022)
    Left double quotation mark (U+201C)
    Right double quotation mark (U+201D)
    Double low-9 quotation mark (U+201E)

expandable-string-characters:
      expandable-string-part
      expandable-string-characters
      expandable-string-part

expandable-string-part:
    Any Unicode character except
        $
        double-quote-character
        ` (The backtick character U+0060)
    braced-variable
    $ Any Unicode character except
        (
        {
        double-quote-character
        ` (The backtick character U+0060)*
    $ escaped-character
    escaped-character
    double-quote-character double-quote-character

dollars:
    $
    dollars $

expandable-here-string-literal:
    @  double-quote-character  whitespace~opt~  new-line-character
        expandable-here-string-characters~opt~  new-line-character  double-
quote-character  @
```

```
expandable-here-string-characters:
    expandable-here-string-part
    expandable-here-string-characters  expandable-here-string-part

expandable-here-string-part:
    Any Unicode character except
        $
        new-line-character
    braced-variable
    $ Any Unicode character except
        (
        new-line-character
    $ new-line-character  Any Unicode character except double-quote-char
    $ new-line-character double-quote-char  Any Unicode character except @
    new-line-character  Any Unicode character except double-quote-char
    new-line-character double-quote-char  Any Unicode character except @

expandable-string-with-subexpr-start:
    double-quote-character  expandable-string-chars~opt~  $(

expandable-string-with-subexpr-end:
    double-quote-char

expandable-here-string-with-subexpr-start:
    @  double-quote-character whitespace~opt~ new-line-character expandable-
here-string-chars~opt~  $(

expandable-here-string-with-subexpr-end:
    new-line-character  double-quote-character  @

verbatim-string-literal:
    single-quote-character verbatim-string-characters~opt~ single-quote-char

single-quote-character:
    ' (U+0027)
    Left single quotation mark (U+2018)
    Right single quotation mark (U+2019)
    Single low-9 quotation mark (U+201A)
    Single high-reversed-9 quotation mark (U+201B)

verbatim-string-characters:
    verbatim-string-part
    verbatim-string-characters verbatim-string-part

verbatim-string-part:
    *Any Unicode character except* single-quote-character
    single-quote-character  single-quote-character

verbatim-here-string-literal:
    @ single-quote-character whitespace~opt~  new-line-character
        verbatim-here-string-characters~opt~  new-line-character
            single-quote-character *@*

verbatim-*here-string-characters:
    verbatim-here-string-part
```

```
    verbatim-here-string-characters  verbatim-here-string-part

verbatim-here-string-part:
    Any Unicode character except* new-line-character
    new-line-character  Any Unicode character except single-quote-character
    new-line-character  single-quote-character  Any Unicode character except
@
```

B.1.10 Simple Names

Syntax

```
simple-name:
    simple-name-first-char simple-name-chars

simple-name-first-char:
    A Unicode character of classes Lu, Ll, Lt, Lm, or Lo
    _ (The underscore character U+005F)

simple-name-chars:
    simple-name-char
    simple-name-chars simple-name-char

simple-name-char:
    A Unicode character of classes Lu, Ll, Lt, Lm, Lo, or Nd
    _ (The underscore character U+005F)
```

B.1.11 Type Names

Syntax

```
type-name:
    type-identifier
    type-name . type-identifier

type-identifier:
    type-characters

type-characters:
    type-character
    type-characters type-character

type-character:
    A Unicode character of classes Lu, Ll, Lt, Lm, Lo, or Nd
    _ (The underscore character U+005F)

array-type-name:
    type-name [
```

```
generic-type-name:
    type-name [
```

B.1.12 Operators and punctuators

Syntax

```
operator-or-punctuator: one of
    {   }   [   ]   (   )   @(   @{   $(   ;
    &&  ||  &   |   ,   ++  ..   ::   .
    !   *   /   %   +
    dash       dashdash
    dash and   dash band   dash bnot   dash bor
    dash bxor  dash not    dash or     dash xor
    assignment-operator
    merging-redirection-operator
    file-redirection-operator
    comparison-operator
    format-operator

assignment-operator: one of
    =    dash =    +=    *=    /=    %=

file-redirection-operator: one of
    >  >>  2>  2>>  3>  3>>  4>  4>>
    5>  5>>  6>  6>>  *>  *>>  <

merging-redirection-operator: one of
    *>&1  2>&1  3>&1  4>&1  5>&1  6>&1
    *>&2  1>&2  3>&2  4>&2  5>&2  6>&2

comparison-operator: one of
    dash as           dash ccontains      dash ceq
    dash cge          dash cgt            dash cle
    dash clike        dash clt            dash cmatch
    dash cne          dash cnotcontains   dash cnotlike
    dash cnotmatch    dash contains       dash creplace
    dash csplit       dash eq             dash ge
    dash gt           dash icontains      dash ieq
    dash ige          dash igt            dash ile
    dash ilike        dash ilt            dash imatch
    dash in           dash ine            dash inotcontains
    dash inotlike     dash inotmatch      dash ireplace
    dash is           dash isnot          dash isplit
    dash join         dash le             dash like
    dash lt           dash match          dash ne
    dash notcontains  dash notin         dash notlike
    dash notmatch     dash replace       dash shl*
    dash shr          dash split

format-operator:
    dash f
```

B.2 Syntactic grammar

B.2.1 Basic concepts

Syntax

```
script-file:
    script-block

module-file:
    script-block

interactive-input:
    script-block

data-file:
    statement-list
```

B.2.2 Statements

Syntax

```
script-block:
    param-block~opt~ statement-terminators~opt~ script-block-body~opt~

param-block:
    new-lines~opt~ attribute-list~opt~ new-lines~opt~ param new-lines~opt~
        ( parameter-list~opt~ new-lines~opt~ )

parameter-list:
    script-parameter
    parameter-list new-lines~opt~ , script-parameter

script-parameter:
    new-lines~opt~ attribute-list~opt~ new-lines~opt~ variable script-
parameter-default~opt~

script-parameter-default:
    new-lines~opt~ = new-lines~opt~ expression

script-block-body:
    named-block-list
    statement-list

named-block-list:
    named-block
    named-block-list named-block
```

```
named-block:
    block-name statement-block statement-terminators~opt~

block-name: one of
    dynamicparam begin process end

statement-block:
    new-lines~opt~ { statement-list~opt~ new-lines~opt~ }

statement-list:
    statement
    statement-list statement

statement:
    if-statement
    label~opt~ labeled-statement
    function-statement
    flow-control-statement statement-terminator
    trap-statement
    try-statement
    data-statement
    inlinescript-statement
    parallel-statement
    sequence-statement
    pipeline statement-terminator

statement-terminator:
    ;
    new-line-character

statement-terminators:
    statement-terminator
    statement-terminators statement-terminator

if-statement:
    if new-lines~opt~ ( new-lines~opt~ pipeline new-lines~opt~ ) statement-
block
        elseif-clauses~opt~ else-clause~opt~

elseif-clauses:
    elseif-clause
    elseif-clauses elseif-clause

elseif-clause:
    new-lines~opt~ elseif new-lines~opt~ ( new-lines~opt~ pipeline new-
lines~opt~ ) statement-block

else-clause:
    new-lines~opt~ else statement-block

labeled-statement:
    switch-statement
    foreach-statement
    for-statement
```

```
    while-statement
    do-statement

switch-statement:
    switch new-lines~opt~ switch-parameters~opt~ switch-condition switch-
body

switch-parameters:
    switch-parameter
    switch-parameters switch-parameter

switch-parameter:
    -regex
    -wildcard
    -exact
    -casesensitive
    -parallel

switch-condition:
    ( new-lines~opt~ pipeline new-lines~opt~ )
    -file new-lines~opt~ switch-filename

switch-filename:
    command-argument
    primary-expression

switch-body:
    new-lines~opt~ { new-lines~opt~ switch-clauses }

switch-clauses:
    switch-clause
    switch-clauses switch-clause

switch-clause:
    switch-clause-condition statement-block statement-terimators~opt~

switch-clause-condition:
    command-argument
    primary-expression

foreach-statement:
    foreach new-lines~opt~ foreach-parameter~opt~ new-lines~opt~
        ( new-lines~opt~ variable new-lines~opt~ in new-lines~opt~ pipeline
        new-lines~opt~ ) statement-block

foreach-parameter:
    -parallel

for-statement:
    for new-lines~opt~ (
        new-lines~opt~ for-initializer~opt~ statement-terminator
        new-lines~opt~ for-condition~opt~ statement-terminator
        new-lines~opt~ for-iterator~opt~
        new-lines~opt~ ) statement-block
    for new-lines~opt~ (
```

```
        new-lines~opt~ for-initializer~opt~ statement-terminator
        new-lines~opt~ for-condition~opt~
        new-lines~opt~ ) statement-block
    for new-lines~opt~ (
        new-lines~opt~ for-initializer~opt~
        new-lines~opt~ ) statement-block

for-initializer:
    pipeline

for-condition:
    pipeline

for-iterator:
    pipeline

while-statement:
    while new-lines~opt~ ( new-lines~opt~ while-condition new-lines~opt~ )
statement-block

do-statement:
    do statement-block new-lines~opt~ while new-lines~opt~ ( while-condition
new-lines~opt~ )
    do statement-block new-lines~opt~ until new-lines~opt~ ( while-condition
new-lines~opt~ )

while-condition:
    new-lines~opt~ pipeline

function-statement:
    function new-lines~opt~ function-name function-parameter-
declaration~opt~ { script-block }
    filter new-lines~opt~ function-name function-parameter-declaration~opt~
{ script-block }
    workflow new-lines~opt~ function-name function-parameter-
declaration~opt~ { script-block }

function-name:
    command-argument

function-parameter-declaration:
    new-lines~opt~ ( parameter-list new-lines~opt~ )

flow-control-statement:
    break label-expression~opt~
    continue label-expression~opt~
    throw pipeline~opt~
    return pipeline~opt~
    exit pipeline~opt~

label-expression:
    simple-name
    unary-expression

trap-statement:
```

```
    trap new-lines~opt~ type-literal~opt~ new-lines~opt~ statement-block

try-statement:
    try statement-block catch-clauses
    try statement-block finally-clause
    try statement-block catch-clauses finally-clause

catch-clauses:
    catch-clause
    catch-clauses catch-clause

catch-clause:
    new-lines~opt~ catch catch-type-list~opt~ statement-block

catch-type-list:
    new-lines~opt~ type-literal
    catch-type-list new-lines~opt~ , new-lines~opt~ type-literal

finally-clause:
    new-lines~opt~ finally statement-block

data-statement:
    data new-lines~opt~ data-name data-commands-allowed~opt~
    statement-block

data-name:
    simple-name

data-commands-allowed:
    new-lines~opt~ -supportedcommand data-commands-list

data-commands-list:
    new-lines~opt~ data-command
    data-commands-list , new-lines~opt~ data-command

data-command:
    command-name-expr

inlinescript-statement:
    inlinescript statement-block

parallel-statement:
    parallel statement-block

sequence-statement:
    sequence statement-block

pipeline:
    assignment-expression
    expression redirections~opt~ pipeline-tail~opt~
    command verbatim-command-argument~opt~ pipeline-tail~opt~

assignment-expression:
    expression assignment-operator statement
```

```
pipeline-tail:
    | new-lines~opt~ command
    | new-lines~opt~ command pipeline-tail

command:
    command-name command-elements~opt~
    command-invocation-operator command-module~opt~ command-name-expr
command-elements~opt~

command-invocation-operator: one of
    &   .

command-module:
    primary-expression

command-name:
    generic-token
    generic-token-with-subexpr

generic-token-with-subexpr:
    No whitespace is allowed between ) and command-name.
    generic-token-with-subexpr-start statement-list~opt~ ) command-name

command-name-expr:
    command-name
    primary-expression

command-elements:
    command-element
    command-elements command-element

command-element:
    command-parameter
    command-argument
    redirection

command-argument:
    command-name-expr

verbatim-command-argument:
    --% verbatim-command-argument-chars

redirections:
    redirection
    redirections redirection

redirection:
    merging-redirection-operator
    file-redirection-operator redirected-file-name

redirected-file-name:
    command-argument
    primary-expression
```

B.2.3 Expressions

Syntax

```
expression:
    logical-expression

logical-expression:
    bitwise-expression
    logical-expression -and new-lines~opt~ bitwise-expression
    logical-expression -or new-lines~opt~ bitwise-expression
    logical-expression -xor new-lines~opt~ bitwise-expression

bitwise-expression:
    comparison-expression
    bitwise-expression -band new-lines~opt~ comparison-expression
    bitwise-expression -bor new-lines~opt~ comparison-expression
    bitwise-expression -bxor new-lines~opt~ comparison-expression

comparison-expression:
    additive-expression
    comparison-expression comparison-operator new-lines~opt~
    additive-expression

additive-expression:
    multiplicative-expression
    additive-expression + new-lines~opt~ multiplicative-expression
    additive-expression dash new-lines~opt~ multiplicative-expression

multiplicative-expression:
    format-expression
    multiplicative-expression \ new-lines~opt~ format-expression
    multiplicative-expression / new-lines~opt~ format-expression
    multiplicative-expression % new-lines~opt~ format-expression

format-expression:
    range-expression
    format-expression format-operator new-lines~opt~ range-expression

range-expression:
    array-literal-expression
    range-expression .. new-lines~opt~ array-literal-expression

array-literal-expression:
    unary-expression
    unary-expression , new-lines~opt~ array-literal-expression

unary-expression:
    primary-expression
    expression-with-unary-operator

expression-with-unary-operator:
    , new-lines~opt~ unary-expression
    -not new-lines~opt~ unary-expression
```

```
    ! new-lines~opt~ unary-expression
    -bnot new-lines~opt~ unary-expression
    + new-lines~opt~ unary-expression
    dash new-lines~opt~ unary-expression
    pre-increment-expression
    pre-decrement-expression
    cast-expression
    -split new-lines~opt~ unary-expression
    -join new-lines~opt~ unary-expression

pre-increment-expression:
    ++ new-lines~opt~ unary-expression

pre-decrement-expression:
    dashdash new-lines~opt~ unary-expression

cast-expression:
    type-literal unary-expression

attributed-expression:
    type-literal variable

primary-expression:
    value
    member-access
    element-access
    invocation-expression
    post-increment-expression
    post-decrement-expression

value:
    parenthesized-expression
    sub-expression
    array-expression
    script-block-expression
    hash-literal-expression
    literal
    type-literal
    variable

parenthesized-expression:
    ( new-lines~opt~ pipeline new-lines~opt~ )

sub-expression:
    $( new-lines~opt~ statement-list~opt~ new-lines~opt~ )

array-expression:
    @( new-lines~opt~ statement-list~opt~ new-lines~opt~ )

script-block-expression:
    { new-lines~opt~ script-block new-lines~opt~ }

hash-literal-expression:
    @{ new-lines~opt~ hash-literal-body~opt~ new-lines~opt~ }
```

```
hash-literal-body:
    hash-entry
    hash-literal-body statement-terminators hash-entry

hash-entry:
    key-expression = new-lines~opt~ statement

key-expression:
    simple-name
    unary-expression

post-increment-expression:
    primary-expression ++

post-decrement-expression:
    primary-expression dashdash

member-access: Note no whitespace is allowed after
    primary-expression.
    primary-expression . member-name
    primary-expression :: member-name

element-access: Note no whitespace is allowed between primary-expression and
[.
    primary-expression [ new-lines~opt~ expression new-lines~opt~ ]

invocation-expression: Note no whitespace is allowed after
    primary-expression.
    primary-expression . member-name argument-list
    primary-expression :: member-name argument-list

argument-list:
    ( argument-expression-list~opt~ new-lines~opt~ )

argument-expression-list:
    argument-expression
    argument-expression new-lines~opt~ , argument-expression-list

argument-expression:
    new-lines~opt~ logical-argument-expression

logical-argument-expression:
    bitwise-argument-expression
    logical-argument-expression -and new-lines~opt~ bitwise-argument-
expression
    logical-argument-expression -or  new-lines~opt~ bitwise-argument-
expression
    logical-argument-expression -xor new-lines~opt~ bitwise-argument-
expression

bitwise-argument-expression:
    comparison-argument-expression
    bitwise-argument-expression -band new-lines~opt~ comparison-argument-
expression
    bitwise-argument-expression -bor  new-lines~opt~ comparison-argument-
```

```
expression
    bitwise-argument-expression -bxor new-lines~opt~ comparison-argument-
expression

comparison-argument-expression:
    additive-argument-expression
    comparison-argument-expression comparison-operator
        new-lines~opt~ additive-argument-expression

additive-argument-expression:
    multiplicative-argument-expression
    additive-argument-expression +    new-lines~opt~ multiplicative-
argument-expression
    additive-argument-expression dash new-lines~opt~ multiplicative-
argument-expression

multiplicative-argument-expression:
    format-argument-expression
    multiplicative-argument-expression \ new-lines~opt~ format-argument-
expression
    multiplicative-argument-expression / new-lines~opt~ format-argument-
expression
    multiplicative-argument-expression % new-lines~opt~ format-argument-
expression

format-argument-expression:
    range-argument-expression
    format-argument-expression format-operator new-lines~opt~ range-
argument-expression

range-argument-expression:
    unary-expression
    range-expression .. new-lines~opt~ unary-expression

member-name:
    simple-name
    string-literal
    string-literal-with-subexpression
    expression-with-unary-operator
    value

string-literal-with-subexpression:
    expandable-string-literal-with-subexpr
    expandable-here-string-literal-with-subexpr

expandable-string-literal-with-subexpr:
    expandable-string-with-subexpr-start statement-list~opt~ )
        expandable-string-with-subexpr-characters expandable-string-with-
subexpr-end
    expandable-here-string-with-subexpr-start statement-list~opt~ )
        expandable-here-string-with-subexpr-characters
        expandable-here-string-with-subexpr-end

expandable-string-with-subexpr-characters:
    expandable-string-with-subexpr-part
```

```
    expandable-string-with-subexpr-characters expandable-string-with-
subexpr-part

expandable-string-with-subexpr-part:
    sub-expression
    expandable-string-part

expandable-here-string-with-subexpr-characters:
    expandable-here-string-with-subexpr-part
    expandable-here-string-with-subexpr-characters expandable-here-string-
with-subexpr-part

expandable-here-string-with-subexpr-part:
    sub-expression
    expandable-here-string-part

type-literal:
    [ type-spec ]

type-spec:
    array-type-name new-lines~opt~ dimension~opt~ ]
    generic-type-name new-lines~opt~ generic-type-arguments ]
    type-name

dimension:
    ,
    dimension ,

generic-type-arguments:
    type-spec new-lines~opt~
    generic-type-arguments , new-lines~opt~ type-spec
```

B.2.4 Attributes

Syntax

```
attribute-list:
    attribute
    attribute-list new-lines~opt~ attribute

attribute:
    [ new-lines~opt~ attribute-name ( attribute-arguments new-lines~opt~ )
new-lines~opt~ ]
    type-literal

attribute-name:
    type-spec

attribute-arguments:
    attribute-argument
    attribute-argument new-lines~opt~ , attribute-arguments
```

```
attribute-argument:
    new-lines~opt~ expression
    new-lines~opt~ simple-name
    new-lines~opt~ simple-name = new-lines~opt~ expression
```

C. References

Article • 01/18/2023

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Windows PowerShell

Article • 09/17/2021

Updated: July 8, 2013

Windows PowerShell® is a task-based command-line shell and scripting language designed especially for system administration. Built on the .NET Framework, Windows PowerShell® helps IT professionals and power users control and automate the administration of the Windows operating system and applications that run on Windows.

The documents published here are written primarily for cmdlet, provider, and host application developers who require reference information about the APIs provided by Windows PowerShell. However, system administrators might also find the information provided by these documents useful.

For the basic information needed to start using Windows PowerShell, see Getting Started with Windows PowerShell .

Windows PowerShell Documents

- Installing the Windows PowerShell SDK Provides information about how to install the Windows PowerShell SDK.
- Writing a Windows PowerShell Module Provides information for administrators, script developers, and cmdlet developers who need to package and distribute their Windows PowerShell solutions.
- Writing a Windows PowerShell Cmdlet Provides information for designing and implementing cmdlets.
- Writing a Windows PowerShell Provider Provides information for designing and implementing Windows PowerShell providers. It will help you understand how Windows PowerShell providers work, and it provides sample code that you can use to start designing or writing your own providers.
- Writing a Windows PowerShell Host Application Provides information that can be used by program managers who are designing host applications and by developers who are implementing them. The host application can, define the runspace where commands are run, open sessions on a local or remote computer, and invoke the commands either synchronously or asynchronously based on the needs of the application.

- Writing a PowerShell Formatting File Provides information for the authoring of formatting files, which control the display format for the objects that are returned by commands (cmdlets, functions, and scripts).
- Windows PowerShell Reference Provides reference content for the APIs used in writing cmdlets, providers, and host applications, as well as other supporting APIs.

Installing the Windows PowerShell SDK

Article • 09/17/2021

Applies To: Windows PowerShell 2.0, Windows PowerShell 3.0

The following topic describes how to install the PowerShell SDK on different versions of Windows.

Installing Windows PowerShell 3.0 SDK for Windows 8 and Windows Server 2012

Windows PowerShell 3.0 is automatically installed with Windows 8 and Windows Server 2012. In addition, you can download and install the reference assemblies for Windows PowerShell 3.0 as part of the Windows 8 SDK. These assemblies allow you to write cmdlets, providers, and host programs for Windows PowerShell 3.0. When you install the Windows SDK for Windows 8, the Windows PowerShell assemblies are automatically installed in the reference assembly folder, in `\Program Files (x86)\Reference Assemblies\Microsoft\WindowsPowerShell\3.0`. For more information, see the Windows 8 SDK download site. Windows PowerShell code samples are also available in the powershell-sdk-samples repository.

Installing Windows PowerShell 3.0 SDK for Windows 7 and Windows Server 2008 R2

Windows 7 and Windows Server 2008 R2 automatically have PowerShell 2.0 installed. In addition, you can install PowerShell 3.0 on these systems. You can also install the Windows 8 SDK on Windows 7 and Windows Server 2008 R2 as described above.

Installing Windows PowerShell 2.0 SDK for Windows 7, Vista, XP, Server 2003, and Server 2008

The Windows PowerShell 2.0 SDK provides the reference assemblies needed to write cmdlets, providers, and hosting applications, and it provides C# sample code that can be used as the starting point when you begin writing code.

Reference assemblies

Reference assemblies are installed in the following location by default: `c:\Program Files\Reference Assemblies\Microsoft\WindowsPowerShell\V1.0`.

> **Note**
>
> Code that is compiled against the Windows PowerShell 2.0 assemblies cannot be loaded into Windows PowerShell 1.0 installations. However, code that is compiled against the Windows PowerShell 1.0 assemblies can be loaded into Windows PowerShell 2.0 installations.

Samples

Code samples are installed in the following location by default: `C:\Program Files\Microsoft SDKs\Windows\v7.0\Samples\sysmgmt\WindowsPowerShell\`. The following sections provide a brief description of what each sample does.

Cmdlet samples

- GetProcessSample01 - Shows how to write a simple cmdlet that gets all the processes on the local computer.
- GetProcessSample02 - Shows how to add parameters to the cmdlet. The cmdlet takes one or more process names and returns the matching processes.
- GetProcessSample03 - Shows how to add parameters that accept input from the pipeline.
- GetProcessSample04 - Shows how to handle non-terminating errors.
- GetProcessSample05 - Shows how to display a list of specified processes.
- SelectObject - Shows how to write a filter to select only certain objects.
- SelectString - Shows how to search files for specified patterns.
- StopProcessSample01 - Shows how to implement a PassThru parameter, and how to request user feedback by calls to the ShouldProcess and ShouldContinue methods. Users specify the PassThru parameter when they want to force the cmdlet to return an object,
- StopProcessSample02 - Shows how to stop a specific process.
- StopProcessSample03 - Shows how to declare aliases for parameters and how to support wildcards.
- StopProcessSample04 - Shows how to declare parameter sets, the object that the cmdlet takes as input, and how to specify the default parameter set to use.

Remoting samples

- RemoteRunspace01 - Shows how to create a remote runspace that is used to establish a remote connection.
- RemoteRunspacePool01 - Shows how to construct a remote runspace pool and how to run multiple commands concurrently by using this pool.
- Serialization01 - Shows how to look at an existing .NET class and make sure that information from selected public properties of this class is preserved across serialization/deserialization.
- Serialization02 - Shows how to look at an existing .NET class and make sure that information from instance of this class is preserved across serialization/deserialization when the information is not available in public properties of the class.
- Serialization03 - Shows how to look at an existing .NET class and make sure that instances of this class and of derived classes are deserialized (rehydrated) into live .NET objects.

Event samples

- Event01 - Shows how to create a cmdlet for event registration by deriving from ObjectEventRegistrationBase.
- Event02 - Shows how to shows how to receive notifications of Windows PowerShell events that are generated on remote computers. It uses the PSEventReceived event exposed through the Runspace class.

Hosting application samples

- Runspace01 - Shows how to use the PowerShell class to run the `Get-Process` cmdlet synchronously. The `Get-Process` cmdlet returns Process objects for each process running on the local computer.
- Runspace02 - Shows how to use the PowerShell class to run the `Get-Process` and `Sort-Object` cmdlets synchronously. The `Get-Process` cmdlet returns Process objects for each process running on the local computer, and the `Sort-Object` sorts the objects based on their Id property. The results of these commands is displayed by using a DataGridView control.
- Runspace03 - Shows how to use the PowerShell class to run a script synchronously, and how to handle non-terminating errors. The script receives a list of process names and then retrieves those processes. The results of the script, including any non-terminating errors that were generated when running the script, are displayed in a console window.

- Runspace04 - Shows how to use the PowerShell class to run commands, and how to catch terminating errors that are thrown when running the commands. Two commands are run, and the last command is passed a parameter argument that is not valid. As a result, no objects are returned and a terminating error is thrown.
- Runspace05 - Shows how to add a snap-in to an InitialSessionState object so that the cmdlet of the snap-in is available when the runspace is opened. The snap-in provides a Get-Proc cmdlet (defined by the GetProcessSample01 Sample) that is run synchronously using a PowerShell object.
- Runspace06 - Shows how to add a module to an InitialSessionState object so that the module is loaded when the runspace is opened. The module provides a Get-Proc cmdlet (defined by the GetProcessSample02 Sample) that is run synchronously using a PowerShell object.
- Runspace07 - Shows how to create a runspace, and then use that runspace to run two cmdlets synchronously using a PowerShell object.
- Runspace08 - Shows how to add commands and arguments to the pipeline of a PowerShell object and how to run the commands synchronously.
- Runspace09 - Shows how to add a script to the pipeline of a PowerShell object and how to run the script asynchronously. Events are used to handle the output of the script.
- Runspace10 - Shows how to create a default initial session state, how to add a cmdlet to the InitialSessionState, how to create a runspace that uses the initial session state, and how to run the command using a PowerShell object.
- Runspace11 - Shows how to use the ProxyCommand class to create a proxy command that calls an existing cmdlet, but restricts the set of available parameters. The proxy command is then added to an initial session state that is used to create a constrained runspace. This means that the user can access the functionality of the cmdlet only through the proxy command.
- PowerShell01 - Shows how to create a constrained runspace using an InitialSessionState object.
- PowerShell02 - Shows how to use a runspace pool to run multiple commands concurrently.

Host samples

- Host01 - Shows how to implement a host application that uses a custom host. In this sample a runspace is created that uses the custom host, and then the PowerShell API is used to run a script that calls `exit`. The host application then looks at the output of the script and prints out the results.
- Host02 - Shows how to write a host application that uses the Windows PowerShell runtime along with a custom host implementation. The host application sets the

host culture to German, runs the `Get-Process` cmdlet and displays the results as you would see them by using pwrsh.exe, and then prints out the current data and time in German.

- Host03 - Shows how to build an interactive console-based host application that reads commands from the command line, executes the commands, and then displays the results to the console.
- Host04 - Shows how to build an interactive console-based host application that reads commands from the command line, executes the commands, and then displays the results to the console. This host application also supports displaying prompts that allow the user to specify multiple choices.
- Host05 - Shows how to build an interactive console-based host application that reads commands from the command line, executes the commands, and then displays the results to the console. This host application also supports calls to remote computers by using the `Enter-PsSession` and `Exit-PsSession` cmdlets.
- Host06 - Shows how to build an interactive console-based host application that reads commands from the command line, executes the commands, and then displays the results to the console. In addition, this sample uses the Tokenizer APIs to specify the color of the text that is entered by the user.

Provider samples

- AccessDBProviderSample01 - Shows how to declare a provider class that derives directly from the CmdletProvider class. It is included here only for completeness.

- AccessDBProviderSample02 - Shows how to overwrite the NewDrive and RemoveDrive methods to support calls to the `New-PSDrive` and `Remove-PSDrive` cmdlets. The provider class in this sample derives from the DriveCmdletProvider class.

- AccessDBProviderSample03 - Shows how to overwrite the GetItem and SetItem methods to support calls to the `Get-Item` and `Set-Item` cmdlets. The provider class in this sample derives from the ItemCmdletProvider class.

- AccessDBProviderSample04 - Shows how to overwrite container methods to support calls to the `Copy-Item`, `Get-ChildItem`, `New-Item`, and `Remove-Item` cmdlets. These methods should be implemented when the data store contains items that are containers. A container is a group of child items under a common parent item. The provider class in this sample derives from the ItemCmdletProvider class.

- AccessDBProviderSample05 - Shows how to overwrite container methods to support calls to the `Move-Item` and `Join-Path` cmdlets. These methods should be implemented when the user needs to move items within a container and if the data store contains nested containers. The provider class in this sample derives from the NavigationCmdletProvider class.
- AccessDBProviderSample06 - Shows how to overwrite content methods to support calls to the `Clear-Content`, `Get-Content`, and `Set-Content` cmdlets. These methods should be implemented when the user needs to manage the content of the items in the data store. The provider class in this sample derives from the NavigationCmdletProvider class, and it implements the IContentCmdletProvider interface.

Windows PowerShell Reference

Article • 09/17/2021

Windows PowerShell is a Microsoft .NET Framework-connected environment designed for administrative automation. Windows PowerShell provides a new approach to building commands, composing solutions, and creating graphical user interface-based management tools.

Windows PowerShell enables a system administrator to automate the administration of system resources by the execution of commands either directly or through scripts.

Developer Audience

The Windows PowerShell Software Development Kit (SDK) is written for command developers who require reference information about the APIs provided by Windows PowerShell. Command developers use Windows PowerShell to create both commands and providers that extend the tasks that can be performed by Windows PowerShell.

Windows PowerShell Resources

In addition to the Windows PowerShell SDK, the following resources provide more information.

Getting Started with Windows PowerShell Provides an introduction to Windows PowerShell: the language, the cmdlets, the providers, and the use of objects.

Writing a Windows PowerShell Module Provides information and examples for administrators, script developers, and cmdlet developers who need to package and distribute their Windows PowerShell solutions using Windows PowerShell modules.

Writing a Windows PowerShell Cmdlet Provides information and code examples for program managers who are designing cmdlets and for developers who are implementing cmdlet code.

Windows PowerShell Team Blog The best resource for learning from and collaborating with other Windows PowerShell users. Read the Windows PowerShell Team blog, and then join the Windows PowerShell User Forum (microsoft.public.windows.powershell). Use Windows Live Search to find other Windows PowerShell blogs and resources. Then, as you develop your expertise, freely contribute your ideas.

PowerShell module browser Provides the latest versions of the command-line Help topics.

Class Libraries

System.Management.Automation This namespace is the root namespace for Windows PowerShell. It contains the classes, enumerations, and interfaces required to implement custom cmdlets. In particular, the System.Management.Automation.Cmdlet class is the base class from which all cmdlet classes must be derived. For more information about cmdlets, see.

System.Management.Automation.Provider This namespace contains the classes, enumerations, and interfaces required to implement a Windows PowerShell provider. In particular, the System.Management.Automation.Provider.Cmdletprovider class is the base class from which all Windows PowerShell provider classes must be derived.

Microsoft.PowerShell.Commands This namespace contains the classes for the cmdlets and providers implemented by Windows PowerShell. Similarly, it is recommended that you create a *YourName*.Commands namespace for those cmdlets that you implement.

System.Management.Automation.Host This namespace contains the classes, enumerations, and interfaces that the cmdlet uses to define the interaction between the user and Windows PowerShell.

System.Management.Automation.Internal This namespace contains the base classes used by other namespace classes. For example, the System.Management.Automation.Internal.Cmdletmetadataattribute class is the base class for the System.Management.Automation.CmdletAttribute class.

System.Management.Automation.Runspaces This namespace contains the classes, enumerations, and interfaces used to create a Windows PowerShell runspace. In this context, the Windows PowerShell runspace is the context in which one or more Windows PowerShell pipelines invoke cmdlets. That is, cmdlets work within the context of a Windows PowerShell runspace. For more information aboutWindows PowerShell runspaces, see Windows PowerShell Runspaces.

What's New

Article • 09/17/2021

Windows PowerShell 2.0 provides the following new features for use when writing cmdlets, providers, and host applications.

Modules

You can now package and distribute Windows PowerShell solutions by using modules. Modules allow you to partition, organize, and abstract your Windows PowerShell code into self-contained, reusable units. For more information about modules, see Writing a Windows PowerShell Module.

The PowerShell class

The PowerShell class provides a simpler solution for creating applications, referred to as host applications, that programmatically run commands. This class allows you to create a pipeline of commands, specify the runspace that is used to run the commands, and specify invoking the commands synchronously or asynchronously.

The RunspacePool class

Runspace pools allow you to create multiple runspaces by using a single call. The CreateRunspacePool method provides several overloads that can be used to create runspaces that have the same features, such as the same host, initial session state, and connection information.

The InitialSessionState class

The InitialSessionState class allows you to create a session state configuration that is used when a runspace is opened. You can create a custom configuration, a default configuration that includes the commands provided by mshshort, and a configuration whose commands are restricted based on the capabilities of the session.

Remote runspaces

You can now create runspaces that can be opened on remote computers, allowing you to run commands on the remote machine and collect the results locally. To create a

remote runspace, you must specify information about the remote connection when creating the runspace. See the CreateRunspace and CreateRunspacePool methods for examples. The connection information is defined by the RunspaceConnectionInfo class.

Private runspace elements

You can now create runspaces whose elements are public or private. This allows you to create runspaces whose elements are available to the runspace, but are not available to the user. See the ConstrainedSessionStateEntry class to find out which elements of the runspace can be made private.

Runspace threading modes and apartment state

You can now specify how threads are created and used when running commands in a runspace. See the System.Management.Automation.Runspaces.Runspace.ThreadOptions and System.Management.Automation.Runspaces.RunspacePool.ThreadOptions properties.

You can now get the apartment state of the threads that are used to run commands in a runspace. See the System.Management.Automation.Runspaces.Runspace.ApartmentState and System.Management.Automation.Runspaces.RunspacePool.ApartmentState properties.

Transaction cmdlets

You can now create cmdlets that can be used within a transaction. When a cmdlet is used in a transaction, its actions are temporary, and they can be accepted or rejected by the transaction cmdlets provided by Windows PowerShell.

For more information about transactions, see How to Support Transactions.

Transaction provider

You can now create providers that can be used within a transaction. Similar to cmdlets, when a provider is used in a transaction, its actions are temporary, and they can be accepted or rejected by the transaction cmdlets provided by Windows PowerShell.

For more information about specifying support for transaction within a provider class, see the

System.Management.Automation.Provider.CmdletProviderAttribute.ProviderCapabilities property.

Job cmdlets

You can now write cmdlets that can perform their action as a job. These jobs are run in the background without interacting with the current session. For more information about how Windows PowerShell supports jobs, see Background Jobs.

Cmdlet output types

You can now specify the .NET Framework types that are returned by your cmdlets by declaring the OutputType attribute when writing your cmdlets. This will allow others to determine what type of objects are returned by a cmdlet by looking at the OutputType property of the cmdlet.

Event support

You can now write cmdlets that add and consume events. See the PSEvent class.

Proxy commands

You can now write proxy commands that can be used to run another command. A proxy command allows you to control what functionality of the source cmdlet is available to the user. For example, you can create a proxy command that removes a parameter that is supplied by the source command. See the ProxyCommand class.

Multiple choice prompts

You can now write applications that can provide prompts that allow the user to select multiple choices. See the IHostUISupportsMultipleChoiceSelection interface

Interactive sessions

You can now write applications that can start and stop an interactive session on a remote computer. See the IHostSupportsInteractiveSession interface.

Custom Cmdlet Help for Providers

You can now create customized Help topics for the provider cmdlets. Custom cmdlet help topics can explain how the cmdlet works in the provider path and document special features, including the dynamic parameters that the provider adds to the cmdlet.

Cmdlet Overview

Article • 09/17/2021

A cmdlet is a lightweight command that is used in the PowerShell environment. The PowerShell runtime invokes these cmdlets within the context of automation scripts that are provided at the command line. The PowerShell runtime also invokes them programmatically through PowerShell APIs.

Cmdlets

Cmdlets perform an action and typically return a Microsoft .NET object to the next command in the pipeline. A cmdlet is a single command that participates in the pipeline semantics of PowerShell. This includes binary (C#) cmdlets, advanced script functions, CDXML, and Workflows.

This SDK documentation describes how to create binary cmdlets written in C#. For information about script-based cmdlets, see:

- about_Functions_Advanced
- about_Functions_CmdletBindingAttribute
- about_Functions_Advanced_Methods

To create a binary cmdlet, you must implement a cmdlet class that derives from one of two specialized cmdlet base classes. The derived class must:

- Declare an attribute that identifies the derived class as a cmdlet.
- Define public properties that are decorated with attributes that identify the public properties as cmdlet parameters.
- Override one or more of the input processing methods to process records.

You can load the assembly that contains the class directly by using the Import-Module cmdlet, or you can create a host application that loads the assembly by using the System.Management.Automation.Runspaces.Initialsessionstate API. Both methods provide programmatic and command-line access to the functionality of the cmdlet.

Cmdlet Terms

The following terms are used frequently in the PowerShell cmdlet documentation:

Cmdlet attribute

A .NET attribute that is used to declare a cmdlet class as a cmdlet. Although PowerShell uses several other attributes that are optional, the Cmdlet attribute is required. For more information about this attribute, see Cmdlet Attribute Declaration.

Cmdlet parameter

The public properties that define the parameters that are available to the user or to the application that is running the cmdlet. Cmdlets can have required, named, positional, and *switch* parameters. Switch parameters allow you to define parameters that are evaluated only if the parameters are specified in the call. For more information about the different types of parameters, see Cmdlet Parameters.

Parameter set

A group of parameters that can be used in the same command to perform a specific action. A cmdlet can have multiple parameter sets, but each parameter set must have at least one parameter that is unique. Good cmdlet design strongly suggests that the unique parameter also be a required parameter. For more information about parameter sets, see Cmdlet Parameter Sets.

Dynamic parameter

A parameter that is added to the cmdlet at runtime. Typically, the dynamic parameters are added to the cmdlet when another parameter is set to a specific value. For more information about dynamic parameters, see Cmdlet Dynamic Parameters.

Input processing methods

The System.Management.Automation.Cmdlet class provides the following virtual methods that are used to process records. All the derived cmdlet classes must override one or more of the first three methods:

- System.Management.Automation.Cmdlet.BeginProcessing: Used to provide optional one-time, pre-processing functionality for the cmdlet.
- System.Management.Automation.Cmdlet.ProcessRecord: Used to provide record-by-record processing functionality for the cmdlet. The System.Management.Automation.Cmdlet.ProcessRecord method might be called any number of times, or not at all, depending on the input of the cmdlet.
- System.Management.Automation.Cmdlet.EndProcessing: Used to provide optional one-time, post-processing functionality for the cmdlet.

- System.Management.Automation.Cmdlet.StopProcessing: Used to stop processing when the user stops the cmdlet asynchronously (for example, by pressing CTRL+C).

For more information about these methods, see Cmdlet Input Processing Methods.

When you implement a cmdlet, you must override at least one of these input processing methods. Typically, the **ProcessRecord()** is the method that you override because it is called for every record that the cmdlet processes. In contrast, the **BeginProcessing()** method and the **EndProcessing()** method are called one time to perform pre-processing or post-processing of the records. For more information about these methods, see Input Processing Methods.

ShouldProcess feature

PowerShell allows you to create cmdlets that prompt the user for feedback before the cmdlet makes a change to the system. To use this feature, the cmdlet must declare that it supports the `ShouldProcess` feature when you declare the Cmdlet attribute, and the cmdlet must call the System.Management.Automation.Cmdlet.ShouldProcess and System.Management.Automation.Cmdlet.ShouldContinue methods from within an input processing method. For more information about how to support the `ShouldProcess` functionality, see Requesting Confirmation.

Transaction

A logical group of commands that are treated as a single task. The task automatically fails if any command in the group fails, and the user has the choice to accept or reject the actions performed within the transaction. To participate in a transaction, the cmdlet must declare that it supports transactions when the Cmdlet attribute is declared. Support for transactions was introduced in Windows PowerShell 2.0. For more information about transactions, see How to Support Transactions.

How Cmdlets Differ from Commands

Cmdlets differ from commands in other command-shell environments in the following ways:

- Cmdlets are instances of .NET classes; they are not stand-alone executables.
- Cmdlets can be created from as few as a dozen lines of code.
- Cmdlets do not generally do their own parsing, error presentation, or output formatting. Parsing, error presentation, and output formatting are handled by the

PowerShell runtime.

- Cmdlets process input objects from the pipeline rather than from streams of text, and cmdlets typically deliver objects as output to the pipeline.
- Cmdlets are record-oriented because they process a single object at a time.

Cmdlet Base Classes

Windows PowerShell supports cmdlets that are derived from the following two base classes.

- Most cmdlets are based on .NET classes that derive from the System.Management.Automation.Cmdlet base class. Deriving from this class allows a cmdlet to use the minimum set of dependencies on the Windows PowerShell runtime. This has two benefits. The first benefit is that the cmdlet objects are smaller, and you are less likely to be affected by changes to the PowerShell runtime. The second benefit is that, if you have to, you can directly create an instance of the cmdlet object and then invoke it directly instead of invoking it through the PowerShell runtime.

- The more-complex cmdlets are based on .NET classes that derive from the System.Management.Automation.PSCmdlet base class. Deriving from this class gives you much more access to the PowerShell runtime. This access allows your cmdlet to call scripts, to access providers, and to access the current session state. (To access the current session state, you get and set session variables and preferences.) However, deriving from this class increases the size of the cmdlet object, and it means that your cmdlet is more tightly coupled to the current version of the PowerShell runtime.

In general, unless you need the extended access to the PowerShell runtime, you should derive from the System.Management.Automation.Cmdlet class. However, the PowerShell runtime has extensive logging capabilities for the execution of cmdlets. If your auditing model depends on this logging, you can prevent the execution of your cmdlet from within another cmdlet by deriving from the System.Management.Automation.PSCmdlet class.

Cmdlet Attributes

PowerShell defines several .NET attributes that are used to manage cmdlets and to specify common functionality that is provided by PowerShell and that might be required by the cmdlet. For example, attributes are used to designate a class as a cmdlet, to specify the parameters of the cmdlet, and to request the validation of input so that

cmdlet developers do not have to implement that functionality in their cmdlet code. For more information about attributes, see PowerShell Attributes.

Cmdlet Names

PowerShell uses a verb-and-noun name pair to name cmdlets. For example, the `Get-Command` cmdlet included in PowerShell is used to get all the cmdlets that are registered in the command shell. The verb identifies the action that the cmdlet performs, and the noun identifies the resource on which the cmdlet performs its action.

These names are specified when the .NET class is declared as a cmdlet. For more information about how to declare a .NET class as a cmdlet, see Cmdlet Attribute Declaration.

Writing Cmdlet Code

This document provides two ways to discover how cmdlet code is written. If you prefer to see the code without much explanation, see Examples of Cmdlet Code. If you prefer more explanation about the code, see the GetProc Tutorial, StopProc Tutorial, or SelectStr Tutorial topics.

For more information about the guidelines for writing cmdlets, see Cmdlet Development Guidelines.

See Also

PowerShell Cmdlet Concepts

Writing a PowerShell Cmdlet

PowerShell SDK

Windows PowerShell Cmdlet Concepts

Article • 09/17/2021

This section describes how cmdlets work.

In This Section

This section includes the following topics.

Cmdlet Development Guidelines This topic provides development guidelines that can be used to produce well-formed cmdlets.

Cmdlet Class Declaration This topic describes cmdlet class declaration.

Approved Verbs for Windows PowerShell Commands This topic lists the predefined cmdlet verbs that you can use when you declare a cmdlet class.

Cmdlet Input Processing Methods This topic describes the methods that allow a cmdlet to perform preprocessing operations, input processing operations, and post processing operations.

Cmdlet Parameters This section describes the different types of parameters that you can add to cmdlets.

Cmdlet Attributes This section describes the attributes that are used to declare .NET Framework classes as cmdlets, to declare fields as cmdlet parameters, and to declare input validation rules for parameters.

Cmdlet Aliases This topic describes cmdlet aliases.

Cmdlet Output This section describes the type of output that cmdlets can return and how to define and display the objects that are returned by cmdlets.

Registering Cmdlets This section describes how to register cmdlets by using modules and snap-ins.

Requesting Confirmation This section describes how cmdlets request confirmation from a user before they make a change to the system.

Windows PowerShell Error Reporting This section describes how cmdlets report terminating errors and non-terminating errors, and it describes how to interpret error records.

Background Jobs This topic describes how cmdlets can perform their work within background jobs that do not interfere with the commands that are executing in the current session.

Invoking Cmdlets and Scripts Within a Cmdlet This topic describes how cmdlets can invoke other cmdlets and scripts from within their input processing methods.

Cmdlet Sets This topic describes using base classes to create sets of cmdlets.

Windows PowerShell Session State This topic describes Windows PowerShell session state.

Cmdlet Development Guidelines

Article • 09/17/2021

The topics in this section provide development guidelines that you can use to produce well-formed cmdlets. By leveraging the common functionality provided by the Windows PowerShell runtime and by following these guidelines, you can develop robust cmdlets with minimal effort and provide the user with a consistent experience. Additionally, you will reduce the test burden because common functionality does not require retesting.

In This Section

- Required Development Guidelines
- Strongly Encouraged Development Guidelines
- Advisory Development Guidelines

See Also

Writing a Windows PowerShell Cmdlet

Windows PowerShell SDK

Required Development Guidelines

Article • 09/17/2021

The following guidelines must be followed when you write your cmdlets. They are separated into guidelines for designing cmdlets and guidelines for writing your cmdlet code. If you do not follow these guidelines, your cmdlets could fail, and your users might have a poor experience when they use your cmdlets.

In this Topic

Design Guidelines

- Use Only Approved Verbs (RD01)
- Cmdlet Names: Characters that cannot be Used (RD02)
- Parameters Names that cannot be Used (RD03)
- Support Confirmation Requests (RD04)
- Support Force Parameter for Interactive Sessions (RD05)
- Document Output Objects (RD06)

Code Guidelines

- Derive from the Cmdlet or PSCmdlet Classes (RC01)
- Specify the Cmdlet Attribute (RC02)
- Override an Input Processing Method (RC03)
- Specify the OutputType Attribute (RC04)
- Do Not Retain Handles to Output Objects (RC05)
- Handle Errors Robustly (RC06)
- Use a Windows PowerShell Module to Deploy your Cmdlets (RC07)

Design Guidelines

The following guidelines must be followed when designing cmdlets to ensure a consistent user experience between using your cmdlets and other cmdlets. When you find a Design guideline that applies to your situation, be sure to look at the Code guidelines for similar guidelines.

Use Only Approved Verbs (RD01)

The verb specified in the Cmdlet attribute must come from the recognized set of verbs provided by Windows PowerShell. It must not be one of the prohibited synonyms. Use the constant strings that are defined by the following enumerations to specify cmdlet verbs:

- System.Management.Automation.VerbsCommon
- System.Management.Automation.VerbsCommunications
- System.Management.Automation.VerbsData
- System.Management.Automation.VerbsDiagnostic
- System.Management.Automation.VerbsLifeCycle
- System.Management.Automation.VerbsSecurity
- System.Management.Automation.VerbsOther

For more information about the approved verb names, see Cmdlet Verbs.

Users need a set of discoverable and expected cmdlet names. Use the appropriate verb so that the user can make a quick assessment of what a cmdlet does and to easily discover the capabilities of the system. For example, the following command-line command gets a list of all the commands on the system whose names begin with "start": `get-command start-*`. Use the nouns in your cmdlets to differentiate your cmdlets from other cmdlets. The noun indicates the resource on which the operation will be performed. The operation itself is represented by the verb.

Cmdlet Names: Characters that cannot be Used (RD02)

When you name cmdlets, do not use any of the following special characters.

Character	Name
#	number sign
,	comma

Character	Name
()	parentheses
{}	braces
[]	brackets
&	ampersand
-	hyphen **Note:** The hyphen can be used to separate the verb from the noun, but it cannot be used within the noun or within the verb.
/	slash mark
\	backslash
$	dollar sign
^	caret
;	semicolon
:	colon
"	double quotation mark
'	single quotation mark
<>	angle brackets
|	vertical bar
?	question mark
@	at sign
`	back tick (grave accent)
*	asterisk
%	percent sign
+	plus sign
=	equals sign
~	tilde

Parameters Names that cannot be Used (RD03)

Windows PowerShell provides a common set a parameters to all cmdlets plus additional parameters that are added in specific situations. When designing your own cmdlets you cannot use the following names: Confirm, Debug, ErrorAction, ErrorVariable, OutBuffer, OutVariable, WarningAction, WarningVariable, WhatIf, UseTransaction, and Verbose. For more information about these parameters, see Common Parameter Names.

Support Confirmation Requests (RD04)

For cmdlets that perform an operation that modifies the system, they should call the System.Management.Automation.Cmdlet.ShouldProcess* method to request confirmation, and in special cases call the System.Management.Automation.Cmdlet.ShouldContinue* method. (The System.Management.Automation.Cmdlet.ShouldContinue* method should be called only after the System.Management.Automation.Cmdlet.ShouldProcess* method is called.)

To make these calls the cmdlet must specify that it supports confirmation requests by setting the `SupportsShouldProcess` keyword of the Cmdlet attribute. For more information about setting this attribute, see Cmdlet Attribute Declaration.

> **Note**
>
> If the Cmdlet attribute of the cmdlet class indicates that the cmdlet supports calls to the **System.Management.Automation.Cmdlet.ShouldProcess*** method, and the cmdlet fails to make the call to the **System.Management.Automation.Cmdlet.ShouldProcess*** method, the user could modify the system unexpectedly.

Use the System.Management.Automation.Cmdlet.ShouldProcess* method for any system modification. A user preference and the `WhatIf` parameter control the System.Management.Automation.Cmdlet.ShouldProcess* method. In contrast, the System.Management.Automation.Cmdlet.ShouldContinue* call performs an additional check for potentially dangerous modifications. This method is not controlled by any user preference or the `WhatIf` parameter. If your cmdlet calls the System.Management.Automation.Cmdlet.ShouldContinue* method, it should have a `Force` parameter that bypasses the calls to these two methods and that proceeds with the operation. This is important because it allows your cmdlet to be used in non-interactive scripts and hosts.

If your cmdlets support these calls, the user can determine whether the action should actually be performed. For example, the Stop-Process cmdlet calls the

System.Management.Automation.Cmdlet.ShouldContinue* method before it stops a set of critical processes, including the System, Winlogon, and Spoolsv processes.

For more information about supporting these methods, see Requesting Confirmation.

Support Force Parameter for Interactive Sessions (RD05)

If your cmdlet is used interactively, always provide a Force parameter to override the interactive actions, such as prompts or reading lines of input). This is important because it allows your cmdlet to be used in non-interactive scripts and hosts. The following methods can be implemented by an interactive host.

- System.Management.Automation.Host.PSHostUserInterface.Prompt*
- System.Management.Automation.Host.Pshostuserinterface.PromptForChoice
- System.Management.Automation.Host.Ihostuisupportsmultiplechoiceselection.PromptForChoice
- System.Management.Automation.Host.Pshostuserinterface.PromptForCredential*
- System.Management.Automation.Host.Pshostuserinterface.ReadLine*
- System.Management.Automation.Host.Pshostuserinterface.ReadLineAsSecureString*

Document Output Objects (RD06)

Windows PowerShell uses the objects that are written to the pipeline. In order for users to take advantage of the objects that are returned by each cmdlet, you must document the objects that are returned, and you must document what the members of those returned objects are used for.

Code Guidelines

The following guidelines must be followed when writing cmdlet code. When you find a Code guideline that applies to your situation, be sure to look at the Design guidelines for similar guidelines.

Derive from the Cmdlet or PSCmdlet Classes (RC01)

A cmdlet must derive from either the System.Management.Automation.Cmdlet or System.Management.Automation.PSCmdlet base class. Cmdlets that derive from the

System.Management.Automation.Cmdlet class do not depend on the Windows PowerShell runtime. They can be called directly from any Microsoft .NET Framework language. Cmdlets that derive from the System.Management.Automation.PSCmdlet class depend on the Windows PowerShell runtime. Therefore, they execute within a runspace.

All cmdlet classes that you implement must be public classes. For more information about these cmdlet classes, see Cmdlet Overview.

Specify the Cmdlet Attribute (RC02)

For a cmdlet to be recognized by Windows PowerShell, its .NET Framework class must be decorated with the Cmdlet attribute. This attribute specifies the following features of the cmdlet.

- The verb-and-noun pair that identifies the cmdlet.
- The default parameter set that is used when multiple parameter sets are specified. The default parameter set is used when Windows PowerShell does not have enough information to determine which parameter set to use.
- Indicates if the cmdlet supports calls to the System.Management.Automation.Cmdlet.ShouldProcess* method. This method displays a confirmation message to the user before the cmdlet makes a change to the system. For more information about how confirmation requests are made, see Requesting Confirmation.
- Indicate the impact level (or severity) of the action associated with the confirmation message. In most cases, the default value of Medium should be used. For more information about how the impact level affects the confirmation requests that are displayed to the user, see Requesting Confirmation.

For more information about how to declare the cmdlet attribute, see CmdletAttribute Declaration.

Override an Input Processing Method (RC03)

For the cmdlet to participate in the Windows PowerShell environment, it must override at least one of the following *input processing methods*.

System.Management.Automation.Cmdlet.BeginProcessing This method is called one time, and it is used to provide pre-processing functionality.

System.Management.Automation.Cmdlet.ProcessRecord This method is called multiple times, and it is used to provide record-by-record functionality.

System.Management.Automation.Cmdlet.EndProcessing This method is called one time, and it is used to provide post-processing functionality.

Specify the OutputType Attribute (RC04)

The OutputType attribute (introduced in Windows PowerShell 2.0) specifies the .NET Framework type that your cmdlet returns to the pipeline. By specifying the output type of your cmdlets you make the objects returned by your cmdlet more discoverable by other cmdlets. For more information about decorating the cmdlet class with this attribute, see OutputType Attribute Declaration.

Do Not Retain Handles to Output Objects (RC05)

Your cmdlet should not retain any handles to the objects that are passed to the System.Management.Automation.Cmdlet.WriteObject* method. These objects are passed to the next cmdlet in the pipeline, or they are used by a script. If you retain the handles to the objects, two entities will own each object, which causes errors.

Handle Errors Robustly (RC06)

An administration environment inherently detects and makes important changes to the system that you are administering. Therefore, it is vital that cmdlets handle errors correctly. For more information about error records, see Windows PowerShell Error Reporting.

- When an error prevents a cmdlet from continuing to process any more records, it is a terminating error. The cmdlet must call the System.Management.Automation.Cmdlet.ThrowTerminatingError* method that references an System.Management.Automation.ErrorRecord object. If an exception is not caught by the cmdlet, the Windows PowerShell runtime itself throws a terminating error that contains less information.

- For a non-terminating error that does not stop operation on the next record that is coming from the pipeline (for example, a record produced by a different process), the cmdlet must call the System.Management.Automation.Cmdlet.WriteError* method that references an System.Management.Automation.ErrorRecord object. An example of a non-terminating error is the error that occurs if a particular process fails to stop. Calling the

System.Management.Automation.Cmdlet.WriteError* method allows the user to consistently perform the actions requested and to retain the information for particular actions that fail. Your cmdlet should handle each record as independently as possible.

- The System.Management.Automation.ErrorRecord object that is referenced by the System.Management.Automation.Cmdlet.ThrowTerminatingError* and System.Management.Automation.Cmdlet.WriteError* methods requires an exception at its core. Follow the .NET Framework design guidelines when you determine the exception to use. If the error is semantically the same as an existing exception, use that exception or derive from that exception. Otherwise, derive a new exception or exception hierarchy directly from the System.Exception type.

An System.Management.Automation.ErrorRecord object also requires an error category that groups errors for the user. The user can view errors based on the category by setting the value of the `$ErrorView` shell variable to CategoryView. The possible categories are defined by the System.Management.Automation.ErrorCategory enumeration.

- If a cmdlet creates a new thread, and if the code that is running in that thread throws an unhandled exception, Windows PowerShell will not catch the error and will terminate the process.

- If an object has code in its destructor that causes an unhandled exception, Windows PowerShell will not catch the error and will terminate the process. This also occurs if an object calls Dispose methods that cause an unhandled exception.

Use a Windows PowerShell Module to Deploy your Cmdlets (RC07)

Create a Windows PowerShell module to package and deploy your cmdlets. Support for modules is introduced in Windows PowerShell 2.0. You can use the assemblies that contain your cmdlet classes directly as binary module files (this is very useful when testing your cmdlets), or you can create a module manifest that references the cmdlet assemblies. (You can also add existing snap-in assemblies when using modules.) For more information about modules, see Writing a Windows PowerShell Module.

See Also

Strongly Encouraged Development Guidelines

Advisory Development Guidelines

Strongly Encouraged Development Guidelines

Article • 10/06/2021

This section describes guidelines that you should follow when you write your cmdlets. They are separated into guidelines for designing cmdlets and guidelines for writing your cmdlet code. You might find that these guidelines are not applicable for every scenario. However, if they do apply and you do not follow these guidelines, your users might have a poor experience when they use your cmdlets.

Design Guidelines

The following guidelines should be followed when designing cmdlets to ensure a consistent user experience between using your cmdlets and other cmdlets. When you find a Design guideline that applies to your situation, be sure to look at the Code guidelines for similar guidelines.

Use a Specific Noun for a Cmdlet Name (SD01)

Nouns used in cmdlet naming need to be very specific so that the user can discover your cmdlets. Prefix generic nouns such as "server" with a shortened version of the product name. For example, if a noun refers to a server that is running an instance of Microsoft SQL Server, use a noun such as "SQLServer". The combination of specific nouns and the short list of approved verbs enable the user to quickly discover and anticipate functionality while avoiding duplication among cmdlet names.

To enhance the user experience, the noun that you choose for a cmdlet name should be singular. For example, use the name `Get-Process` instead of `Get-Processes`. It is best to follow this rule for all cmdlet names, even when a cmdlet is likely to act upon more than one item.

Use Pascal Case for Cmdlet Names (SD02)

Use Pascal case for parameter names. In other words, capitalize the first letter of verb and all terms used in the noun. For example, "`Clear-ItemProperty`".

Parameter Design Guidelines (SD03)

A cmdlet needs parameters that receive the data on which it must operate, and parameters that indicate information that is used to determine the characteristics of the operation. For example, a cmdlet might have a `Name` parameter that receives data from the pipeline, and the cmdlet might have a `Force` parameter to indicate that the cmdlet can be forced to perform its operation. There is no limit to the number of parameters that a cmdlet can define.

Use Standard Parameter Names

Your cmdlet should use standard parameter names so that the user can quickly determine what a particular parameter means. If a more specific name is required, use a standard parameter name, and then specify a more specific name as an alias. For example, the `Get-Service` cmdlet has a parameter that has a generic name (`Name`) and a more specific alias (`ServiceName`). Both terms can be used to specify the parameter.

For more information about parameter names and their data types, see Cmdlet Parameter Name and Functionality Guidelines.

Use Singular Parameter Names

Avoid using plural names for parameters whose value is a single element. This includes parameters that take arrays or lists because the user might supply an array or list with only one element.

Plural parameter names should be used only in those cases where the value of the parameter is always a multiple-element value. In these cases, the cmdlet should verify that multiple elements are supplied, and the cmdlet should display a warning to the user if multiple elements are not supplied.

Use Pascal Case for Parameter Names

Use Pascal case for parameter names. In other words, capitalize the first letter of each word in the parameter name, including the first letter of the name. For example, the parameter name `ErrorAction` uses the correct capitalization. The following parameter names use incorrect capitalization:

- `errorAction`
- `erroraction`

Parameters That Take a List of Options

There are two ways to create a parameter whose value can be selected from a set of options.

- Define an enumeration type (or use an existing enumeration type) that specifies the valid values. Then, use the enumeration type to create a parameter of that type.
- Add the **ValidateSet** attribute to the parameter declaration. For more information about this attribute, see ValidateSet Attribute Declaration.

Use Standard Types for Parameters

To ensure consistency with other cmdlets, use standard types for parameters where ever possible. For more information about the types that should be used for different parameter, see Standard Cmdlet Parameter Names and Types. This topic provides links to several topics that describe the names and .NET Framework types for groups of standard parameters, such as the "activity parameters".

Use Strongly-Typed .NET Framework Types

Parameters should be defined as .NET Framework types to provide better parameter validation. For example, parameters that are restricted to one value from a set of values should be defined as an enumeration type. To support a Uniform Resource Identifier (URI) value, define the parameter as a System.Uri type. Avoid basic string parameters for all but free-form text properties.

Use Consistent Parameter Types

When the same parameter is used by multiple cmdlets, always use the same parameter type. For example, if the `Process` parameter is an System.Int16 type for one cmdlet, do not make the `Process` parameter for another cmdlet a System.Uint16 type.

Parameters That Take True and False

If your parameter takes only `true` and `false`, define the parameter as type System.Management.Automation.SwitchParameter. A switch parameter is treated as `true` when it is specified in a command. If the parameter is not included in a command, Windows PowerShell considers the value of the parameter to be `false`. Do not define Boolean parameters.

If your parameter needs to differentiate between 3 values: $true, $false and "unspecified", then define a parameter of type Nullable<bool>. The need for a 3rd, "unspecified" value typically occurs when the cmdlet can modify a Boolean property of an object. In this case "unspecified" means to not change the current value of the property.

Support Arrays for Parameters

Frequently, users must perform the same operation against multiple arguments. For these users, a cmdlet should accept an array as parameter input so that a user can pass the arguments into the parameter as a Windows PowerShell variable. For example, the Get-Process cmdlet uses an array for the strings that identify the names of the processes to retrieve.

Support the PassThru Parameter

By default, many cmdlets that modify the system, such as the Stop-Process cmdlet, act as "sinks" for objects and do not return a result. These cmdlet should implement the `PassThru` parameter to force the cmdlet to return an object. When the `PassThru` parameter is specified, the cmdlet returns an object by using a call to the System.Management.Automation.Cmdlet.WriteObject method. For example, the following command stops the Calc process and passes the resultant process to the pipeline.

PowerShell

```
Stop-Process calc -passthru
```

In most cases, Add, Set, and New cmdlets should support a `PassThru` parameter.

Support Parameter Sets

A cmdlet is intended to accomplish a single purpose. However, there is frequently more than one way to describe the operation or the operation target. For example, a process might be identified by its name, by its identifier, or by a process object. The cmdlet should support all the reasonable representations of its targets. Normally, the cmdlet satisfies this requirement by specifying sets of parameters (referred to as parameter sets) that operate together. A single parameter can belong to any number of parameter sets. For more information about parameter sets, see Cmdlet Parameter Sets.

When you specify parameter sets, set only one parameter in the set to ValueFromPipeline. For more information about how to declare the **Parameter** attribute, see ParameterAttribute Declaration.

When parameter sets are used, the default parameter set is defined by the **Cmdlet** attribute. The default parameter set should include the parameters most likely to be used in an interactive Windows PowerShell session. For more information about how to declare the **Cmdlet** attribute, see CmdletAttribute Declaration.

Provide Feedback to the User (SD04)

Use the guidelines in this section to provide feedback to the user. This feedback allows the user to be aware of what is occurring in the system and to make better administrative decisions.

The Windows PowerShell runtime allows a user to specify how to handle output from each call to the `Write` method by setting a preference variable. The user can set several preference variables, including a variable that determines whether the system should display information and a variable that determines whether the system should query the user before taking further action.

Support the WriteWarning, WriteVerbose, and WriteDebug Methods

A cmdlet should call the System.Management.Automation.Cmdlet.WriteWarning method when the cmdlet is about to perform an operation that might have an unintended result. For example, a cmdlet should call this method if the cmdlet is about to overwrite a read-only file.

A cmdlet should call the System.Management.Automation.Cmdlet.WriteVerbose method when the user requires some detail about what the cmdlet is doing. For example, a cmdlet should call this information if the cmdlet author feels that there are scenarios that might require more information about what the cmdlet is doing.

The cmdlet should call the System.Management.Automation.Cmdlet.WriteDebug method when a developer or product support engineer must understand what has corrupted the cmdlet operation. It is not necessary for the cmdlet to call the System.Management.Automation.Cmdlet.WriteDebug method in the same code that calls the System.Management.Automation.Cmdlet.WriteVerbose method because the `Debug` parameter presents both sets of information.

Support WriteProgress for Operations that take a Long Time

Cmdlet operations that take a long time to complete and that cannot run in the background should support progress reporting through periodic calls to the System.Management.Automation.Cmdlet.WriteProgress method.

Use the Host Interfaces

Occasionally, a cmdlet must communicate directly with the user instead of by using the various Write or Should methods supported by the System.Management.Automation.Cmdlet class. In this case, the cmdlet should derive from the System.Management.Automation.PSCmdlet class and use the System.Management.Automation.PSCmdlet.Host* property. This property supports different levels of communication type, including the PromptForChoice, Prompt, and WriteLine/ReadLine types. At the most specific level, it also provides ways to read and write individual keys and to deal with buffers.

Unless a cmdlet is specifically designed to generate a graphical user interface (GUI), it should not bypass the host by using the System.Management.Automation.PSCmdlet.Host* property. An example of a cmdlet that is designed to generate a GUI is the Out-GridView cmdlet.

> ⓘ **Note**
>
> Cmdlets should not use the **System.Console** API.

Create a Cmdlet Help File (SD05)

For each cmdlet assembly, create a Help.xml file that contains information about the cmdlet. This information includes a description of the cmdlet, descriptions of the cmdlet's parameters, examples of the cmdlet's use, and more.

Code Guidelines

The following guidelines should be followed when coding cmdlets to ensure a consistent user experience between using your cmdlets and other cmdlets. When you find a Code guideline that applies to your situation, be sure to look at the Design guidelines for similar guidelines.

Coding Parameters (SC01)

Define a parameter by declaring a public property of the cmdlet class that is decorated with the **Parameter** attribute. Parameters do not have to be static members of the derived .NET Framework class for the cmdlet. For more information about how to declare the **Parameter** attribute, see Parameter Attribute Declaration.

Support Windows PowerShell Paths

The Windows PowerShell path is the mechanism for normalizing access to namespaces. When you assign a Windows PowerShell path to a parameter in the cmdlet, the user can define a custom "drive" that acts as a shortcut to a specific path. When a user designates such a drive, stored data, such as data in the Registry, can be used in a consistent way.

If your cmdlet allows the user to specify a file or a data source, it should define a parameter of type System.String. If more than one drive is supported, the type should be an array. The name of the parameter should be `Path`, with an alias of `PSPath`. Additionally, the `Path` parameter should support wildcard characters. If support for wildcard characters is not required, define a `LiteralPath` parameter.

If the data that the cmdlet reads or writes has to be a file, the cmdlet should accept Windows PowerShell path input, and the cmdlet should use the System.Management.Automation.Sessionstate.Path property to translate the Windows PowerShell paths into paths that the file system recognizes. The specific mechanisms include the following methods:

- System.Management.Automation.PSCmdlet.GetResolvedProviderPathFromPSPath
- System.Management.Automation.PSCmdlet.GetUnresolvedProviderPathFromPSPath
- System.Management.Automation.PathIntrinsics.GetResolvedProviderPathFromPSPath
- System.Management.Automation.PathIntrinsics.GetUnresolvedProviderPathFromPSPath

If the data that the cmdlet reads or writes is only a set of strings instead of a file, the cmdlet should use the provider content information (`Content` member) to read and write. This information is obtained from the System.Management.Automation.Provider.CmdletProvider.InvokeProvider property. These mechanisms allow other data stores to participate in the reading and writing of data.

Support Wildcard Characters

A cmdlet should support wildcard characters if possible. Support for wildcard characters occurs in many places in a cmdlet (especially when a parameter takes a string to identify one object from a set of objects). For example, the sample `Stop-Proc` cmdlet from the StopProc Tutorial defines a `Name` parameter to handle strings that represent process names. This parameter supports wildcard characters so that the user can easily specify the processes to stop.

When support for wildcard characters is available, a cmdlet operation usually produces an array. Occasionally, it does not make sense to support an array because the user might use only a single item at a time. For example, the Set-Location cmdlet does not need to support an array because the user is setting only a single location. In this instance, the cmdlet still supports wildcard characters, but it forces resolution to a single location.

For more information about wildcard-character patterns, see Supporting Wildcard Characters in Cmdlet Parameters.

Defining Objects

This section contains guidelines for defining objects for cmdlets and for extending existing objects.

Define Standard Members

Define standard members to extend an object type in a custom Types.ps1xml file (use the Windows PowerShell Types.ps1xml file as a template). Standard members are defined by a node with the name PSStandardMembers. These definitions allow other cmdlets and the Windows PowerShell runtime to work with your object in a consistent way.

Define ObjectMembers to Be Used as Parameters

If you are designing an object for a cmdlet, ensure that its members map directly to the parameters of the cmdlets that will use it. This mapping allows the object to be easily sent to the pipeline and to be passed from one cmdlet to another.

Preexisting .NET Framework objects that are returned by cmdlets are frequently missing some important or convenient members that are needed by the script developer or user. These missing members can be particularly important for display and for creating the correct member names so that the object can be correctly passed to the pipeline. Create a custom Types.ps1xml file to document these required members. When you

create this file, we recommend the following naming convention: *<Your_Product_Name>*.Types.ps1xml.

For example, you could add a `Mode` script property to the System.IO.FileInfo type to display the attributes of a file more clearly. Additionally, you could add a `Count` alias property to the System.Array type to allow the consistent use of that property name (instead of `Length`).

Implement the IComparable Interface

Implement a System.IComparable interface on all output objects. This allows the output objects to be easily piped to various sorting and analysis cmdlets.

Update Display Information

If the display for an object does not provide the expected results, create a custom *<YourProductName>*.Format.ps1xml file for that object.

Support Well Defined Pipeline Input (SC02)

Implement for the Middle of a Pipeline

Implement a cmdlet assuming that it will be called from the middle of a pipeline (that is, other cmdlets will produce its input or consume its output). For example, you might assume that the `Get-Process` cmdlet, because it generates data, is used only as the first cmdlet in a pipeline. However, because this cmdlet is designed for the middle of a pipeline, this cmdlet allows previous cmdlets or data in the pipeline to specify the processes to retrieve.

Support Input from the Pipeline

In each parameter set for a cmdlet, include at least one parameter that supports input from the pipeline. Support for pipeline input allows the user to retrieve data or objects, to send them to the correct parameter set, and to pass the results directly to a cmdlet.

A parameter accepts input from the pipeline if the **Parameter** attribute includes the `ValueFromPipeline` keyword, the `ValueFromPipelineByPropertyName` keyword attribute, or both keywords in its declaration. If none of the parameters in a parameter set support the `ValueFromPipeline` or `ValueFromPipelineByPropertyName` keywords, the cmdlet

cannot meaningfully be placed after another cmdlet because it will ignore any pipeline input.

Support the ProcessRecord Method

To accept all the records from the preceding cmdlet in the pipeline, your cmdlet must implement the System.Management.Automation.Cmdlet.ProcessRecord method. Windows PowerShell calls this method multiple times, once for every record that is sent to your cmdlet.

Write Single Records to the Pipeline (SC03)

When a cmdlet returns objects, the cmdlet should write the objects immediately as they are generated. The cmdlet should not hold them in order to buffer them into a combined array. The cmdlets that receive the objects as input will then be able to process, display, or process and display the output objects without delay. A cmdlet that generates output objects one at a time should call the System.Management.Automation.Cmdlet.WriteObject method. A cmdlet that generates output objects in batches (for example, because an underlying API returns an array of output objects) should call the System.Management.Automation.Cmdlet.WriteObject Method with its second parameter set to `true`.

Make Cmdlets Case-Insensitive and Case-Preserving (SC04)

By default, Windows PowerShell itself is case-insensitive. However, because it deals with many preexisting systems, Windows PowerShell does preserve case for ease of operation and compatibility. In other words, if a character is supplied in uppercase letters, Windows PowerShell keeps it in uppercase letters. For systems to work well, a cmdlet needs to follow this convention. If possible, it should operate in a case-insensitive way. It should, however, preserve the original case for cmdlets that occur later in a command or in the pipeline.

See Also

Required Development Guidelines

Advisory Development Guidelines

Writing a Windows PowerShell Cmdlet

Advisory Development Guidelines

Article • 10/06/2021

This section describes guidelines that you should consider to ensure good development and user experiences. Sometimes they might apply, and sometimes they might not.

Design Guidelines

The following guidelines should be considered when designing cmdlets. When you find a Design guideline that applies to your situation, be sure to look at the Code guidelines for similar guidelines.

Support an InputObject Parameter (AD01)

Because Windows PowerShell works directly with Microsoft .NET Framework objects, a .NET Framework object is often available that exactly matches the type the user needs to perform a particular operation. `InputObject` is the standard name for a parameter that takes such an object as input. For example, the sample `Stop-Proc` cmdlet in the StopProc Tutorial defines an `InputObject` parameter of type Process that supports the input from the pipeline. The user can get a set of process objects, manipulate them to select the exact objects to stop, and then pass them to the `Stop-Proc` cmdlet directly.

Support the Force Parameter (AD02)

Occasionally, a cmdlet needs to protect the user from performing a requested operation. Such a cmdlet should support a **Force** parameter to allow the user to override that protection if the user has permissions to perform the operation.

For example, the Remove-Item cmdlet does not normally remove a read-only file. However, this cmdlet supports a **Force** parameter so a user can force removal of a read-only file. If the user already has permission to modify the read-only attribute, and the user removes the file, use of the **Force** parameter simplifies the operation. However, if the user does not have permission to remove the file, the **Force** parameter has no effect.

Handle Credentials Through Windows PowerShell (AD03)

A cmdlet should define a `Credential` parameter to represent credentials. This parameter must be of type System.Management.Automation.PSCredential and must be defined using a Credential attribute declaration. This support automatically prompts the user for

the user name, for the password, or for both when a full credential is not supplied directly. For more information about the Credential attribute, see Credential Attribute Declaration.

Support Encoding Parameters (AD04)

If your cmdlet reads or writes text to or from a binary form, such as writing to or reading from a file in a filesystem, then your cmdlet has to have Encoding parameter that specifies how the text is encoded in the binary form.

Test Cmdlets Should Return a Boolean (AD05)

Cmdlets that perform tests against their resources should return a System.Boolean type to the pipeline so that they can be used in conditional expressions.

Code Guidelines

The following guidelines should be considered when writing cmdlet code. When you find a guideline that applies to your situation, be sure to look at the Design guidelines for similar guidelines.

Follow Cmdlet Class Naming Conventions (AC01)

By following standard naming conventions, you make your cmdlets more discoverable, and you help the user understand exactly what the cmdlets do. This practice is particularly important for other developers using Windows PowerShell because cmdlets are public types.

Define a Cmdlet in the Correct Namespace

You normally define the class for a cmdlet in a .NET Framework namespace that appends ".Commands" to the namespace that represents the product in which the cmdlet runs. For example, cmdlets that are included with Windows PowerShell are defined in the `Microsoft.PowerShell.Commands` namespace.

Name the Cmdlet Class to Match the Cmdlet Name

When you name the .NET Framework class that implements a cmdlet, name the class "<*Verb*>**<Noun>**<*Command*>", where you replace the <*Verb*> and <*Noun*>

placeholders with the verb and noun used for the cmdlet name. For example, the Get-Process cmdlet is implemented by a class called `GetProcessCommand`.

If No Pipeline Input Override the BeginProcessing Method (AC02)

If your cmdlet does not accept input from the pipeline, processing should be implemented in the System.Management.Automation.Cmdlet.BeginProcessing method. Use of this method allows Windows PowerShell to maintain ordering between cmdlets. The first cmdlet in the pipeline always returns its objects before the remaining cmdlets in the pipeline get a chance to start their processing.

To Handle Stop Requests Override the StopProcessing Method (AC03)

Override the System.Management.Automation.Cmdlet.StopProcessing method so that your cmdlet can handle stop signal. Some cmdlets take a long time to complete their operation, and they let a long time pass between calls to the Windows PowerShell runtime, such as when the cmdlet blocks the thread in long-running RPC calls. This includes cmdlets that make calls to the System.Management.Automation.Cmdlet.WriteObject method, to the System.Management.Automation.Cmdlet.WriteError method, and to other feedback mechanisms that may take a long time to complete. For these cases the user might need to send a stop signal to these cmdlets.

Implement the IDisposable Interface (AC04)

If your cmdlet has objects that are not disposed of (written to the pipeline) by the System.Management.Automation.Cmdlet.ProcessRecord method, your cmdlet might require additional object disposal. For example, if your cmdlet opens a file handle in its System.Management.Automation.Cmdlet.BeginProcessing method and keeps the handle open for use by the System.Management.Automation.Cmdlet.ProcessRecord method, this handle has to be closed at the end of processing.

The Windows PowerShell runtime does not always call the System.Management.Automation.Cmdlet.EndProcessing method. For example, the System.Management.Automation.Cmdlet.EndProcessing method might not be called if the cmdlet is canceled midway through its operation or if a terminating error occurs in any part of the cmdlet. Therefore, the .NET Framework class for a cmdlet that requires object cleanup should implement the complete System.IDisposable interface pattern,

including the finalizer, so that the Windows PowerShell runtime can call both the System.Management.Automation.Cmdlet.EndProcessing and System.IDisposable.Dispose* methods at the end of processing.

Use Serialization-friendly Parameter Types (AC05)

To support running your cmdlet on remote computers, use types that can be easily serialized on the client computer and then rehydrated on the server computer. The follow types are serialization-friendly.

Primitive types:

- Byte, SByte, Decimal, Single, Double, Int16, Int32, Int64, Uint16, UInt32, and UInt64.
- Boolean, Guid, Byte[], TimeSpan, DateTime, Uri, and Version.
- Char, String, XmlDocument.

Built-in rehydratable types:

- PSPrimitiveDictionary
- SwitchParameter
- PSListModifier
- PSCredential
- IPAddress, MailAddress
- CultureInfo
- X509Certificate2, X500DistinguishedName
- DirectorySecurity, FileSecurity, RegistrySecurity

Other types:

- SecureString
- Containers (lists and dictionaries of the above type)

Use SecureString for Sensitive Data (AC06)

When handling sensitive data always use the System.Security.Securestring data type. This could include pipeline input to parameters, as well as returning sensitive data to the

pipeline.

See Also

Required Development Guidelines

Strongly Encouraged Development Guidelines

Writing a Windows PowerShell Cmdlet

Cmdlet Class Declaration

Article • 09/17/2021

A Microsoft .NET Framework class is declared as a cmdlet by specifying the **Cmdlet** attribute as metadata for the class. (The **Cmdlet** attribute is the only required attribute for all cmdlets). When you specify the **Cmdlet** attribute, you must specify the verb-and-noun pair that identifies the cmdlet to the user. And, you must describe the Windows PowerShell functionality that the cmdlet supports. For more information about the declaration syntax that is used to specify the **Cmdlet** attribute, see Cmdlet Attribute Declaration.

> **Note**
>
> The **Cmdlet** attribute is defined by the **System.Management.Automation.CmdletAttribute** class. The properties of this class correspond to the declaration parameters that are used when you declare the attribute.

Nouns

The noun of the cmdlet specifies the resources upon which the cmdlet acts. The noun differentiates your cmdlets from other cmdlets.

Nouns in cmdlet names must be specific, and in the case of generic nouns, such as *server*, it is best to add a short prefix that differentiates your resource from other similar resources. For example, a cmdlet name that includes a noun with a prefix is `Get-SQLServer`. The combination of a specific noun with a more general verb enables the user to quickly locate the cmdlet by its action and then identify the cmdlet by its resource while avoiding unnecessary cmdlet name duplication.

For a list of special characters that cannot be used in cmdlet names, see Required Development Guidelines.

Verbs

When you specify a verb, the development guidelines require you to use one of the predefined verbs provided by Windows PowerShell. By using one of these predefined verbs, you will ensure consistency between the cmdlets that you write and the cmdlets

that are written by Microsoft and by others. For example, the "Get" verb is used for cmdlets that retrieve data.

For more information about guidelines for verbs, see Cmdlet Verb Names. For a list of special characters that cannot be used in cmdlet names, see Required Development Guidelines.

Supporting Windows PowerShell Functionality

The **Cmdlet** attribute also allows you to specify that your cmdlet supports some of the common functionality that is provided by Windows PowerShell. This includes support for common functionality such as user feedback confirmation (referred to as support for the ShouldProcess feature) and support for transactions. (Support for transactions was introduced in Windows PowerShell 2.0).

For more information about the declaration syntax that is used to specify the **Cmdlet** attribute, see Cmdlet Attribute Declaration.

Cmdlet Class Definition

The following code is the definition for a GetProc cmdlet class. Notice that Pascal casing is used and that the name of the class includes the verb and noun of the cmdlet.

C#

```
[Cmdlet(VerbsCommon.Get, "Proc")]
public class GetProcCommand : Cmdlet
```

Pascal Casing

When you name cmdlets, use Pascal casing. For example, the `Get-Item` and `Get-ItemProperty` cmdlets show the correct way to use capitalization when you are naming cmdlets.

See Also

System.Management.Automation.CmdletAttribute

CmdletAttribute Declaration

Cmdlet Verb Names

Writing a Windows PowerShell Cmdlet

Windows PowerShell SDK

Approved Verbs for PowerShell Commands

Article • 01/31/2022

PowerShell uses a verb-noun pair for the names of cmdlets and for their derived .NET classes. The verb part of the name identifies the action that the cmdlet performs. The noun part of the name identifies the entity on which the action is performed. For example, the `Get-Command` cmdlet retrieves all the commands that are registered in PowerShell.

> **Note**
>
> PowerShell uses the term *verb* to describe a word that implies an action even if that word is not a standard verb in the English language. For example, the term *New* is a valid PowerShell verb name because it implies an action even though it is not a verb in the English language.

Each approved verb has a corresponding *alias prefix* defined. We use this alias prefix in aliases for commands using that verb. For example, the alias prefix for `Import` is `ip` and, accordingly, the alias for `Import-Module` is `ipmo`. This is a recommendation but not a rule; in particular, it need not be respected for command aliases mimicking well known commands from other environments.

Verb Naming Recommendations

The following recommendations help you choose an appropriate verb for your cmdlet, to ensure consistency between the cmdlets that you create, the cmdlets that are provided by PowerShell, and the cmdlets that are designed by others.

- Use one of the predefined verb names provided by PowerShell
- Use the verb to describe the general scope of the action, and use parameters to further refine the action of the cmdlet.
- Do not use a synonym of an approved verb. For example, always use `Remove`, never use `Delete` or `Eliminate`.
- Use only the form of each verb that is listed in this topic. For example, use `Get`, but do not use `Getting` or `Gets`.
- Do not use the following reserved verbs or aliases. The PowerShell language and a rare few cmdlets use these verbs under exceptional circumstances.

- ForEach (foreach)
- Ping (pi)
- Sort (sr)
- Tee (te)
- Where (wh)

You may get a complete list of verbs using the `Get-Verb` cmdlet.

Similar Verbs for Different Actions

The following similar verbs represent different actions.

New vs. Add

Use the `New` verb to create a new resource. Use the `Add` to add something to an existing container or resource. For example, `Add-Content` adds output to an existing file.

New vs. Set

Use the `New` verb to create a new resource. Use the `Set` verb to modify an existing resource, optionally creating it if it does not exist, such as the `Set-Variable` cmdlet.

Find vs. Search

Use the `Find` verb to look for an object. Use the `Search` verb to create a reference to a resource in a container.

Get vs. Read

Use the `Get` verb to obtain information about a resource (such as a file) or to obtain an object with which you can access the resource in future. Use the `Read` verb to open a resource and extract information contained within.

Invoke vs. Start

Use the `Invoke` verb to perform synchronous operations, such as running a command and waiting for it to end. Use the `Start` verb to begin asynchronous operations, such as starting an autonomous process.

Ping vs. Test

Use the `Test` verb.

Common Verbs

PowerShell uses the System.Management.Automation.VerbsCommon enumeration class to define generic actions that can apply to almost any cmdlet. The following table lists most of the defined verbs.

Verb (alias)	Action	Synonyms to avoid
Add (a)	Adds a resource to a container, or attaches an item to another item. For example, the `Add-Content` cmdlet adds content to a file. This verb is paired with `Remove`.	Append, Attach, Concatenate, Insert
Clear (cl)	Removes all the resources from a container but does not delete the container. For example, the `Clear-Content` cmdlet removes the contents of a file but does not delete the file.	Flush, Erase, Release, Unmark, Unset, Nullify
Close (cs)	Changes the state of a resource to make it inaccessible, unavailable, or unusable. This verb is paired with `Open.`	
Copy (cp)	Copies a resource to another name or to another container. For example, the `Copy-Item` cmdlet copies an item (such as a file) from one location in the data store to another location.	Duplicate, Clone, Replicate, Sync
Enter (et)	Specifies an action that allows the user to move into a resource. For example, the `Enter-PSSession` cmdlet places the user in an interactive session. This verb is paired with `Exit`.	Push, Into
Exit (ex)	Sets the current environment or context to the most recently used context. For example, the `Exit-PSSession` cmdlet places the user in the session that was used to start the interactive session. This verb is paired with `Enter`.	Pop, Out
Find (fd)	Looks for an object in a container that is unknown, implied, optional, or specified.	Search
Format (f)	Arranges objects in a specified form or layout	
Get (g)	Specifies an action that retrieves a resource. This verb is paired with `Set`.	Read, Open, Cat, Type, Dir, Obtain, Dump, Acquire, Examine, Find, Search

Verb (alias)	Action	Synonyms to avoid
Hide (h)	Makes a resource undetectable. For example, a cmdlet whose name includes the Hide verb might conceal a service from a user. This verb is paired with `Show`.	Block
Join (j)	Combines resources into one resource. For example, the `Join-Path` cmdlet combines a path with one of its child paths to create a single path. This verb is paired with `Split`.	Combine, Unite, Connect, Associate
Lock (lk)	Secures a resource. This verb is paired with `Unlock`.	Restrict, Secure
Move (m)	Moves a resource from one location to another. For example, the `Move-Item` cmdlet moves an item from one location in the data store to another location.	Transfer, Name, Migrate
New (n)	Creates a resource. (The `Set` verb can also be used when creating a resource that includes data, such as the `Set-Variable` cmdlet.)	Create, Generate, Build, Make, Allocate
Open (op)	Changes the state of a resource to make it accessible, available, or usable. This verb is paired with `Close`.	
Optimize (om)	Increases the effectiveness of a resource.	
Pop (pop)	Removes an item from the top of a stack. For example, the `Pop-Location` cmdlet changes the current location to the location that was most recently pushed onto the stack.	
Push (pu)	Adds an item to the top of a stack. For example, the `Push-Location` cmdlet pushes the current location onto the stack.	
Redo (re)	Resets a resource to the state that was undone.	
Remove (r)	Deletes a resource from a container. For example, the `Remove-Variable` cmdlet deletes a variable and its value. This verb is paired with `Add`.	Clear, Cut, Dispose, Discard, Erase
Rename (rn)	Changes the name of a resource. For example, the `Rename-Item` cmdlet, which is used to access stored data, changes the name of an item in the data store.	Change
Reset (rs)	Sets a resource back to its original state.	
Resize(rz)	Changes the size of a resource.	
Search (sr)	Creates a reference to a resource in a container.	Find, Locate

Verb (alias)	Action	Synonyms to avoid
Select (sc)	Locates a resource in a container. For example, the `Select-String` cmdlet finds text in strings and files.	Find, Locate
Set (s)	Replaces data on an existing resource or creates a resource that contains some data. For example, the `Set-Date` cmdlet changes the system time on the local computer. (The `New` verb can also be used to create a resource.) This verb is paired with `Get`.	Write, Reset, Assign, Configure
Show (sh)	Makes a resource visible to the user. This verb is paired with `Hide`.	Display, Produce
Skip (sk)	Bypasses one or more resources or points in a sequence.	Bypass, Jump
Split (sl)	Separates parts of a resource. For example, the `Split-Path` cmdlet returns different parts of a path. This verb is paired with `Join`.	Separate
Step (st)	Moves to the next point or resource in a sequence.	
Switch (sw)	Specifies an action that alternates between two resources, such as to change between two locations, responsibilities, or states.	
Undo (un)	Sets a resource to its previous state.	
Unlock (uk)	Releases a resource that was locked. This verb is paired with `Lock`.	Release, Unrestrict, Unsecure
Watch (wc)	Continually inspects or monitors a resource for changes.	

Communications Verbs

PowerShell uses the System.Management.Automation.VerbsCommunications class to define actions that apply to communications. The following table lists most of the defined verbs.

Verb (alias)	Action	Synonyms to avoid
Connect (cc)	Creates a link between a source and a destination. This verb is paired with `Disconnect`.	Join, Telnet

Verb (alias)	Action	Synonyms to avoid
Disconnect (dc)	Breaks the link between a source and a destination. This verb is paired with `Connect`.	Break, Logoff
Read (rd)	Acquires information from a source. This verb is paired with `Write`.	Acquire, Prompt, Get
Receive (rc)	Accepts information sent from a source. This verb is paired with `Send`.	Read, Accept, Peek
Send (sd)	Delivers information to a destination. This verb is paired with `Receive`.	Put, Broadcast, Mail, Fax
Write (wr)	Adds information to a target. This verb is paired with `Read`.	Put, Print

Data Verbs

PowerShell uses the System.Management.Automation.VerbsData class to define actions that apply to data handling. The following table lists most of the defined verbs.

Verb Name (alias)	Action	Synonyms to avoid
Backup (ba)	Stores data by replicating it.	Save, Burn, Replicate, Sync
Checkpoint (ch)	Creates a snapshot of the current state of the data or of its configuration.	Diff
Compare (cr)	Evaluates the data from one resource against the data from another resource.	Diff
Compress (cm)	Compacts the data of a resource. Pairs with `Expand`.	Compact
Convert (cv)	Changes the data from one representation to another when the cmdlet supports bidirectional conversion or when the cmdlet supports conversion between multiple data types.	Change, Resize, Resample
ConvertFrom (cf)	Converts one primary type of input (the cmdlet noun indicates the input) to one or more supported output types.	Export, Output, Out
ConvertTo (ct)	Converts from one or more types of input to a primary output type (the cmdlet noun indicates the output type).	Import, Input, In

Verb Name (alias)	Action	Synonyms to avoid
Dismount (dm)	Detaches a named entity from a location. This verb is paired with `Mount`.	Unmount, Unlink
Edit (ed)	Modifies existing data by adding or removing content.	Change, Update, Modify
Expand (en)	Restores the data of a resource that has been compressed to its original state. This verb is paired with `Compress`.	Explode, Uncompress
Export (ep)	Encapsulates the primary input into a persistent data store, such as a file, or into an interchange format. This verb is paired with `Import`.	Extract, Backup
Group (gp)	Arranges or associates one or more resources	
Import (ip)	Creates a resource from data that is stored in a persistent data store (such as a file) or in an interchange format. For example, the `Import-CSV` cmdlet imports data from a comma-separated value (CSV) file to objects that can be used by other cmdlets. This verb is paired with `Export`.	BulkLoad, Load
Initialize (in)	Prepares a resource for use, and sets it to a default state.	Erase, Init, Renew, Rebuild, Reinitialize, Setup
Limit (l)	Applies constraints to a resource.	Quota
Merge (mg)	Creates a single resource from multiple resources.	Combine, Join
Mount (mt)	Attaches a named entity to a location. This verb is paired with `Dismount`.	Connect
Out (o)	Sends data out of the environment. For example, the `Out-Printer` cmdlet sends data to a printer.	
Publish (pb)	Makes a resource available to others. This verb is paired with `Unpublish`.	Deploy, Release, Install
Restore (rr)	Sets a resource to a predefined state, such as a state set by `Checkpoint`. For example, the `Restore-Computer` cmdlet starts a system restore on the local computer.	Repair, Return, Undo, Fix
Save (sv)	Preserves data to avoid loss.	

Verb Name (alias)	Action	Synonyms to avoid
Sync (sy)	Assures that two or more resources are in the same state.	Replicate, Coerce, Match
Unpublish (ub)	Makes a resource unavailable to others. This verb is paired with `Publish`.	Uninstall, Revert, Hide
Update (ud)	Brings a resource up-to-date to maintain its state, accuracy, conformance, or compliance. For example, the `Update-FormatData` cmdlet updates and adds formatting files to the current PowerShell console.	Refresh, Renew, Recalculate, Re-index

Diagnostic Verbs

PowerShell uses the System.Management.Automation.VerbsDiagnostic class to define actions that apply to diagnostics. The following table lists most of the defined verbs.

Verb (alias)	Action	Synonyms to avoid
Debug (db)	Examines a resource to diagnose operational problems.	Diagnose
Measure (ms)	Identifies resources that are consumed by a specified operation, or retrieves statistics about a resource.	Calculate, Determine, Analyze
Ping (pi)	Deprecated - Use the Test verb instead.	
Repair (rp)	Restores a resource to a usable condition	Fix, Restore
Resolve (rv)	Maps a shorthand representation of a resource to a more complete representation.	Expand, Determine
Test (t)	Verifies the operation or consistency of a resource.	Diagnose, Analyze, Salvage, Verify
Trace (tr)	Tracks the activities of a resource.	Track, Follow, Inspect, Dig

Lifecycle Verbs

PowerShell uses the System.Management.Automation.VerbsLifeCycle class to define actions that apply to the lifecycle of a resource. The following table lists most of the

defined verbs.

Verb (alias)	Action	Synonyms to avoid
Approve (ap)	Confirms or agrees to the status of a resource or process.	
Assert (as)	Affirms the state of a resource.	Certify
Build (bd)	Creates an artifact (usually a binary or document) out of some set of input files (usually source code or declarative documents.) This verb was added in PowerShell 6.	
Complete (cp)	Concludes an operation.	
Confirm (cn)	Acknowledges, verifies, or validates the state of a resource or process.	Acknowledge, Agree, Certify, Validate, Verify
Deny (dn)	Refuses, objects, blocks, or opposes the state of a resource or process.	Block, Object, Refuse, Reject
Deploy (dp)	Sends an application, website, or solution to a remote target[s] in such a way that a consumer of that solution can access it after deployment is complete. This verb was added in PowerShell 6.	
Disable (d)	Configures a resource to an unavailable or inactive state. For example, the `Disable-PSBreakpoint` cmdlet makes a breakpoint inactive. This verb is paired with `Enable`.	Halt, Hide
Enable (e)	Configures a resource to an available or active state. For example, the `Enable-PSBreakpoint` cmdlet makes a breakpoint active. This verb is paired with `Disable`.	Start, Begin
Install (is)	Places a resource in a location, and optionally initializes it. This verb is paired with `Uninstall`.	Setup
Invoke (i)	Performs an action, such as running a command or a method.	Run, Start
Register (rg)	Creates an entry for a resource in a repository such as a database. This verb is paired with `Unregister`.	
Request (rq)	Asks for a resource or asks for permissions.	
Restart (rt)	Stops an operation and then starts it again. For example, the `Restart-Service` cmdlet stops and then starts a service.	Recycle

Verb (alias)	Action	Synonyms to avoid
Resume (ru)	Starts an operation that has been suspended. For example, the `Resume-Service` cmdlet starts a service that has been suspended. This verb is paired with `Suspend`.	
Start (sa)	Initiates an operation. For example, the `Start-Service` cmdlet starts a service. This verb is paired with `Stop`.	Launch, Initiate, Boot
Stop (sp)	Discontinues an activity. This verb is paired with `Start`.	End, Kill, Terminate, Cancel
Submit (sb)	Presents a resource for approval.	Post
Suspend (ss)	Pauses an activity. For example, the `Suspend-Service` cmdlet pauses a service. This verb is paired with `Resume`.	Pause
Uninstall (us)	Removes a resource from an indicated location. This verb is paired with `Install`.	
Unregister (ur)	Removes the entry for a resource from a repository. This verb is paired with `Register`.	Remove
Wait (w)	Pauses an operation until a specified event occurs. For example, the `Wait-Job` cmdlet pauses operations until one or more of the background jobs are complete.	Sleep, Pause

Security Verbs

PowerShell uses the System.Management.Automation.VerbsSecurity class to define actions that apply to security. The following table lists most of the defined verbs.

Verb (alias)	Action	Synonyms to avoid
Block (bl)	Restricts access to a resource. This verb is paired with `Unblock`.	Prevent, Limit, Deny
Grant (gr)	Allows access to a resource. This verb is paired with `Revoke`.	Allow, Enable
Protect (pt)	Safeguards a resource from attack or loss. This verb is paired with `Unprotect`.	Encrypt, Safeguard, Seal

Verb (alias)	Action	Synonyms to avoid
Revoke (rk)	Specifies an action that does not allow access to a resource. This verb is paired with `Grant`.	Remove, Disable
Unblock (ul)	Removes restrictions to a resource. This verb is paired with `Block`.	Clear, Allow
Unprotect (up)	Removes safeguards from a resource that were added to prevent it from attack or loss. This verb is paired with `Protect`.	Decrypt, Unseal

Other Verbs

PowerShell uses the System.Management.Automation.VerbsOther class to define canonical verb names that do not fit into a specific verb name category such as the common, communications, data, lifecycle, or security verb names verbs.

Verb (alias)	Action	Synonyms to avoid
Use (u)	Uses or includes a resource to do something.	

See Also

- System.Management.Automation.VerbsCommon
- System.Management.Automation.VerbsCommunications
- System.Management.Automation.VerbsData
- System.Management.Automation.VerbsDiagnostic
- System.Management.Automation.VerbsLifeCycle
- System.Management.Automation.VerbsSecurity
- System.Management.Automation.VerbsOther
- Cmdlet Declaration
- Windows PowerShell Programmer's Guide
- Windows PowerShell Shell SDK

Cmdlet Input Processing Methods

Article • 09/17/2021

Cmdlets must override one or more of the input processing methods described in this topic to perform their work. These methods allow the cmdlet to perform operations of pre-processing, input processing, and post-processing. These methods also allow you to stop cmdlet processing. For a more detailed example of how to use these methods, see SelectStr Tutorial.

Pre-Processing Operations

Cmdlets should override the System.Management.Automation.Cmdlet.BeginProcessing method to add any preprocessing operations that are valid for all the records that will be processed later by the cmdlet. When PowerShell processes a command pipeline, PowerShell calls this method once for each instance of the cmdlet in the pipeline. For more information about how PowerShell invokes the command pipeline, see Cmdlet Processing Lifecycle.

The following code shows an implementation of the BeginProcessing method.

C#

```
protected override void BeginProcessing()
{
  // Replace the WriteObject method with the logic required by your cmdlet.
  WriteObject("This is a test of the BeginProcessing template.");
}
```

Input Processing Operations

Cmdlets can override the System.Management.Automation.Cmdlet.ProcessRecord method to process the input that is sent to the cmdlet. When PowerShell processes a command pipeline, PowerShell calls this method for each input record that is processed by the cmdlet. For more information about how PowerShell invokes the command pipeline, see Cmdlet Processing Lifecycle.

The following code shows an implementation of the ProcessRecord method.

C#

```
protected override void ProcessRecord()
{
```

```
  // Replace the WriteObject method with the logic required by your cmdlet.
  WriteObject("This is a test of the ProcessRecord template.");
}
```

Post-Processing Operations

Cmdlets should override the System.Management.Automation.Cmdlet.EndProcessing method to add any post-processing operations that are valid for all the records that were processed by the cmdlet. For example, your cmdlet might have to clean up object variables after it is finished processing.

When PowerShell processes a command pipeline, PowerShell calls this method once for each instance of the cmdlet in the pipeline. However, it is important to remember that the PowerShell runtime will not call the EndProcessing method if the cmdlet is canceled midway through its input processing or if a terminating error occurs in any part of the cmdlet. For this reason, a cmdlet that requires object cleanup should implement the complete System.IDisposable pattern, including a finalizer, so that the runtime can call both the EndProcessing and System.IDisposable.Dispose methods at the end of processing. For more information about how PowerShell invokes the command pipeline, see Cmdlet Processing Lifecycle.

The following code shows an implementation of the EndProcessing method.

C#

```
protected override void EndProcessing()
{
  // Replace the WriteObject method with the logic required by your cmdlet.
  WriteObject("This is a test of the EndProcessing template.");
}
```

See Also

System.Management.Automation.Cmdlet.BeginProcessing

System.Management.Automation.Cmdlet.ProcessRecord

System.Management.Automation.Cmdlet.EndProcessing

SelectStr Tutorial

System.IDisposable

Windows PowerShell Shell SDK

Cmdlet Parameters

Article • 09/17/2021

Cmdlet parameters provide the mechanism that allows a cmdlet to accept input. Parameters can accept input directly from the command line, or from objects passed to the cmdlet through the pipeline, The arguments (also known as *values*) of these parameters can specify the input that the cmdlet accepts, how the cmdlet should perform its actions, and the data that the cmdlet returns to the pipeline.

In This Section

Declaring Properties as Parameters Provides basic information you must understand before you declare the parameters of a cmdlet.

Types of Cmdlet Parameters Describes the different types of parameters that you can declare in cmdlets.

Cmdlet Parameter Name and Functionality Guidelines Discusses the names, recommended data type, and functionality of standard parameters.

Parameter Aliases Discusses the aliases that you can define for parameters.

Common Parameter Names This topic describes the parameters that Windows PowerShell adds to cmdlets.

Cmdlet Parameter Sets Discusses how parameter sets enable you to write a single cmdlet that can perform different actions for different scenarios.

Cmdlet Dynamic Parameters Discusses parameters that are available to the user under special conditions.

Supporting Wildcard Characters in Cmdlet Parameters Describes how to provide support for wildcard characters when you design a cmdlet that will be run against a group of resources.

Validating Parameter Input Describes how Windows PowerShell validates the arguments passed to cmdlet parameters.

Input Filter Parameters Discusses the `Filter`, `Include`, and `Exclude` parameters that filter the set of input objects that the cmdlet affects.

Related Sections

How to Validate Parameter Input

See Also

Parameter Attribute Declaration

Windows PowerShell Cmdlets

Declaring Properties as Parameters

Article • 09/17/2021

This topic provides basic information you must understand before you declare the parameters of a cmdlet.

To declare the parameters of a cmdlet within your cmdlet class, define the public properties that represent each parameter, and then add one or more Parameter attributes to each property. The Windows PowerShell runtime uses the Parameter attributes to identify the property as a cmdlet parameter. The basic syntax for declaring the Parameter attribute is `[Parameter()]`.

Here is an example of a property defined as a required parameter.

C#

```
[Parameter(Position = 0, Mandatory = true)]
public string UserName
{
  get { return userName; }
  set { userName = value; }
}
private string userName;
```

Here are some things to remember about parameters.

- A parameter must be explicitly marked as public. Parameters that are not marked as public default to internal and will not be found by the Windows PowerShell runtime.
- Parameters should be defined as Microsoft .NET Framework types to provide better parameter validation. For example, parameters that are restricted to one value out of a set of values should be defined as an enumeration type. Parameters that take a Uniform Resource Identifier (URI) value should be of type System.Uri.
- Avoid basic string parameters for all but free-form text properties.
- You can add a parameter to any number of parameter sets. For more information about parameter sets, see Cmdlet Parameter Sets.

Windows PowerShell also provides a set of common parameters that are automatically available to every cmdlet. For more information about these parameters and their aliases, see Cmdlet Common Parameters.

See Also

Cmdlet Common Parameters

Types of Cmdlet Parameter

Writing a Windows PowerShell Cmdlet

Types of Cmdlet Parameters

Article • 09/17/2021

This topic describes the different types of parameters that you can declare in cmdlets. Cmdlet parameters can be positional, named, required, optional, or switch parameters.

Positional and Named Parameters

All cmdlet parameters are either named or positional parameters. A named parameter requires that you type the parameter name and argument when calling the cmdlet. A positional parameter requires only that you type the arguments in relative order. The system then maps the first unnamed argument to the first positional parameter. The system maps the second unnamed argument to the second unnamed parameter, and so on. By default, all cmdlet parameters are named parameters.

To define a named parameter, omit the `Position` keyword in the **Parameter** attribute declaration, as shown in the following parameter declaration.

C#

```
[Parameter(ValueFromPipeline=true)]
public string UserName
{
  get { return userName; }
  set { userName = value; }
}
private string userName;
```

To define a positional parameter, add the `Position` keyword in the Parameter attribute declaration, and then specify a position. In the following sample, the `UserName` parameter is declared as a positional parameter with position 0. This means that the first argument of the call will be automatically bound to this parameter.

C#

```
[Parameter(Position = 0)]
public string UserName
{
  get { return userName; }
  set { userName = value; }
}
private string userName;
```

> **Note**
>
> Good cmdlet design recommends that the most-used parameters be declared as positional parameters so that the user does not have to enter the parameter name when the cmdlet is run.

Positional and named parameters accept single arguments or multiple arguments separated by commas. Multiple arguments are allowed only if the parameter accepts a collection such as an array of strings. You may mix positional and named parameters in the same cmdlet. In this case, the system retrieves the named arguments first, and then attempts to map the remaining unnamed arguments to the positional parameters.

The following commands show the different ways in which you can specify single and multiple arguments for the parameters of the `Get-Command` cmdlet. Notice that in the last two samples, **-name** does not need to be specified because the `Name` parameter is defined as a positional parameter.

PowerShell

```
Get-Command -Name get-service
Get-Command -Name get-service,set-service
Get-Command get-service
Get-Command get-service,set-service
```

Mandatory and Optional Parameters

You can also define cmdlet parameters as mandatory or optional parameters. (A mandatory parameter must be specified before the Windows PowerShell runtime invokes the cmdlet.) By default, parameters are defined as optional.

To define a mandatory parameter, add the `Mandatory` keyword in the Parameter attribute declaration, and set it to `true`, as shown in the following parameter declaration.

C#

```
[Parameter(Position = 0, Mandatory = true)]
public string UserName
{
  get { return userName; }
  set { userName = value; }
}
private string userName;
```

To define an optional parameter, omit the `Mandatory` keyword in the **Parameter** attribute declaration, as shown in the following parameter declaration.

C#

```
[Parameter(Position = 0)]
public string UserName
{
  get { return userName; }
  set { userName = value; }
}
private string userName;
```

Switch Parameters

Windows PowerShell provides a System.Management.Automation.SwitchParameter type that allows you to define a parameter whose value is automatically set to `false` if the parameter is not specified when the cmdlet is called. Whenever possible, use switch parameters in place of Boolean parameters.

Consider the following sample. By default, several Windows PowerShell cmdlets do not pass an output object down the pipeline. However, these cmdlets have a `PassThru` switch parameter that overrides the default behavior. If the `PassThru` parameter is specified when these cmdlets are called, the cmdlet returns an output object to the pipeline.

If you need the parameter to have a default value of `true` when the parameter is not specified in the call, consider reversing the sense of the parameter. For sample, instead of setting the parameter attribute to a Boolean value of `true`, declare the property as the System.Management.Automation.SwitchParameter type, and then set the default value of the parameter to `false`.

To define a switch parameter, declare the property as the System.Management.Automation.SwitchParameter type, as shown in the following sample.

C#

```
[Parameter(Position = 1)]
public SwitchParameter GoodBye
{
  get { return goodbye; }
  set { goodbye = value; }
```

```
}
private bool goodbye;
```

To make the cmdlet act on the parameter when it is specified, use the following structure within one of the input processing methods.

C#

```
protected override void ProcessRecord()
{
  WriteObject("Switch parameter test: " + userName + ".");
  if(goodbye)
  {
    WriteObject(" Goodbye!");
  }
} // End ProcessRecord
```

See Also

Writing a Windows PowerShell Cmdlet

Standard Cmdlet Parameter Names and Types

Article • 09/17/2021

Cmdlet parameter names should be consistent across the cmdlets that you design. The following topics list the parameter names that we recommend you use when you declare cmdlet parameters. The topics also describe the recommended data type and functionality of each parameter.

In This Section

Activity Parameters

Date and Time Parameters

Format Parameters

Property Parameters

Quantity Parameters

Resource Parameters

Security Parameters

Activity Parameters

Article • 06/23/2022

The following table lists the recommended names and functionality for activity parameters.

Parameter	Functionality
Append Data type: SwitchParameter	Implement this parameter so that the user can add content to the end of a resource when the parameter is specified.
CaseSensitive Data type: SwitchParameter	Implement this parameter so the user can require case sensitivity when the parameter is specified.
Command Data type: String	Implement this parameter so the user can specify a command string to run.
CompatibleVersion Data type: System.Version object	Implement this parameter so the user can specify the semantics that the cmdlet must be compatible with for compatibility with previous versions.
Compress Data type: SwitchParameter	Implement this parameter so that data compression is used when the parameter is specified.
Compress Data type: Keyword	Implement this parameter so that the user can specify the algorithm to use for data compression.
Continuous Data type: SwitchParameter	Implement this parameter so that data is processed until the user terminates the cmdlet when the parameter is specified. If the parameter is not specified, the cmdlet processes a predefined amount of data and then terminates the operation.
Create Data type: SwitchParameter	Implement this parameter to indicate that a resource is created if one does not already exist when the parameter is specified.
Delete Data type: SwitchParameter	Implement this parameter so that resources are deleted when the cmdlet has completed its operation when the parameter is specified.
Drain Data type: SwitchParameter	Implement this parameter to indicate that outstanding work items are processed before the cmdlet processes new data when the parameter is specified. If the parameter is not specified, the work items are processed immediately.

Parameter	Functionality
Erase Data type: Int32	Implement this parameter so that the user can specify the number of times a resource is erased before it is deleted.
ErrorLevel Data type: Int32	Implement this parameter so that the user can specify the level of errors to report.
Exclude Data type: String[]	Implement this parameter so that the user can exclude something from an activity. For more information about how to use input filters, see Input Filter Parameters.
Filter Data type: Keyword	Implement this parameter so that the user can specify a filter that selects the resources upon which to perform the cmdlet action. For more information about how to use input filters, see Input Filter Parameters.
Follow Data type: SwitchParameter	Implement this parameter so that progress is tracked when the parameter is specified.
Force Data type: SwitchParameter	Implement this parameter to indicate that the user can perform an action even if restrictions are encountered when the parameter is specified. The parameter does not allow security to be compromised. For example, this parameter lets a user overwrite a read-only file.
Include Data type: String[]	Implement this parameter so that the user can include something in an activity. For more information about how to use input filters, see Input Filter Parameters.
Incremental Data type: SwitchParameter	Implement this parameter to indicate that processing is performed incrementally when the parameter is specified. For example, this parameter lets a user perform incremental backups that back up files only since the last backup.
InputObject Data type: Object	Implement this parameter when the cmdlet takes input from other cmdlets. When you define an **InputObject** parameter, always specify the **ValueFromPipeline** keyword when you declare the **Parameter** attribute. For more information about using input filters, see Input Filter Parameters.
Insert Data type: SwitchParameter	Implement this parameter so that the cmdlet inserts an item when the parameter is specified.
Interactive Data type: SwitchParameter	Implement this parameter so that the cmdlet works interactively with the user when the parameter is specified.
Interval Data type: HashTable	Implement this parameter so that the user can specify a hash table of keywords that contains the values. The following example shows sample values for the **Interval** parameter: `-interval @{ResumeScan=15; Retry=3}`.

Parameter	Functionality
Log Data type: SwitchParameter	Implement this parameter audit the actions of the cmdlet when the parameter is specified.
NoClobber Data type: SwitchParameter	Implement this parameter so that the resource will not be overwritten when the parameter is specified. This parameter generally applies to cmdlets that create new objects so that they can be prevented from overwriting existing objects with the same name.
Notify Data type: SwitchParameter	Implement this parameter so that the user will be notified that the activity is complete when the parameter is specified.
NotifyAddress Data type: Email address	Implement this parameter so that the user can specify the e-mail address to use to send a notification when the **Notify** parameter is specified.
Overwrite Data type: SwitchParameter	Implement this parameter so that the cmdlet overwrites any existing data when the parameter is specified.
Prompt Data type: String	Implement this parameter so that the user can specify a prompt for the cmdlet.
Quiet Data type: SwitchParameter	Implement this parameter so that the cmdlet suppresses user feedback during its actions when the parameter is specified.
Recurse Data type: SwitchParameter	Implement this parameter so that the cmdlet recursively performs its actions on resources when the parameter is specified.
Repair Data type: SwitchParameter	Implement this parameter so that the cmdlet will attempt to correct something from a broken state when the parameter is specified.
RepairString Data type: String	Implement this parameter so that the user can specify a string to use when the **Repair** parameter is specified.
Retry Data type: Int32	Implement this parameter so the user can specify the number of times the cmdlet will attempt an action.
Select Data type: Keyword array	Implement this parameter so that the user can specify an array of the types of items.
Stream Data type: SwitchParameter	Implement this parameter so the user can stream multiple output objects through the pipeline when the parameter is specified.

Parameter	Functionality
Strict Data type: SwitchParameter	Implement this parameter so that all errors are handled as terminating errors when the parameter is specified.
TempLocation Data type: String	Implement this parameter so the user can specify the location of temporary data that is used during the operation of the cmdlet.
Timeout Data type: Int32	Implement this parameter so that the user can specify the timeout interval (in milliseconds).
Truncate Data type: SwitchParameter	Implement this parameter so that the cmdlet will truncate its actions when the parameter is specified. If the parameter is not specified, the cmdlet performs another action.
Verify Data type: SwitchParameter	Implement this parameter so that the cmdlet will test to determine whether an action has occurred when the parameter is specified.
Wait Data type: SwitchParameter	Implement this parameter so that the cmdlet will wait for user input before continuing when the parameter is specified.
WaitTime Data type: Int32	Implement this parameter so that the user can specify the duration (in seconds) that the cmdlet will wait for user input when the **Wait** parameter is specified.

See Also

Cmdlet Parameters

Writing a Windows PowerShell Cmdlet

Windows PowerShell SDK

Date and Time Parameters

Article • 09/17/2021

The following table lists recommended names and functionality for parameters that handle date and time information. Date and time parameters are typically used to record when something is created or accessed.

Parameter	Functionality
Accessed Data type: SwitchParameter	Implement this parameter so that when it is specified the cmdlet will operate on the resources that have been accessed based on the date and time specified by the **Before** and **After** parameters. If this parameter is specified, the **Created** and **Modified** parameters must be not be specified.
After Data type: DateTime	Implement this parameter to specify the date and time after which the cmdlet was used. For the **After** parameter to work, the cmdlet must also have an **Accessed**, **Created**, or **Modified** parameter. And, that parameter must be set to **true** when the cmdlet is called.
Before Data type: DateTime	Implement this parameter to specify the date and time before which the cmdlet was used. For the **Before** parameter to work, the cmdlet must also have an **Accessed**, **Created**, or **Modified** parameter. And, that parameter must be set to **true** when the cmdlet is called.
Created Data type: SwitchParameter	Implement this parameter so that when it is specified the cmdlet will operate on the resources that have been created based on the date and time specified by the **Before** and **After** parameters. If this parameter is specified, the **Accessed** and **Modified** parameters must not be specified.
Exact Data type: SwitchParameter	Implement this parameter so that when it is specified the resource term must match the resource name exactly. When the parameter is not specified the resource term and name do not need to match exactly.
Modified Data type: DateTime	Implement this parameter so that when it is specified the cmdlet will operate on resources that have been changed based on the date and time specified by the **Before** and **After** parameters. If this parameter is specified, the **Accessed** and **Created** parameters must not be specified.

See Also

Cmdlet Parameters

Writing a Windows PowerShell Cmdlet

Windows PowerShell SDK

Format Parameters

Article • 09/17/2021

The following table lists recommended names and functionality for parameters that are used to format or to generate data.

Parameter	Functionality
As Data type: Keyword	Implement this parameter to specify the cmdlet output format. For example, possible values could be Text or Script.
Binary Data type: SwitchParameter	Implement this parameter to indicate that the cmdlet handles binary values.
Encoding Data type: Keyword	Implement this parameter to specify the type of encoding that is supported. For example, possible values could be ASCII, UTF8, Unicode, UTF7, BigEndianUnicode, Byte, and String.
NewLine Data type: SwitchParameter	Implement this parameter so that the newline characters are supported when the parameter is specified.
ShortName Data type: SwitchParameter	Implement this parameter so that short names are supported when the parameter is specified.
Width Data type: Int32	Implement this parameter so that the user can specify the width of the output device.
Wrap Data type: SwitchParameter	Implement this parameter so that text wrapping is supported when the parameter is specified.

See Also

Cmdlet Parameters

Writing a Windows PowerShell Cmdlet

Windows PowerShell SDK

Property Parameters

Article • 09/17/2021

The following table lists the recommended names and functionality for property parameters.

Parameter	Functionality
Count Data type: Int32	Implement this parameter so that the user can specify the number of objects to be processed.
Description Data type: String	Implement this parameter so that the user can specify a description for a resource.
From Data type: String	Implement this parameter so that the user can specify the reference object to get information from.
Id Data type: Resource dependent	Implement this parameter so that the user can specify the identifier of a resource.
Input Data type: String	Implement this parameter so that the user can specify the input file specification.
Location Data type: String	Implement this parameter so that the user can specify the location of the resource.
LogName Data type: String	Implement this parameter so that the user can specify the name of the log file to process or use.
Name Data type: String	Implement this parameter so that the user can specify the name of the resource.
Output Data type: String	Implement this parameter so that the user can specify the output file.
Owner Data type: String	Implement this parameter so that the user can specify the name of the owner of the resource.
Property Data type: String	Implement this parameter so that the user can specify the name or the names of the properties to use.
Reason Data type: String	Implement this parameter so that the user can specify why this cmdlet is being invoked.
Regex Data type: SwitchParameter	Implement this parameter so that regular expressions are used when the parameter is specified. When this parameter is specified, wildcard characters are not resolved.

Parameter	Functionality
Speed Data type: Int32	Implement this parameter so that the user can specify the baud rate. The user sets this parameter to the speed of the resource.
State Data type: Keyword array	Implement this parameter so that the user can specify the names of states, such as KEYDOWN.
Value Data type: Object	Implement this parameter so that the user can specify a value to provide to the cmdlet.
Version Data type: String	Implement this parameter so that the user can specify the version of the property.

See Also

Cmdlet Parameters

Writing a Windows PowerShell Cmdlet

Windows PowerShell SDK

Quantity Parameters

Article • 09/17/2021

The following table lists the recommended names and functionality for quantity parameters.

Parameter	Functionality
All Data type: Boolean	Implement this parameter so that `true` indicates that all resources should be acted upon instead of a default subset of resources. Implement this parameter so that `false` indicates a subset of the resources.
Allocation Data type: Int32	Implement this parameter so that the user can specify the number of items to allocate.
BlockCount Data type: Int64	Implement this parameter so that the user can specify the block count.
Count Data type: Int64	Implement this parameter so that the user can specify the count.
Scope Data type: Keyword	Implement this parameter so that the user can specify the scope to operate on.

See Also

Cmdlet Parameters

Writing a Windows PowerShell Cmdlet

Windows PowerShell SDK

Resource Parameters

Article • 09/17/2021

The following table lists the recommended names and functionality for resource parameters. For these parameters, the resources could be the assembly that contains the cmdlet class or the host application that is running the cmdlet.

Parameter	Functionality
Application Data type: String	Implement this parameter so that the user can specify an application.
Assembly Data type: String	Implement this parameter so that the user can specify an assembly.
Attribute Data type: String	Implement this parameter so that the user can specify an attribute.
Class Data type: String	Implement this parameter so that the user can specify a Microsoft .NET Framework class.
Cluster Data type: String	Implement this parameter so that the user can specify a cluster.
Culture Data type: String	Implement this parameter so that the user can specify the culture in which to run the cmdlet.
Domain Data type: String	Implement this parameter so that the user can specify the domain name.
Drive Data type: String	Implement this parameter so that the user can specify a drive name.
Event Data type: String	Implement this parameter so that the user can specify an event name.
Interface Data type: String	Implement this parameter so that the user can specify a network interface name.

Parameter	Functionality
IpAddress Data type: String	Implement this parameter so that the user can specify an IP address.
Job Data type: String	Implement this parameter so that the user can specify a job.
LiteralPath Data type: String	Implement this parameter so that the user can specify the path to a resource when wildcard characters are not supported. (Use the **Path** parameter when wildcard characters are supported.)
Mac Data type: String	Implement this parameter so that the user can specify a media access controller (MAC) address.
ParentId Data type: String	Implement this parameter so that the user can specify the parent identifier.
Path Data type: String, String[]	Implement this parameter so that the user can indicate the paths to a resource when wildcard characters are supported. (Use the **LiteralPath** parameter when wildcard characters are not supported.) We recommend that you develop this parameter so that it supports the full `provider:path` syntax used by providers. We also recommend that you develop it so that it works with as many providers as possible.
Port Data type: Integer, String	Implement this parameter so that the user can specify an integer value for networking or a string value such as "biztalk" for other types of port.
Printer Data type: Integer, String	Implement this parameter so that the user can specify the printer for the cmdlet to use.
Size Data type: Int32	Implement this parameter so that the user can specify a size.
TID Data type: String	Implement this parameter so that the user can specify a transaction identifier (TID) for the cmdlet.
Type Data type: String	Implement this parameter so that the user can specify the type of resource on which to operate.

Parameter	Functionality
URL Data type: String	Implement this parameter so that the user can specify a Uniform Resource Locator (URL).
User Data type: String	Implement this parameter so that the user can specify their name or the name of another user.

See Also

Cmdlet Parameters

Writing a Windows PowerShell Cmdlet

Windows PowerShell SDK

Security Parameters

Article • 09/17/2021

The following table lists the recommended names and functionality for parameters used to provide security information for an operation, such as parameters that specify certificate key and privilege information.

Parameter	Functionality
ACL Data type: String	Implement this parameter to specify the access control level of protection for a catalog or for a Uniform Resource Identifier (URI).
CertFile Data type: String	Implement this parameter so that the user can specify the name of a file that contains one of the following: - A Base64 or Distinguished Encoding Rules (DER) encoded x.509 certificate - A Public Key Cryptography Standards (PKCS) #12 file that contains at least one certificate and key
CertIssuerName Data type: String	Implement this parameter so that the user can specify the name of the issuer of a certificate or so that the user can specify a substring.
CertRequestFile Data type: String	Implement this parameter to specify the name of a file that contains a Base64 or DER-encoded PKCS #10 certificate request.
CertSerialNumber Data type: String	Implement this parameter to specify the serial number that was issued by the certification authority.
CertStoreLocation Data type: String	Implement this parameter so that the user can specify the location of the certificate store. The location is typically a file path.
CertSubjectName Data type: String	Implement this parameter so that the user can specify the issuer of a certificate or so that the user can specify a substring.
CertUsage Data type: String	Implement this parameter to specify the key usage or the enhanced key usage. The key can be represented as a bit mask, a bit, an object identifier (OID), or a string.

Parameter	Functionality
Credential Data type: System.Management.Automation.PSCredential	Implement this parameter so that the cmdlet will automatically prompt the user for a user name or password. A prompt for both is displayed if a full credential is not supplied directly.
CSPName Data type: String	Implement this parameter so that the user can specify the name of the certificate service provider (CSP).
CSPType Data type: Integer	Implement this parameter so that the user can specify the type of CSP.
Group Data type: String	Implement this parameter so that the user can specify a collection of principals for access. For more information, see the description of the **Principal** parameter.
KeyAlgorithm Data type: String	Implement this parameter so that the user can specify the key generation algorithm to use for security.
KeyContainerName Data type: String	Implement this parameter so that the user can specify the name of the key container.
KeyLength Data type: Integer	Implement this parameter so that the user can specify the length of the key in bits.
Operation Data type: String	Implement this parameter so that the user can specify an action that can be performed on a protected object.
Principal Data type: String	Implement this parameter so that the user can specify a unique identifiable entity for access.
Privilege Data type: String	Implement this parameter so that the user can specify the right a cmdlet needs to perform an operation for a particular entity.
Privileges Data type: Array of privileges	Implement this parameter so that the user can specify the rights that a cmdlet needs to perform its operation for a particular entry.
Role Data type: String	Implement this parameter so that the user can specify a set of operations that can be performed by an entity.
SaveCred Data type: SwitchParameter	Implement this parameter so that credentials that were previously saved by the user will be used when the parameter is specified.

Parameter	Functionality
Scope Data type: String	Implement this parameter so that the user can specify the group of protected objects for the cmdlet.
SID Data type: String	Implement this parameter so that the user can specify a unique identifier that represents a principal.
Trusted Data type: SwitchParameter	Implement this parameter so that trust levels are supported when the parameter is specified.
TrustLevel Data type: Keyword	Implement this parameter so that the user can specify the trust level that is supported. For example, possible values include internet, intranet, and fulltrust.

See Also

Cmdlet Parameters

Writing a Windows PowerShell Cmdlet

Windows PowerShell SDK

Parameter Aliases

Article • 09/17/2021

Cmdlet parameters can also have aliases. You can use the aliases instead of the parameter names when you type or specify the parameter in a command.

Benefits of Using Aliases

Adding aliases to parameters provides the following benefits.

- You can provide a shortcut so that the user does not have to use the complete parameter name when the cmdlet is called. For example, you could use the "CN" alias instead of the parameter name "ComputerName".
- You can define multiple aliases if you want to provide different names for the same parameter. You might want to define multiple aliases if you have to work with multiple user groups that refer to the same data in different ways.
- You can provide backwards compatibility for existing scripts if the name of a parameter changes.
- By using the Alias attribute along with the ValueFromPipelineByName attribute, you can define a parameter that allows your cmdlet to bind to different object types. For example, say you had two objects of different types and the first object had a writer property and the second object had an editor property. If your cmdlet had a parameter that had writer and editor aliases and the cmdlet accepted pipeline input based in property names, your cmdlet could bind to both objects using the two parameter aliases.

For more information about aliases that can be used with specific parameters, see Common Parameter Names.

Defining Parameter Aliases

To define an alias for a parameter, declare the Alias attribute, as shown in the following parameter declaration. In this example, multiple aliases are defined for the same parameter. (For more information, seeHow to Declare Cmdlet Parameters.)

C#

```
[Alias("UN","Writer","Editor")]
[Parameter()]
```

```
public string UserName
{
  get { return userName; }
  set { userName = value; }
}
private string userName;
```

See Also

Common Parameter Names

How to Declare Cmdlet Parameters

Writing a Windows PowerShell Cmdlet

Common Parameter Names

Article • 09/17/2021

The parameters described in this topic are referred to as **common parameters**. They are added to cmdlets by the Windows PowerShell runtime and cannot be declared by the cmdlet.

> **Note**
>
> These parameters are also added to provider cmdlets and to functions that are decorated with the `CmdletBinding` attribute.

General Common Parameters

The following parameters are added to all cmdlets and can be accessed whenever the cmdlet is run. These parameters are defined by the System.Management.Automation.Internal.Commonparameters class.

Confirm (alias: cf)

Data type: SwitchParameter

This parameter specifies whether the cmdlet displays a prompt that asks if the user is sure that they want to continue.

Debug (alias: db)

Data type: SwitchParameter

This parameter specifies whether programmer-level debugging messages that can be displayed at the command line. These messages are intended for troubleshooting the operation of the cmdlet, and are generated by calls to the System.Management.Automation.Cmdlet.WriteDebug method. Debug messages do not need to be localized.

ErrorAction (alias: ea)

Data type: Enumeration

This parameter specifies what action should take place when an error occurs. The possible values for this parameter are defined by the System.Management.Automation.Actionpreference enumeration.

ErrorVariable (alias: ev)

Data type: String

This parameter specifies the variable in which to place objects when an error occurs. To append to this variable, use *+varname* rather than clearing and setting the variable.

OutBuffer (alias: ob)

Data type: Int32

This parameter defines the number of objects to store in the output buffer before any objects are passed down the pipeline. By default, objects are passed immediately down the pipeline.

OutVariable (alias: ov)

Data type: String

This parameter specifies the variable in which to place all output objects generated by the cmdlet. To append to this variable, use *+varname* rather than clearing and setting the variable.

PipelineVariable (alias: pv)

Data type: String

This parameter stores the value of the current pipeline element as a variable for any named command as it flows through the pipeline.

Verbose (alias: vb)

Data type: SwitchParameter

This parameter specifies whether the cmdlet writes explanatory messages that can be displayed at the command line. These messages are intended to provide additional help to the user, and are generated by calls to the System.Management.Automation.Cmdlet.WriteVerbose method.

WarningAction (alias: wa)

Data type: Enumeration

This parameter specifies what action should take place when the cmdlet writes a warning message. The possible values for this parameter are defined by the System.Management.Automation.Actionpreference enumeration.

WarningVariable (alias: wv)

Data type: String

This parameter specifies the variable in which warning messages can be saved. To append to this variable, use *+varname* rather than clearing and setting the variable.

Risk-Mitigation Parameters

The following parameters are added to cmdlets that requests confirmation before they perform their action. For more information about confirmation requests, see Requesting Confirmation. These parameters are defined by the System.Management.Automation.Internal.Shouldprocessparameters class.

WhatIf (alias: wi)

Data type: SwitchParameter

This parameter specifies whether the cmdlet writes a message that describes the effects of running the cmdlet without actually performing any action.

Transaction Parameters

The following parameter is added to cmdlets that support transactions. These parameters are defined by the System.Management.Automation.Internal.Transactionparameters class. Transaction support was introduced in PowerShell 3.0 and discontinued in PowerShell 6.0.

UseTransaction (alias: usetx)

Data type: SwitchParameter

This parameter specifies whether the cmdlet will use the current transaction to perform its action.

See Also

System.Management.Automation.Internal.Commonparameters

System.Management.Automation.Internal.Shouldprocessparameters

System.Management.Automation.Internal.Transactionparameters

Writing a Windows PowerShell Cmdlet

Windows PowerShell SDK

Cmdlet parameter sets

Article • 09/17/2021

PowerShell uses parameter sets to enable you to write a single cmdlet that can do different actions for different scenarios. Parameter sets enable you to expose different parameters to the user. And, to return different information based on the parameters specified by the user.

Examples of parameter sets

For example, the PowerShell `Get-EventLog` cmdlet returns different information depending on whether the user specifies the **List** or **LogName** parameter. If the **List** parameter is specified, the cmdlet returns information about the log files themselves but not the event information they contain. If the **LogName** parameter is specified, the cmdlet returns information about the events in a specific event log. The **List** and **LogName** parameters identify two separate parameter sets.

Unique parameter

Each parameter set must have a unique parameter that the PowerShell runtime uses to expose the appropriate parameter set. If possible, the unique parameter should be a mandatory parameter. When a parameter is mandatory, the user must specify the parameter, and the PowerShell runtime uses that parameter to identify the parameter set. The unique parameter can't be mandatory if your cmdlet is designed to run without specifying any parameters.

Multiple parameter sets

In the following illustration, the left column shows three valid parameter sets. **Parameter A** is unique to the first parameter set, **parameter B** is unique to the second parameter set, and **parameter C** is unique to the third parameter set. In the right column, the parameter sets don't have a unique parameter.

Valid Parameter Sets	Invalid Parameter Sets
A D B D E C D	A B B C A C

Parameter set requirements

The following requirements apply to all parameter sets.

- Each parameter set must have at least one unique parameter. If possible, make this parameter a mandatory parameter.
- A parameter set that contains multiple positional parameters must define unique positions for each parameter. No two positional parameters can specify the same position.
- Only one parameter in a set can declare the `ValueFromPipeline` keyword with a value of `true`. Multiple parameters can define the `ValueFromPipelineByPropertyName` keyword with a value of `true`.
- If no parameter set is specified for a parameter, the parameter belongs to all parameter sets.

> **Note**
>
> For a cmdlet or function, there is a limit of 32 parameter sets.

Default parameter sets

When multiple parameter sets are defined, you can use the `DefaultParameterSetName` keyword of the **Cmdlet** attribute to specify the default parameter set. PowerShell uses the default parameter set if it can't determine the parameter set to use based on the information provided by the command. For more information about the **Cmdlet** attribute, see Cmdlet Attribute Declaration.

Declaring parameter sets

To create a parameter set, you must specify the `ParameterSetName` keyword when you declare the **Parameter** attribute for every parameter in the parameter set. For parameters that belong to multiple parameter sets, add a **Parameter** attribute for each parameter set. This attribute enables you to define the parameter differently for each parameter set. For example, you can define a parameter as mandatory in one set and optional in another. However, each parameter set must contain one unique parameter. For more information, see Parameter Attribute Declaration.

In the following example, the **UserName** parameter is the unique parameter of the `Test01` parameter set, and the **ComputerName** parameter is the unique parameter of the `Test02` parameter set. The **SharedParam** parameter belongs to both sets and is mandatory for the `Test01` parameter set but optional for the `Test02` parameter set.

C#

```
[Parameter(Position = 0, Mandatory = true, ParameterSetName = "Test01")]
public string UserName
{
  get { return userName; }
  set { userName = value; }
}
private string userName;

[Parameter(Position = 0, Mandatory = true, ParameterSetName = "Test02")]
public string ComputerName
{
  get { return computerName; }
  set { computerName = value; }
}
private string computerName;

[Parameter(Mandatory= true, ParameterSetName = "Test01")]
[Parameter(ParameterSetName = "Test02")]
public string SharedParam
{
    get { return sharedParam; }
    set { sharedParam = value; }
}
private string sharedParam;
```

Cmdlet dynamic parameters

Article • 09/17/2021

Cmdlets can define parameters that are available to the user under special conditions, such as when the argument of another parameter is a specific value. These parameters are added at runtime and are referred to as dynamic parameters because they're only added when needed. For example, you can design a cmdlet that adds several parameters only when a specific switch parameter is specified.

> **Note**
>
> Providers and PowerShell functions can also define dynamic parameters.

Dynamic parameters in PowerShell cmdlets

PowerShell uses dynamic parameters in several of its provider cmdlets. For example, the `Get-Item` and `Get-ChildItem` cmdlets add a **CodeSigningCert** parameter at runtime when the **Path** parameter specifies the **Certificate** provider path. If the **Path** parameter specifies a path for a different provider, the **CodeSigningCert** parameter isn't available.

The following examples show how the **CodeSigningCert** parameter is added at runtime when `Get-Item` is run.

In this example, the PowerShell runtime has added the parameter and the cmdlet is successful.

PowerShell

```powershell
Get-Item -Path cert:\CurrentUser -CodeSigningCert
```

Output

```
Location   : CurrentUser
StoreNames : {SmartCardRoot, UserDS, AuthRoot, CA...}
```

In this example, a **FileSystem** drive is specified and an error is returned. The error message indicates that the **CodeSigningCert** parameter can't be found.

PowerShell

```powershell
Get-Item -Path C:\ -CodeSigningCert
```

Output

```
Get-Item : A parameter cannot be found that matches parameter name
'codesigningcert'.
At line:1 char:37
+  get-item -path C:\ -codesigningcert <<<<
--------
    CategoryInfo          : InvalidArgument: (:) [Get-Item],
ParameterBindingException
    FullyQualifiedErrorId :
NamedParameterNotFound,Microsoft.PowerShell.Commands.GetItemCommand
```

Support for dynamic parameters

To support dynamic parameters, the following elements must be included in the cmdlet code.

Interface

System.Management.Automation.IDynamicParameters. This interface provides the method that retrieves the dynamic parameters.

For example:

`public class SendGreetingCommand : Cmdlet, IDynamicParameters`

Method

System.Management.Automation.IDynamicParameters.GetDynamicParameters. This method retrieves the object that contains the dynamic parameter definitions.

For example:

C#

```
 public object GetDynamicParameters()
 {
   if (employee)
   {
     context= new SendGreetingCommandDynamicParameters();
     return context;
   }
   return null;
}
private SendGreetingCommandDynamicParameters context;
```

Class

A class that defines the dynamic parameters to be added. This class must include a **Parameter** attribute for each parameter and any optional **Alias** and **Validation** attributes that are needed by the cmdlet.

For example:

C#

```
public class SendGreetingCommandDynamicParameters
{
  [Parameter]
  [ValidateSet ("Marketing", "Sales", "Development")]
  public string Department
  {
    get { return department; }
    set { department = value; }
  }
  private string department;
}
```

For a complete example of a cmdlet that supports dynamic parameters, see How to Declare Dynamic Parameters.

See also

System.Management.Automation.IDynamicParameters

System.Management.Automation.IDynamicParameters.GetDynamicParameters

How to Declare Dynamic Parameters

Writing a Windows PowerShell Cmdlet

Supporting Wildcard Characters in Cmdlet Parameters

Article • 09/17/2021

Often, you will have to design a cmdlet to run against a group of resources rather than against a single resource. For example, a cmdlet might need to locate all the files in a data store that have the same name or extension. You must provide support for wildcard characters when you design a cmdlet that will be run against a group of resources.

> ⓘ **Note**
>
> Using wildcard characters is sometimes referred to as *globbing*.

Windows PowerShell Cmdlets That Use Wildcards

Many Windows PowerShell cmdlets support wildcard characters for their parameter values. For example, almost every cmdlet that has a `Name` or `Path` parameter supports wildcard characters for these parameters. (Although most cmdlets that have a `Path` parameter also have a `LiteralPath` parameter that does not support wildcard characters.) The following command shows how a wildcard character is used to return all the cmdlets in the current session whose name contains the Get verb.

```
Get-Command get-*
```

Supported Wildcard Characters

Windows PowerShell supports the following wildcard characters.

Wildcard	Description	Example	Matches	Does not match
*	Matches zero or more characters, starting at the specified position	`a*`	A, ag, Apple	
?	Matches any character at the specified position	`?n`	An, in, on	ran

Wildcard	Description	Example	Matches	Does not match
[ ]	Matches a range of characters	`[a-l]ook`	book, cook, look	nook, took
[ ]	Matches the specified characters	`[bn]ook`	book, nook	cook, look

When you design cmdlets that support wildcard characters, allow for combinations of wildcard characters. For example, the following command uses the `Get-ChildItem` cmdlet to retrieve all the .txt files that are in the c:\Techdocs folder and that begin with the letters "a" through "l."

```
Get-ChildItem c:\techdocs\[a-l]\*.txt
```

The previous command uses the range wildcard `[a-l]` to specify that the file name should begin with the characters "a" through "l" and uses the `*` wildcard character as a placeholder for any characters between the first letter of the filename and the **.txt** extension.

The following example uses a range wildcard pattern that excludes the letter "d" but includes all the other letters from "a" through "f."

```
Get-ChildItem c:\techdocs\[a-cef]\*.txt
```

Handling Literal Characters in Wildcard Patterns

If the wildcard pattern you specify contains literal characters that should not be interpretted as wildcard characters, use the backtick character (`` ` ``) as an escape character. When you specify literal characters int the PowerShell API, use a single backtick. When you specify literal characters at the PowerShell command prompt, use two backticks.

For example, the following pattern contains two brackets that must be taken literally.

When used in the PowerShell API use:

- "John Smith `[*`]"

When used from the PowerShell command prompt:

- "John Smith ``[*``]"

This pattern matches "John Smith [Marketing]" or "John Smith [Development]". For example:

```
PS> "John Smith [Marketing]" -like "John Smith ``[*``]"
True

PS> "John Smith [Development]" -like "John Smith ``[*``]"
True
```

Cmdlet Output and Wildcard Characters

When cmdlet parameters support wildcard characters, the operation usually generates an array output. Occasionally, it makes no sense to support an array output because the user might use only a single item. For example, the `Set-Location` cmdlet does not support array output because the user sets only a single location. In this instance, the cmdlet still supports wildcard characters, but it forces resolution to a single location.

See Also

Writing a Windows PowerShell Cmdlet

WildcardPattern Class

Validating Parameter Input

Article • 09/17/2021

PowerShell can validate the arguments passed to cmdlet parameters in several ways. PowerShell can validate the length, the range, and the pattern of the characters of the argument. It can validate the number of arguments available (the count). These validation rules are defined by validation attributes that are declared with the Parameter attribute on public properties of the cmdlet class.

To validate a parameter argument, the PowerShell runtime uses the information provided by the validation attributes to confirm the value of the parameter before the cmdlet is run. If the parameter input is not valid, the user receives an error message. Each validation parameter defines a validation rule that is enforced by PowerShell.

PowerShell enforces the validation rules based on the following attributes.

ValidateCount

Specifies the minimum and maximum number of arguments that a parameter can accept. For more information, see ValidateCount Attribute Declaration.

ValidateLength

Specifies the minimum and maximum number of characters in the parameter argument. For more information, see ValidateLength Attribute Declaration.

ValidatePattern

Specifies a regular expression that validates the parameter argument. For more information, see ValidatePattern Attribute Declaration.

ValidateRange

Specifies the minimum and maximum values of the parameter argument. For more information, see ValidateRange Attribute Declaration.

ValidateScript

Specifies the valid values for the parameter argument. For more information, see ValidateScript Attribute Declaration.

ValidateSet

Specifies the valid values for the parameter argument. For more information, see ValidateSet Attribute Declaration.

See Also

How to Validate Parameter Input

Writing a Windows PowerShell Cmdlet

Input Filter Parameters

Article • 09/17/2021

A cmdlet can define `Filter`, `Include`, and `Exclude` parameters that filter the set of input objects that the cmdlet affects.

Typically, the set of input objects is specified by an `InputObject`, `Path`, or `Name` parameter. For example, a cmdlet can have a `Path` parameter that accepts multiple paths by using wildcard characters, and each path points to an input object. Used together, the `Filter`, `Include`, and `Exclude` parameters further qualify the paths the cmdlet works on each time it is invoked.

Include and Exclude Parameters

The `Include` and `Exclude` parameters identify the objects that are included or excluded from the set of input objects passed to the cmdlet. Use these parameters when the filter can be expressed in the standard wildcard language. (For more information about wildcard characters, see Supporting Wildcards in Cmdlet Parameters.) The `Include` parameter includes all the objects whose names match the inclusion filter. The `Exclude` parameter excludes all the objects whose names match the filter.

Filter Parameter

The `Filter` parameter specifies a filter that is not expressed in the standard wildcard language. For example, Active Directory Service Interfaces (ADSI) or SQL filters might be passed to the cmdlet through its `Filter` parameter. In the cmdlets provided by Windows PowerShell, these filters are specified by the Windows PowerShell providers that use the cmdlet to access a data store. Each provider typically defines its own filter.

Filtering If No Set of Input Objects Is Specified

If no set of input objects is specified, this typically means to filter against all objects. For more information, seeGet-Process.

See Also

Writing a Windows PowerShell Cmdlet

Cmdlet Attributes

Article • 09/17/2021

Windows PowerShell defines several attributes that you can use to add common functionality to your cmdlets without implementing that functionality within your own code. This includes the Cmdlet attribute that identifies a Microsoft .NET Framework class as a cmdlet class, the OutputType attribute that specifies the .NET Framework types returned by the cmdlet, the Parameter attribute that identifies public properties as cmdlet parameters, and more.

In This Section

Attributes in Cmdlet Code Describes the benefit of using attributes in cmdlet code.

Attribute Types Describes the different attributes that can decorate a cmdlet class.

Alias Attribute Declaration Describes how to define aliases for a cmdlet parameter name.

Cmdlet Attribute Declaration Describes how to define a .NET Framework class as a cmdlet.

Credential Attribute Declaration Describes how to add support for converting string input into a System.Management.Automation.PSCredential object.

OutputType attribute Declaration Describes how to specify the .NET Framework types returned by the cmdlet.

Parameter Attribute Declaration Describes how to define the parameters of a cmdlet.

ValidateCount Attribute Declaration Describes how to define how many arguments are allowed for a parameter.

ValidateLength Attribute Declaration Describes how to define the length (in characters) of a parameter argument.

ValidatePattern Attribute Declaration Describes how to define the valid patterns for a parameter argument.

ValidateRange Attribute Declaration Describes how to define the valid range for a parameter argument.

ValidateScript Attribute Declaration Describes how to define the possible values for a parameter argument.

ValidateSet Attribute Declaration Describes how to define the possible values for a parameter argument.

Reference

Writing a Windows PowerShell Cmdlet

Attributes in Cmdlet Code

Article • 09/17/2021

To use the common functionality provided by Windows PowerShell, the classes and public properties defined in the cmdlet code are decorated with attributes. For example, the following class definition uses the Cmdlet attribute to identify the Microsoft .NET Framework class in which the **Get-Proc** cmdlet is implemented. (This cmdlet is used as an example in this document, and is similar to the `Get-Process` cmdlet provided by Windows PowerShell.)

C#

```
[Cmdlet(VerbsCommon.Get, "Proc")]
public class GetProcCommand : Cmdlet
```

These attributes are considered metadata because their implementation is separate from the implementation of the cmdlet code. When the Windows PowerShell runtime runs the cmdlet, it recognizes the attributes and then performs the appropriate action for each attribute.

Although you might want to implement your own version of the functionality provided by these attributes, a good cmdlet design uses these common functionalities.

For more information about the different attributes that can be declared in your cmdlets, see Attribute Types.

See Also

Attribute Types

Writing a Windows PowerShell Cmdlet

Attribute Types

Article • 09/17/2021

Cmdlet attributes can be grouped by functionality. The following sections describe the available attributes and describe what the runtime does when the attribute is invoked.

Cmdlet Attributes

Cmdlet

Identifies a .NET Framework class as a cmdlet. This is the required base attribute. For more information, see Cmdlet Attribute Declaration.

Parameter Attributes

Parameter

Identifies a public property in the cmdlet class as a cmdlet parameter. For more information, see Parameter Attribute Declaration.

Alias

Specifies one or more aliases for a parameter. For more information, see Alias Attribute Declaration.

Argument Validation Attributes

ValidateCount

Specifies the minimum and maximum number of arguments that are allowed for a cmdlet parameter. For more information, see ValidateCount Attribute Declaration.

ValidateLength

Specifies a minimum and maximum number of characters for a cmdlet parameter argument. For more information, see ValidateLength Attribute Declaration.

ValidatePattern

Specifies a regular expression pattern that the cmdlet parameter argument must match. For more information, see ValidatePattern Attribute Declaration.

ValidateRange

Specifies the minimum and maximum values for a cmdlet parameter argument. For more information, see ValidateRange Attribute Declaration.

ValidateSet

Specifies a set of valid values for the cmdlet parameter argument. For more information, see ValidateSet Attribute Declaration.

See Also

Windows PowerShell SDK

Alias Attribute Declaration

Article • 09/17/2021

The **Alias** attribute allows the user to specify different names for a cmdlet or a cmdlet parameter. Aliases can be used to provide shortcuts for a parameter name, or they can provide different names that are appropriate for different scenarios.

Syntax

C#

```
[Alias(aliasNames)]
```

Parameters

`aliasNames` (String[]) Required. Specifies a set of comma-separated alias names for the cmdlet parameter.

Remarks

The **Alias** attribute is defined by the System.Management.Automation.Aliasattribute class.

Cmdlet aliases

- The **Alias** attribute is used with the cmdlet declaration. For more information about how to declare these attributes, see Cmdlet Aliases.
- Each parameter alias name must be unique. Windows PowerShell does not check for duplicate alias names.

Parameter aliases

- The **Alias** attribute is used with the **Parameter** attribute when you specify a cmdlet parameter. For more information about how to declare these attributes, see How to Declare Cmdlet Parameters.
- Each parameter alias name must be unique within a cmdlet. Windows PowerShell does not check for duplicate alias names.
- The Alias attribute is used once for each parameter in a cmdlet.

See Also

Cmdlet Aliases

Parameter Aliases

Writing a Windows PowerShell Cmdlet

Cmdlet Attribute Declaration

Article • 09/17/2021

The Cmdlet attribute identifies a Microsoft .NET Framework class as a cmdlet and specifies the verb and noun used to invoke the cmdlet.

Syntax

```
C#
```

```
[Cmdlet("verbName", "nounName")]
[Cmdlet("verbName", "nounName", Named Parameters...)]
```

Parameters

`VerbName` (System.String) Required. Specifies the cmdlet verb. This verb specifies the action taken by the cmdlet. For more information about approved cmdlet verbs, see Cmdlet Verb Names and Required Development Guidelines.

`NounName` (System.String) Required. Specifies the cmdlet noun. This noun specifies the resource that the cmdlet acts upon. For more information about cmdlet nouns, see Cmdlet Declaration and Strongly Encouraged Development Guidelines.

`SupportsShouldProcess` (System.Boolean) Optional named parameter. `True` indicates that the cmdlet supports calls to the System.Management.Automation.Cmdlet.ShouldProcess method, which provides the cmdlet with a way to prompt the user before an action that changes the system is performed. `False`, the default value, indicates that the cmdlet does not support calls to the System.Management.Automation.Cmdlet.ShouldProcess method. For more information about confirmation requests, see Requesting Confirmation.

`ConfirmImpact` (System.Management.Automation.Confirmimpact) Optional named parameter. Specifies when the action of the cmdlet should be confirmed by a call to the System.Management.Automation.Cmdlet.ShouldProcess method. System.Management.Automation.Cmdlet.ShouldProcess will only be called when the ConfirmImpact value of the cmdlet (by default, Medium) is equal to or greater than the value of the `$ConfirmPreference` variable. This parameter should be specified only when the `SupportsShouldProcess` parameter is specified.

`DefaultParameterSetName` (System.String) Optional named parameter. Specifies the default parameter set that the Windows PowerShell runtime attempts to use when it cannot determine which parameter set to use. Notice that this situation can be eliminated by making the unique parameter of each parameter set a mandatory parameter.

There is one case where Windows PowerShell cannot use the default parameter set even if a default parameter set name is specified. The Windows PowerShell runtime cannot distinguish between parameter sets based solely on object type. For example, if you have one parameter set that takes a string as the file path, and another set that takes a **FileInfo** object directly, Windows PowerShell cannot determine which parameter set to use based on the values passed to the cmdlet, nor does it use the default parameter set. In this case, even if you specify a default parameter set name, Windows PowerShell throws an ambiguous parameter set error message.

`SupportsTransactions` (System.Boolean) Optional named parameter. `True` indicates that the cmdlet can be used within a transaction. When `True` is specified, the Windows PowerShell runtime adds the `UseTransaction` parameter to the parameter list of the cmdlet. `False`, the default value, indicates that the cmdlet cannot be used within a transaction.

Remarks

- Together, the verb and noun are used to identify your registered cmdlet and to invoke your cmdlet within a script.
- When the cmdlet is invoked from the Windows PowerShell console, the command resembles the following command:

VerbName-NounName

- All cmdlets that change resources outside of Windows PowerShell should include the `SupportsShouldProcess` keyword when the Cmdlet attribute is declared, which allows the cmdlet to call the System.Management.Automation.Cmdlet.ShouldProcess method before the cmdlet performs its action. If the System.Management.Automation.Cmdlet.ShouldProcess call returns `false`, the action should not be taken. For more information about the confirmation requests generated by the System.Management.Automation.Cmdlet.ShouldProcess call, see Requesting Confirmation.

The `Confirm` and `WhatIf` cmdlet parameters are available only for cmdlets that support System.Management.Automation.Cmdlet.ShouldProcess calls.

Example

The following class definition uses the Cmdlet attribute to identify the .NET Framework class for a **Get-Proc** cmdlet that retrieves information about the processes running on the local computer.

C#

```
[Cmdlet(VerbsCommon.Get, "Proc")]
public class GetProcCommand : Cmdlet
```

For more information about the **Get-Proc** cmdlet, see GetProc Tutorial.

See Also

Writing a Windows PowerShell Cmdlet

Credential Attribute Declaration

Article • 09/17/2021

The Credential attribute is an optional attribute that can be used with credential parameters of type System.Management.Automation.PSCredential so that a string can also be passed as an argument to the parameter. When this attribute is added to a parameter declaration, Windows PowerShell converts the string input into a System.Management.Automation.PSCredential object. For example, the Get-Credential cmdlet uses this attribute to have Windows PowerShell generate the System.Management.Automation.PSCredential object that is returned by the cmdlet.

Syntax

```
C#

[Credential]
```

Remarks

- Typically this attribute is used by parameters of type System.Management.Automation.PSCredential so that a string can also be passed as an argument to the parameter. When a System.Management.Automation.PSCredential object is passed to the parameter, Windows PowerShell does nothing.
- When creating the System.Management.Automation.PSCredential object, Windows PowerShell uses the current Host to display the appropriate prompts to the user. For example, the default Host displays a prompt for a user name and password when this attribute is used. However, if a custom host is being used that defines a different prompt then that prompt would be displayed.
- This attribute is used with the Parameter attribute. For more information about that attribute, see Parameter Attribute Declaration.
- The credential attribute is defined by the System.Management.Automation.Credentialattribute class.

See Also

Parameter Aliases

Parameter Attribute Declaration

Writing a Windows PowerShell Cmdlet

OutputType Attribute Declaration

Article • 09/17/2021

The `OutputType` attribute identifies the .NET Framework types returned by a cmdlet, function, or script.

Syntax

C#

```
[OutputType(params string[] type)]
[OutputType(params Type[] type)]
[OutputType(params string[] type, Named Parameters...)]
[OutputType(params Type[] type, Named Parameters...)]
```

Parameters

Type (`string[]` or `Type[]`) Required. Specifies the types returned by the cmdlet function, or script.

ParameterSetName (string[]) Optional. Specifies the parameter sets that return the types specified in the `type` parameter.

providerCmdlet Optional. Specifies the provider cmdlet that returns the types specified in the `type` parameter.

See Also

Writing a Windows PowerShell Cmdlet

Parameter Attribute Declaration

Article • 09/17/2021

The Parameter attribute identifies a public property of the cmdlet class as a cmdlet parameter.

Syntax

```
C#
```

```
[Parameter()]
[Parameter(Named Parameters...)]
```

Parameters

`Mandatory` (System.Boolean) Optional named parameter. `True` indicates the cmdlet parameter is required. If a required parameter is not provided when the cmdlet is invoked, Windows PowerShell prompts the user for a parameter value. The default is `false`.

`ParameterSetName` (System.String) Optional named parameter. Specifies the parameter set that this cmdlet parameter belongs to. If no parameter set is specified, the parameter belongs to all parameter sets.

`Position` (System.Int32) Optional named parameter. Specifies the position of the parameter within a Windows PowerShell command.

`ValueFromPipeline` (System.Boolean) Optional named parameter. `True` indicates that the cmdlet parameter takes its value from a pipeline object. Specify this keyword if the cmdlet accesses the complete object, not just a property of the object. The default is `false`.

`ValueFromPipelineByPropertyName` (System.Boolean) Optional named parameter. `True` indicates that the cmdlet parameter takes its value from a property of a pipeline object that has either the same name or the same alias as this parameter. For example, if the cmdlet has a `Name` parameter and the pipeline object also has a `Name` property, the value of the `Name` property is assigned to the `Name` parameter of the cmdlet. The default is `false`.

`ValueFromRemainingArguments` (System.Boolean) Optional named parameter. `True` indicates that the cmdlet parameter accepts all remaining arguments that are passed to the cmdlet. The default is `false`.

`HelpMessage` Optional named parameter. Specifies a short description of the parameter. Windows PowerShell displays this message when a cmdlet is run and a mandatory parameter is not specified.

`HelpMessageBaseName` Optional named parameter. Specifies the location where resource identifiers reside. For example, this parameter could specify a resource assembly that contains Help messages that you want to localize.

`HelpMessageResourceId` Optional named parameter.Specifies the resource identifier for a Help message.

Remarks

- For more information about how to declare this attribute, see How to Declare Cmdlet Parameters.
- A cmdlet can have any number of parameters. However, for a better user experience, limit the number of parameters.
- Parameters must be declared on public non-static fields or properties. Parameters should be declared on properties. The property must have a public set accessor, and if the `ValueFromPipeline` or `ValueFromPipelineByPropertyName` keyword is specified, the property must have a public get accessor.
- When you specify positional parameters, limit the number of positional parameters in a parameter set to less than five. And, positional parameters do not have to be contiguous. Positions 5, 100, and 250 work the same as positions 0, 1, and 2.
- When the `Position` keyword is not specified, the cmdlet parameter must be referenced by its name.
- When you use parameter sets, note the following:
    - Each parameter set must have at least one unique parameter. Good cmdlet design indicates this unique parameter should also be mandatory if possible. If your cmdlet is designed to be run without parameters, the unique parameter cannot be mandatory.

    - No parameter set should contain more than one positional parameter with the same position.
    - Only one parameter in a parameter set should declare `ValueFromPipeline = true`.
    - Multiple parameters can define `ValueFromPipelineByPropertyName = true`.
- For more information about the guidelines for parameter names, see Cmdlet Parameter Names.
- The parameter attribute is defined by the System.Management.Automation.Parameterattribute class.

See Also

System.Management.Automation.Parameterattribute

Cmdlet Parameter Names

Writing a Windows PowerShell Cmdlet

ValidateCount Attribute Declaration

Article • 09/17/2021

The ValidateCount attribute specifies the minimum and maximum number of arguments allowed for a cmdlet parameter.

Syntax

```
C#

[ValidateCount(int minLength, int maxlength)]
```

Parameters

`MinLength` (System.Int32) Required. Specifies the minimum number of arguments.

`MaxLength`(System.Int32) Required. Specifies the maximum number of arguments.

Remarks

- For more information about how to declare this attribute, see How to Validate an Argument Count.
- When this attribute is not invoked, the corresponding cmdlet parameter can have any number of arguments.
- The Windows PowerShell runtime throws an error under the following conditions:
  - The `MinLength` and `MaxLength` attribute parameters are not of type System.Int32.
  - The value of the `MaxLength` attribute parameter is less than the value of the `MinLength` attribute parameter.
- The ValidateCount attribute is defined by the System.Management.Automation.ValidateCountAttribute class.

See Also

System.Management.Automation.ValidateCountAttribute

How to Validate an Argument Count

Writing a Windows PowerShell Cmdlet

ValidateLength Attribute Declaration

Article • 09/17/2021

The ValidateLength attribute specifies the minimum and maximum number of characters for a cmdlet parameter argument. This attribute can also be used by Windows PowerShell functions.

Syntax

C#

```
[ValidateLength(int minLength, int maxlength)]
```

Parameters

`MinLength` (System.Int32) Required. Specifies the minimum number of characters allowed.

`MaxLength` (System.Int32) Required. Specifies the maximum number of characters allowed.

Remarks

- For more information about how to declare this attribute, see How to Declare Input Validation Rules.
- When this attribute is not used, the corresponding parameter argument can be of any length.
- The Windows PowerShell runtime throws an error under the following conditions:
  - When the value of the `MaxLength` attribute parameter is less than the value of the `MinLength` attribute parameter.
  - When the `MaxLength` attribute parameter is set to 0.
  - When the argument is not a string.
- The ValidateLength attribute is defined by the System.Management.Automation.Validatelengthattribute class.

See Also

System.Management.Automation.Validatelengthattribute

Writing a Windows PowerShell Cmdlet

ValidatePattern Attribute Declaration

Article • 09/17/2021

The ValidatePattern attribute specifies a regular expression pattern that validates the argument of a cmdlet parameter. This attribute can also be used by Windows PowerShell functions.

When ValidatePattern is invoked within a cmdlet, the Windows PowerShell runtime converts the argument of the cmdlet parameter to a string and then compares that string to the pattern supplied by the ValidatePattern attribute. The cmdlet is run only if the converted string representation of the argument and the supplied pattern match. If they do not match, an error is thrown by the Windows PowerShell runtime.

Syntax

C#

```
[ValidatePattern(string regexString)]
[ValidatePattern(string regexString, Named Parameters)]
```

Parameters

`RegexString` (System.String) Required. Specifies a regular expression that validates the parameter argument.

Options (System.Text.Regularexpressions.Regexoptions) Optional named parameter. Specifies a bitwise combination of System.Text.Regularexpressions.Regexoptions flags that specify regular expression options.

Remarks

- This attribute can be used only once per parameter.
- You can use the `Option` parameter of the attribute to further define the pattern. For example, you can make the pattern case sensitive.
- If this attribute is applied to a collection, each element in the collection must match the pattern.

- The ValidatePattern attribute is defined by the System.Management.Automation.Validatepatternattribute class.

See Also

System.Management.Automation.Validatepatternattribute

Writing a Windows PowerShell Cmdlet

ValidateRange Attribute Declaration

Article • 09/17/2021

The ValidateRange attribute specifies the minimum and maximum values (the range) for the cmdlet parameter argument. This attribute can also be used by Windows PowerShell functions.

Syntax

C#

```
[ValidateRange(object minRange, object maxRange)]
```

Parameters

`MinRange` (System.Object) Required. Specifies the minimum value allowed.

`MaxRange` (System.Object) Required. Specifies the maximum value allowed.

Remarks

- The Windows PowerShell runtime throws a construction error when the value of the `MinRange` parameter is greater than the value of the `MaxRange` parameter.
- The Windows PowerShell runtime throws a validation error under the following conditions:
  - When the value of the argument is less than the `MinRange` limit or greater than the `MaxRange` limit.
  - When the argument is not of the same type as the `MinRange` and the `MaxRange` parameters.
- The ValidateRange attribute is defined by the System.Management.Automation.Validaterangeattribute class.

See Also

System.Management.Automation.Validaterangeattribute

ValidateScript Attribute Declaration

Article • 10/03/2022

The `ValidateScript` attribute specifies a script that's used to validate a parameter or variable value. PowerShell pipes the value to the script, and generates an error if the script returns `$false` or if the script throws an exception.

When you use the `ValidateScript` attribute, the value that's being validated is mapped to the `$_` variable. You can use the `$_` variable to refer to the value in the script.

Syntax

C#

```
[ValidateScriptAttribute(ScriptBlock scriptBlock)]
[ValidateScriptAttribute(ScriptBlock scriptBlock, Named Parameters)]
```

Parameters

- `scriptBlock` - (System.Management.Automation.ScriptBlock) Required. The script block used to validate the input.
- `ErrorMessage` - Optional named parameter - The item being validated and the validating scriptblock are passed as the first and second formatting arguments.

> **Note**
>
> The `ErrorMessage` argument was added in PowerShell 6.

Remarks

- This attribute can be used only once per parameter.
- If this attribute is applied to a collection, each element in the collection must match the pattern.
- The ValidateScript attribute is defined by the System.Management.Automation.ValidateScriptAttribute class.

See Also

System.Management.Automation.ValidateScriptAttribute

Writing a Windows PowerShell Cmdlet

ValidateSet Attribute Declaration

Article • 09/17/2021

The ValidateSetAttribute attribute specifies a set of possible values for a cmdlet parameter argument. This attribute can also be used by Windows PowerShell functions.

When this attribute is specified, the Windows PowerShell runtime determines whether the supplied argument for the cmdlet parameter matches an element in the supplied element set. The cmdlet is run only if the parameter argument matches an element in the set. If no match is found, an error is thrown by the Windows PowerShell runtime.

Syntax

```
C#

[ValidateSetAttribute(params string[] validValues)]
[ValidateSetAttribute(params string[] validValues, Named Parameters)]
```

Parameters

`ValidValues` (System.String) Required. Specifies the valid parameter element values. The following sample shows how to specify one element or multiple elements.

```
C#

[ValidateSetAttribute("Steve")]
[ValidateSetAttribute("Steve","Mary")]
```

`IgnoreCase` (System.Boolean) Optional named parameter. The default value of `true` indicates that case is ignored. A value of `false` makes the cmdlet case-sensitive.

Remarks

- This attribute can be used only once per parameter.
- If the parameter value is an array, every element of the array must match an element of the attribute set.
- The ValidateSetAttribute attribute is defined by the System.Management.Automation.Validatesetattribute class.

See Also

System.Management.Automation.Validatesetattribute

Writing a Windows PowerShell Cmdlet

Cmdlet Aliases

Article • 09/17/2021

You can use cmdlet aliases to improve the cmdlet user experience. You can add aliases to frequently used cmdlets to reduce typing and to make it easier to complete tasks quickly. You can include built-in aliases in your cmdlets, or users can define their own custom aliases.

For example, the Get-Command cmdlet has a built-in `gcm` alias. You can also use aliases to add command names from other languages so that users do not have to learn new commands.

Alias Guidelines

Follow these guidelines when you create built-in aliases for your cmdlets:

- Before you assign aliases, start Windows PowerShell, and then run the Get-Alias cmdlet to see the aliases that are already used.
- Include an alias prefix that references the verb of the cmdlet name and an alias suffix that references the noun of the cmdlet name. For example, the alias for the `Import-Module` cmdlet is `ipmo`. For a list of all the verbs and their aliases, see Cmdlet Verbs.
- For cmdlets that have the same verb, include the same alias prefix. For example, the aliases for all the Windows PowerShell cmdlets that have the "Get" verb in their name use the "g" prefix.
- For cmdlets that have the same noun, include the same alias suffix. For example, the aliases for all the Windows PowerShell cmdlets that have the "Session" noun in their name use the "sn" suffix.
- For cmdlets that are equivalent to commands in other languages, use the name of the command.
- In general, make aliases as short as possible. Make sure the alias has at least one distinct character for the verb and one distinct character for the noun. Add more characters as needed to make the alias unique.
- For cmdlet written in C# (or any other compiled .NET language), the alias can be defined using the Alias attibute. For example:

```
```

C#

```
[Cmdlet("Get", "SomeObject")]
[Alias("gso")]
public class GetSomeObjectCommand : Cmdlet
```

See Also

Writing a Windows PowerShell Cmdlet

Cmdlet Output

Article • 09/17/2021

This section discusses the types of cmdlet output and the methods that cmdlets can call to generate output such as error messages and objects. This section also describes how to define the .NET Framework types that are returned by your cmdlets and how those objects are displayed.

In This Section

Types of Cmdlet Output Describes the types and output that cmdlets can generate and the methods that cmdlets call to generate the output.

Cmdlet Error Reporting Discusses cmdlet error reporting, a subset of cmdlet output.

Extending Output Objects Discusses how to use the types files (.ps1xml) to extend the .NET Framework objects that are returned by cmdlets, functions, and scripts.

PowerShell Formatting Files Describes the formatting files (.format.ps1xml) files that define the default display for a specific set of .NET Framework objects in Windows PowerShell.

Custom Formatting Files Describes how to create your own custom formatting files to overwrite the default display formats or to define the display of objects returned by your own commands.

See Also

Writing a Windows PowerShell Cmdlet

Types of cmdlet output

Article • 09/17/2021

PowerShell provides several methods that can be called by cmdlets to generate output. These methods use a specific operation to write their output to a specific data stream, such as the success data stream or the error data stream. This article describes the types of output and the methods used to generate them.

Types of output

Success output

Cmdlets can report success by returning an object that can be processed by the next command in the pipeline. After the cmdlet has successfully performed its action, the cmdlet calls the System.Management.Automation.Cmdlet.WriteObject method. We recommend that you call this method instead of the System.Console.WriteLine or System.Management.Automation.Host.PSHostUserInterface.WriteLine methods.

You can provide a **PassThru** switch parameter for cmdlets that do not typically return objects. When the **PassThru** switch parameter is specified at the command line, the cmdlet is asked to return an object. For an example of a cmdlet that has a **PassThru** parameter, see Add-History.

Error output

Cmdlets can report errors. When a terminating error occurs, the cmdlet throws an exception. When a non-terminating error occurs, the cmdlet calls the System.Management.Automation.Provider.CmdletProvider.WriteError method to send an error record to the error data stream. For more information about error reporting, see Error Reporting Concepts.

Verbose output

Cmdlets can provide useful information to you while the cmdlet is correctly processing records by calling the System.Management.Automation.Cmdlet.WriteVerbose method. The method generates verbose messages that indicate how the action is proceeding.

By default, verbose messages are not displayed. You can specify the **Verbose** parameter when the cmdlet is run to display these messages. **Verbose** is a common parameter that

is available to all cmdlets.

Progress output

Cmdlets can provide progress information to you when the cmdlet is performing tasks that take a long time to complete, such as copying a directory recursively. To display progress information the cmdlet calls the System.Management.Automation.Cmdlet.WriteProgress method.

Debug output

Cmdlets can provide debug messages that are helpful when troubleshooting the cmdlet code. To display debug information the cmdlet calls the System.Management.Automation.Cmdlet.WriteDebug method.

By default, debug messages are not displayed. You can specify the **Debug** parameter when the cmdlet is run to display these messages. **Debug** is a common parameter that is available to all cmdlets.

Warning output

Cmdlets can display warning messages by calling the System.Management.Automation.Cmdlet.WriteWarning method.

By default, warning messages are displayed. However, you can configure warning messages by using the `$WarningPreference` variable or by using the **Verbose** and **Debug** parameters when the cmdlet is called.

Displaying output

For all write-method calls, the content display is determined by specific runtime variables. The exception is the System.Management.Automation.Cmdlet.WriteObject method. By using these variables, you can make the appropriate write call at the correct place in your code and not worry about when or if the output should be displayed.

Accessing the output functionality of a host application

You can also design a cmdlet to directly access the output functionality of a host application through the PowerShell runtime. Using the host APIs provided by PowerShell

instead of System.Console or System.Windows.Forms ensures that your cmdlet will work with a variety of hosts. For example: the **powershell.exe** console host, the **powershell_ise.exe** graphical host, the PowerShell remoting host, and third-party hosts.

See also

Error Reporting Concepts

Cmdlet Overview

Writing a Windows PowerShell Cmdlet

Cmdlet error reporting

Article • 09/17/2021

Cmdlets should report errors differently depending on whether the errors are terminating errors or nonterminating errors. Terminating errors are errors that cause the pipeline to be terminated immediately, or errors that occur when there's no reason to continue processing. Nonterminating errors are those errors that report a current error condition, but the cmdlet can continue to process input objects. With nonterminating errors, the user is typically notified of the problem, but the cmdlet continues to process the next input object.

Terminating and nonterminating errors

The following guidelines can be used to determine if an error condition is a terminating error or a nonterminating error.

- Does the error condition prevent your cmdlet from successfully processing any further input objects? If so, this is a terminating error.
- Is the error condition related to a specific input object or a subset of input objects? If so, this is a nonterminating error.
- Does the cmdlet accept multiple input objects, such that processing may succeed on another input object? If so, this is a nonterminating error.
- Cmdlets that can accept multiple input objects should decide between what are terminating and nonterminating errors, even when a particular situation applies to only a single input object.
- Cmdlets can receive any number of input objects and send any number of success or error objects before throwing a terminating exception. There's no relationship between the number of input objects received and the number of success and error objects sent.
- Cmdlets that can accept only 0-1 input objects and generate only 0-1 output objects should treat errors as terminating errors and generate terminating exceptions.

Reporting nonterminating errors

The reporting of a nonterminating error should always be done within the cmdlet's implementation of the System.Management.Automation.Cmdlet.BeginProcessing method, the System.Management.Automation.Cmdlet.ProcessRecord method, or the System.Management.Automation.Cmdlet.EndProcessing method. These types of errors are reported by calling the System.Management.Automation.Cmdlet.WriteError method that in turn sends an error record to the error stream.

Reporting terminating errors

Terminating errors are reported by throwing exceptions or by calling the System.Management.Automation.Cmdlet.ThrowTerminatingError method. Be aware that cmdlets can also catch and rethrow exceptions such as **OutOfMemory**, however, they aren't required to rethrow exceptions as the PowerShell runtime will catch them as well.

You can also define your own exceptions for issues specific to your situation, or add additional information to an existing exception using its error record.

Error records

PowerShell describes a nonterminating error condition with System.Management.Automation.ErrorRecord objects. Each object provides error category information, an optional target object, and details about the error condition.

Error identifiers

The error identifier is a simple string that identifies the error condition within the cmdlet. PowerShell combines this identifier with a cmdlet identifier to create a fully qualified error identifier that can be used later when filtering error streams or logging errors, when responding to specific errors, or with other user-specific activities.

The following guidelines should be followed when specifying error identifiers:

- Assign different, highly specific, error identifiers to different code paths. Each code path that calls System.Management.Automation.Cmdlet.WriteError or System.Management.Automation.Cmdlet.ThrowTerminatingError should have its own error identifier.
- Error identifiers should be unique to Common Language Runtime (CLR) exception types for both terminating and nonterminating errors.
- Don't change the semantics of an error identifier between versions of your cmdlet or PowerShell provider. After the semantics of an error identifier is established, it

should remain constant throughout the lifecycle of your cmdlet.

- For terminating errors, use a unique error identifier for a particular CLR exception type. If the exception type changes, use a new error identifier.
- For nonterminating errors, use a specific error identifier for a specific input object.
- Choose text for the identifier that tersely corresponds to the error being reported. Don't use white space or punctuation.
- Don't generate error identifiers that aren't reproducible. For example, don't generate identifiers that include a process identifier. Error identifiers are useful only when they correspond to identifiers that are seen by other users who are experiencing the same problem.

Error categories

Error categories are used to group errors for the user. PowerShell defines these categories and cmdlets and PowerShell providers must choose between them when generating the error record.

For a description of the error categories that are available, see the System.Management.Automation.ErrorCategory enumeration. In general, you should avoid using **NoError**, **UndefinedError**, and **GenericError** whenever possible.

Users can view errors based on category when they set `$ErrorView` to **CategoryView**.

See also

Cmdlet Overview

Types of Cmdlet Output

Windows PowerShell Reference

Extending Output Objects

Article • 09/17/2021

You can extend the .NET Framework objects that are returned by cmdlets, functions, and scripts by using types files (.ps1xml). Types files are XML-based files that let you add properties and methods to existing objects. For example, Windows PowerShell provides the Types.ps1xml file, which adds elements to several existing .NET Framework objects. The Types.ps1xml file is located in the Windows PowerShell installation directory (`$pshome`). You can create your own types file to further extend those objects or to extend other objects. When you extend an object by using a types file, any instance of the object is extended with the new elements.

Extending the System.Array Object

The following example shows how Windows PowerShell extends the System.Array object in the Types.ps1xml file. By default, System.Array objects have a `Length` property that lists the number of objects in the array. However, because the name "length" does not clearly describe the property, Windows PowerShell adds the `Count` alias property, which displays the same value as the `Length` property. The following XML adds the `Count` property to the System.Array type.

XML

```
<Type>
  <Name>System.Array</Name>
  <Members>
    <AliasProperty>
      <Name>Count</Name>
      <ReferencedMemberName>Length</ReferencedMemberName>
    </AliasProperty>
  </Members>
</Type>
```

To see this new alias property, use a Get-Member command on any array, as shown in the following example.

PowerShell

```
Get-Member -InputObject (1,2,3,4)
```

The command returns the following results.

Output

```
Name           MemberType    Definition
----           ----------    ----------
Count          AliasProperty Count = Length
Address        Method        System.Object& Address(Int32 )
Clone          Method        System.Object Clone()
CopyTo         Method        System.Void CopyTo(Array array, Int32 index):
Equals         Method        System.Boolean Equals(Object obj)
Get            Method        System.Object Get(Int32 )
...
Length         Property      System.Int32 Length {get;}
```

You can use either the `Count` property or the `Length` property to determine how many objects are in an array. For example:

PowerShell

```
PS> (1, 2, 3, 4).Count
```

Output

```
4
```

PowerShell

```
PS> (1, 2, 3, 4).Length
```

Output

```
4
```

Custom Types Files

To create a custom types file, start by copying an existing types file. The new file can have any name, but it must have a .ps1xml file name extension. When you copy the file, you can place the new file in any directory that is accessible to Windows PowerShell, but it is useful to place the files in the Windows PowerShell installation directory (`$pshome`) or in a subdirectory of the installation directory.

To add your own extended types to the file, add a types element for each object that you want to extend. The following topics provide examples.

- For more information about adding properties and property sets, see Extended Properties
- For more information about adding methods, see Extended Methods.
- For more information about adding member sets, see Extended Member Sets.

After you define your own extended types, use one of the following methods to make your extended objects available:

- To make your extended types file available to the current session, use the Update-TypeData cmdlet to add the new file. If you want your types to take precedence over the types that are defined in other types files (including the Types.ps1xml file), use the `PrependData` parameter of the Update-TypeData cmdlet.
- To make your extended types file available to all future sessions, add the types file to a module, export the current session, or add the Update-TypeData command to your Windows PowerShell profile.

Signing Types Files

Types files should be digitally signed to prevent tampering because the XML can include script blocks. For more information about adding digital signatures, see about_Signing

See Also

Defining Default Properties for Objects

Defining Default Methods for Objects

Defining Default Member Sets for Objects

Writing a Windows PowerShell Cmdlet

Extending Properties for Objects

Article • 09/17/2021

When you extend .NET Framework objects, you can add alias properties, code properties, note properties, script properties, and property sets to the objects. The XML that defines these properties is described in the following sections.

> **Note**
>
> The examples in the following sections are from the default `Types.ps1xml` types file in the PowerShell installation directory (`$PSHOME`). For more information, see **About Types.ps1xml**.

Alias properties

An alias property defines a new name for an existing property.

In the following example, the **Count** property is added to the System.Array type. The AliasProperty element defines the extended property as an alias property. The Name element specifies the new name. And, the ReferencedMemberName element specifies the existing property that is referenced by the alias. You can also add the `AliasProperty` element to the members of the MemberSets element.

XML

```
<Type>
  <Name>System.Array</Name>
  <Members>
    <AliasProperty>
      <Name>Count</Name>
      <ReferencedMemberName>Length</ReferencedMemberName>
    </AliasProperty>
  </Members>
</Type>
```

Code properties

A code property references a static property of a .NET Framework object.

In the following example, the **Mode** property is added to the System.IO.DirectoryInfo type. The CodeProperty element defines the extended property as a code property. The

Name element specifies the name of the extended property. And, the GetCodeReference element defines the static method that is referenced by the extended property. You can also add the `CodeProperty` element to the members of the MemberSets element.

XML

```
<Type>
  <Name>System.IO.DirectoryInfo</Name>
  <Members>
    <CodeProperty>
      <Name>Mode</Name>
      <GetCodeReference>

<TypeName>Microsoft.PowerShell.Commands.FileSystemProvider</TypeName>
        <MethodName>Mode</MethodName>
      </GetCodeReference>
    </CodeProperty>
  </Members>
</Type>
```

Note properties

A note property defines a property that has a static value.

In the following example, the **Status** property, whose value is always **Success**, is added to the System.IO.DirectoryInfo type. The NoteProperty element defines the extended property as a note property. The Name element specifies the name of the extended property. The Value element specifies the static value of the extended property. The `NoteProperty` element can also be added to the members of the MemberSets element.

XML

```
<Type>
  <Name>System.IO.DirectoryInfo</Name>
  <Members>
    <NoteProperty>
      <Name>Status</Name>
      <Value>Success</Value>
    </NoteProperty>
  </Members>
</Type>
```

Script properties

A script property defines a property whose value is the output of a script.

In the following example, the **VersionInfo** property is added to the System.IO.FileInfo type. The ScriptProperty element defines the extended property as a script property. The Name element specifies the name of the extended property. And, the GetScriptBlock element specifies the script that generates the property value. You can also add the `ScriptProperty` element to the members of the MemberSets element.

XML

```
<Type>
  <Name>System.IO.FileInfo</Name>
  <Members>
    <ScriptProperty>
      <Name>VersionInfo</Name>
      <GetScriptBlock>
        [System.Diagnostics.FileVersionInfo]::GetVersionInfo($this.FullName)
      </GetScriptBlock>
    </ScriptProperty>
  </Members>
</Type>
```

Property sets

A property set defines a group of extended properties that can be referenced by the name of the set. For example, the Format-Table **Property** parameter can specify a specific property set to be displayed. When a property set is specified, only those properties that belong to the set are displayed.

There's no restriction on the number of property sets that can be defined for an object. However, the property sets used to define the default display properties of an object must be specified within the **PSStandardMembers** member set. In the `Types.ps1xml` types file, the default property set names include **DefaultDisplayProperty**, **DefaultDisplayPropertySet**, and **DefaultKeyPropertySet**. Any additional property sets that you add to the **PSStandardMembers** member set are ignored.

In the following example, the **DefaultDisplayPropertySet** property set is added to the **PSStandardMembers** member set of the System.Serviceprocess.Servicecontroller type. The PropertySet element defines the group of properties. The Name element specifies the name of the property set. And, the ReferencedProperties element specifies the properties of the set. You can also add the `PropertySet` element to the members of the Type element.

XML

```
<Type>
  <Name>System.ServiceProcess.ServiceController</Name>
  <Members>
    <MemberSet>
      <Name>PSStandardMembers</Name>
      <Members>
        <PropertySet>
           <Name>DefaultDisplayPropertySet</Name>
           <ReferencedProperties>
            <Name>Status</Name
            <Name>Name</Name>
            <Name>DisplayName</Name>
          </ReferencedProperties>
        </PropertySet>
      </Members>
    </MemberSet>
  </Members>
</Type>
```

See also

About Types.ps1xml

System.Management.Automation

Writing a Windows PowerShell Cmdlet

Defining Default Methods for Objects

Article • 09/17/2021

When you extend .NET Framework objects, you can add code methods and script methods to the objects. The XML that is used to define these methods is described in the following sections.

> ⓘ **Note**
>
> The examples in the following sections are from the `Types.ps1xml` types file in the Windows PowerShell installation directory (`$PSHOME`). For more information, see **About Types.ps1xml**.

Code methods

A code method references a static method of a .NET Framework object.

In the following example, the **ToString** method is added to the System.Xml.XmlNode type. The PSCodeMethod element defines the extended method as a code method. The Name element specifies the name of the extended method. And, the CodeReference element specifies the static method. You can also add the PSCodeMethod element to the members of the PSMemberSets element.

XML

```
<Type>
  <Name>System.Xml.XmlNode</Name>
  <Members>
    <CodeMethod>
      <Name>ToString</Name>
      <CodeReference>
        <TypeName>Microsoft.PowerShell.ToStringCodeMethods</TypeName>
        <MethodName>XmlNode</MethodName>
      </CodeReference>
    </CodeMethod>
  </Members>
</Type>
```

Script methods

A script method defines a method whose value is the output of a script. In the following example, the **ConvertToDateTime** method is added to the System.Management.ManagementObject type. The PSScriptMethod element defines the extended method as a script method. The Name element specifies the name of the extended method. And, the Script element specifies the script that generates the method value. You can also add the PSScriptMethod element to the members of the PSMemberSets element.

XML

```
<Type>
  <Name>System.Management.ManagementObject</Name>
  <Members>
    <ScriptMethod>
      <Name>ConvertToDateTime</Name>
      <Script>

[System.Management.ManagementDateTimeConverter]::ToDateTime($args[0])
      </Script>
    </ScriptMethod>
  </Members>
</Type>
```

See also

Writing a Windows PowerShell Cmdlet

Defining Default Member Sets for Objects

Article • 09/17/2021

The PSStandardMembers member set is used by Windows PowerShell to define the default property sets for an object. The default property sets can be used by commands such as the formatting cmdlets to display only those properties that are defined by the property set. The default property sets include DefaultDisplayProperty, DefaultDisplayPropertySet, and DefaultKeyPropertySet. Windows PowerShell ignores all other member sets and any other property sets added to the PSStandardMembers member set.

Member Set for System.Diagnostics.Process

In the following example, the PSStandardMembers member set defines the DefaultDisplayPropertySet property set for System.Diagnostics.Process objects. This property set is used by the Format-List cmdlet.

XML

```
<Type>
  <Name>System.Diagnostics.Process</Name>
  <Members>
    <MemberSet>
     <Name>PSStandardMembers</Name>
     <Members>
       <PropertySet>
         <Name>DefaultDisplayPropertySet</Name>
         <ReferencedProperties>
           <Name>Id</Name>
           <Name>Handles</Name>
           <Name>CPU</Name>
           <Name>Name</Name>
         </ReferencedProperties>
      </PropertySet>
    </Members>
  </MemberSet>
```

The following output shows the default properties returned by the Format-List cmdlet. Only the `Id`, `Handles`, `CPU`, and `Name` properties are returned for each process object.

PowerShell

```
Get-Process | format-list
```

Output

```
Id      : 2036
Handles : 27
CPU     :
Name    : AEADISRV

Id      : 272
Handles : 38
CPU     :
Name    : agrsmsvc
...
```

See Also

Writing a Windows PowerShell Cmdlet

Custom Formatting Files

Article • 09/17/2021

The display format for the objects returned by cmdlets, functions, and scripts are defined using formatting files (format.ps1xml files). Several of these files are provided by Windows PowerShell to define the default display format for those objects returned by Windows PowerShell cmdlets. However, you can also create your own custom formatting files to overwrite the default display formats or to define the display of objects returned by your own commands.

Windows PowerShell uses the data in these formatting files to determine what is displayed and how the data is formatted. The displayed data can include the properties of an object or the value of a script block. Script blocks are used if you want to display some value that is not available directly from the properties of an object. For example, you may want to add the value of two properties of an object and display the sum as a separate piece of data. When you write your own formatting file, you will need to define *views* for the objects that you want to display. You can define a single view for each object, you can define a single view for multiple objects, or you can define multiple views for the same object. There is no limit to the number of views that you can define.

> **ⓘ Important**
>
> Formatting files do not determine the elements of an object that are returned to the pipeline. When an object is returned to the pipeline, all members of that object are available.

Format Views

Formatting views can display objects in a table format, a list format, a wide format, and a custom format. For the most part, each formatting definition is described by a set of XML tags that describe a view. Each view contains the name of the view, the objects that use the view, and the elements of the view, such as the column and row information for a table view.

The following views are available.

Table view Lists the properties of an object or a script block value in one or more columns. Each column represents a property of the object or a script block value. You can define a table view that displays all the properties of an object, a subset of the properties of an object, or a combination of properties and script block values. Each row

of the table represents a returned object. For more information about this view, see Table View.

List view Lists the properties of an object or a script block value in a single column. Each row of the list displays an optional label or the property name followed by the value of the property or script block. For more information about this view, see List View.

Wide view Lists a single property of an object or a script block value in one or more columns. There is no label or header for this view. For more information about this view, see Wide View.

Custom view Displays a customizable view of object properties or script block values that does not adhere to the rigid structure of table views, list views, or wide views. You can define a standalone custom view, or you can define a custom view that is used by another view, such as a table view or list view. For more information about this view, see Custom View.

View XML Elements

The following example shows the XML tags used to define a table view that contains two columns. The ViewDefinitions element is the container element for all the views defined in the formatting file. The View element defines the specific table, list, wide, or custom view. Within each view, the Name element specifies the name of the view, the ViewSelectedBy element defines the objects that use the view, and the different control elements (such as the `TableControl` element) define the format of the view.

XML

```
ViewDefinitions
  <View>
    <Name>Name of View</Name>
    <ViewSelectedBy>
      <TypeName>Object to display using this view</TypeName>
      <TypeName>Object to display using this view</TypeName>
    </ViewSelectedBy>
    <TableControl>
      <TableHeaders>
        <TableColumnHeader>
          <Width></Width>
        </TableColumnHeader>
        <TableColumnHeader>
          <Width></Width>
        </TableColumnHeader>
      </TableHeaders>
      <TableRowEntries>
        <TableRowEntry>
          <TableColumnItems>
```

```
            <TableColumnItem>
              <PropertyName>Header for column 1</PropertyName>
            </TableColumnItem>
            <TableColumnItem>
              <PropertyName>Header for column 2</PropertyName>
            </TableColumnItem>
          </TableColumnItems>
        </TableRowEntry>
      </TableRowEntries>
    </TableControl)
  </View>
</ViewDefinitions>
```

See Also

Table View

List View

Wide View

Custom View

Writing a Windows PowerShell Cmdlet

Requesting Confirmation

Article • 09/17/2021

This section discusses confirmation messages that can be displayed before a cmdlet, function, or provider performs an action.

In This Section

Requesting Confirmation Process for Commands Discusses the process that cmdlets, functions, and providers must follow to request a confirmation before they make a change to the system.

Users Requesting Confirmation Discusses how users can make a cmdlet, function, or provider request confirmation when the System.Management.Automation.Cmdlet.ShouldProcess method is called.

Confirmation Messages Provides samples of the different confirmation messages that can be displayed.

See Also

Writing a Windows PowerShell Cmdlet

Requesting Confirmation from Cmdlets

Article • 09/17/2021

Cmdlets should request confirmation when they are about to make a change to the system that is outside of the Windows PowerShell environment. For example, if a cmdlet is about to add a user account or stop a process, the cmdlet should require confirmation from the user before it proceeds. In contrast, if a cmdlet is about to change a Windows PowerShell variable, the cmdlet does not need to require confirmation.

In order to make a confirmation request, the cmdlet must indicate that it supports confirmation requests, and it must call the System.Management.Automation.Cmdlet.ShouldProcess and System.Management.Automation.Cmdlet.ShouldContinue (optional) methods to display a confirmation request message.

Supporting Confirmation Requests

To support confirmation requests, the cmdlet must set the `SupportsShouldProcess` parameter of the Cmdlet attribute to `true`. This enables the `Confirm` and `WhatIf` cmdlet parameters that are provided by Windows PowerShell. The `Confirm` parameter allows the user to control whether the confirmation request is displayed. The `WhatIf` parameter allows the user to determine whether the cmdlet should display a message or perform its action. Do not manually add the `Confirm` and `WhatIf` parameters to a cmdlet.

The following example shows a Cmdlet attribute declaration that supports confirmation requests.

C#

```
[Cmdlet(VerbsDiagnostic.Test, "RequestConfirmationTemplate1",
        SupportsShouldProcess = true)]
```

Calling the Confirmation request methods

In the cmdlet code, call the System.Management.Automation.Cmdlet.ShouldProcess method before the operation that changes the system is performed. Design the cmdlet so that if the call returns a value of `false`, the operation is not performed, and the cmdlet processes the next operation.

Calling the ShouldContinue Method

Most cmdlets request confirmation using only the System.Management.Automation.Cmdlet.ShouldProcess method. However, some cases might require additional confirmation. For these cases, supplement the System.Management.Automation.Cmdlet.ShouldProcess call with a call to the System.Management.Automation.Cmdlet.ShouldContinue method. This allows the cmdlet or provider to more finely control the scope of the **Yes to all** response to the confirmation prompt.

If a cmdlet calls the System.Management.Automation.Cmdlet.ShouldContinue method, the cmdlet must also provide a `Force` switch parameter. If the user specifies `Force` when the user invokes the cmdlet, the cmdlet should still call System.Management.Automation.Cmdlet.ShouldProcess, but it should bypass the call to System.Management.Automation.Cmdlet.ShouldContinue.

System.Management.Automation.Cmdlet.ShouldContinue will throw an exception when it is called from a non-interactive environment where the user cannot be prompted. Adding a `Force` parameter ensures that the command can still be performed when it is invoked in a non-interactive environment.

The following example shows how to call System.Management.Automation.Cmdlet.ShouldProcess and System.Management.Automation.Cmdlet.ShouldContinue.

C#

```
if (ShouldProcess (...) )
{
  if (Force || ShouldContinue(...))
  {
     // Add code that performs the operation.
  }
}
```

The behavior of a System.Management.Automation.Cmdlet.ShouldProcess call can vary depending on the environment in which the cmdlet is invoked. Using the previous guidelines will help ensure that the cmdlet behaves consistently with other cmdlets, regardless of the host environment.

For an example of calling the System.Management.Automation.Cmdlet.ShouldProcess method, see How to Request Confirmations.

Specify the Impact Level

When you create the cmdlet, specify the impact level (the severity) of the change. To do this, set the value of the `ConfirmImpact` parameter of the Cmdlet attribute to High, Medium, or Low. You can specify a value for `ConfirmImpact` only when you also specify the `SupportsShouldProcess` parameter for the cmdlet.

For most cmdlets, you do not have to explicitly specify `ConfirmImpact`. Instead, use the default setting of the parameter, which is Medium. If you set `ConfirmImpact` to High, the operation will be confirmed by default. Reserve this setting for highly disruptive actions, such as reformatting a hard-disk volume.

Calling Non-Confirmation Methods

If the cmdlet or provider must send a message but not request confirmation, it can call the following three methods. Avoid using the System.Management.Automation.Cmdlet.WriteObject method to send messages of these types because System.Management.Automation.Cmdlet.WriteObject output is intermingled with the normal output of your cmdlet or provider, which makes script writing difficult.

- To caution the user and continue with the operation, the cmdlet or provider can call the System.Management.Automation.Cmdlet.WriteWarning method.
- To provide additional information that the user can retrieve using the `Verbose` parameter, the cmdlet or provider can call the System.Management.Automation.Cmdlet.WriteVerbose method.
- To provide debugging-level detail for other developers or for product support, the cmdlet or provider can call the System.Management.Automation.Cmdlet.WriteDebug method. The user can retrieve this information using the `Debug` parameter.

Cmdlets and providers first call the following methods to request confirmation before they attempt to perform an operation that changes a system outside of Windows PowerShell:

- System.Management.Automation.Cmdlet.Shouldprocess
- System.Management.Automation.Provider.Cmdletprovider.Shouldprocess

They do so by calling the System.Management.Automation.Cmdlet.Shouldprocess method, which prompts the user to confirm the operation based on how the user

invoked the command.

See Also

Writing a Windows PowerShell Cmdlet

Users Requesting Confirmation

Article • 09/30/2021

When you specify a value of `true` for the `SupportsShouldProcess` parameter of the Cmdlet attribute declaration, the **Confirm** parameter is added to the parameters of the cmdlet.

In the default environment, users can specify the **Confirm** parameter or `"-Confirm:$true` so that confirmation is requested when the `ShouldProcess()` method is called. This forces confirmation regardless of the impact level setting.

If **Confirm** parameter is not used, the `ShouldProcess()` call requests confirmation if the `$ConfirmPreference` preference variable is equal to or greater than the `ConfirmImpact` setting of the cmdlet or provider. The default setting of `$ConfirmPreference` is **High**. Therefore, in the default environment, only cmdlets and providers that specify a high-impact action request confirmation.

If **Confirm** is explicitly set to false (`-Confirm:$false`), the cmdlet runs without prompting for confirmation and the `$ConfirmPreference` shell variable is ignored.

Remarks

- For cmdlets and providers that specify `SupportsShouldProcess`, but not `ConfirmImpact`, those actions are handled as "medium impact" actions, and they will not prompt by default. Their impact level is less than the default setting of the `$ConfirmPreference` preference variable.
- If the user specifies the `Verbose` parameter, they will be notified of the operation even if they are not prompted for confirmation.

See Also

- Writing a Windows PowerShell Cmdlet
- System.Management.Automation.Cmdlet.ShouldProcess

Confirmation Messages

Article • 09/17/2021

Here are different confirmation messages that can be displayed depending on the variants of the System.Management.Automation.Cmdlet.ShouldProcess and System.Management.Automation.Cmdlet.ShouldContinue methods that are called.

> **ⓘ Important**
>
> For sample code that shows how to request confirmations, see **How to Request Confirmations**.

Specifying the Resource

You can specify the resource that is about to be changed by calling the System.Management.Automation.Cmdlet.Shouldprocess%2A?Displayproperty=Fullname method. In this case, you supply the resource by using the `target` parameter of the method, and the operation is added by Windows PowerShell. In the following message, the text "MyResource" is the resource acted on and the operation is the name of the command that makes the call.

Output

```
Confirm
Are you sure you want to perform this action?
Performing operation "Test-RequestConfirmationTemplate1" on Target
"MyResource".
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
(default is "Y"):
```

If the user selects **Yes** or **Yes to All** to the confirmation request (as shown in the following example), a call to the System.Management.Automation.Cmdlet.ShouldContinue method is made, which causes a second confirmation message to be displayed.

Output

```
Confirm
Are you sure you want to perform this action?
Performing operation "Test-RequestConfirmationTemplate1" on Target
"MyResource".
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
```

```
(default is "Y"): y

Confirm
Continue with this operation?
[Y] Yes  [N] No  [S] Suspend  [?] Help (default is "Y"):
```

Specifying the Operation and Resource

You can specify the resource that is about to be changed and the operation that the command is about to perform by calling the System.Management.Automation.Cmdlet.Shouldprocess%2A?Displayproperty=Fullname method. In this case, you supply the resource by using the `target` parameter and the operation by using the `target` parameter. In the following message, the text "MyResource" is the resource acted on and "MyAction" is the operation to be performed.

Output

```
Confirm
Are you sure you want to perform this action?
Performing operation "MyAction" on Target "MyResource".
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
(default is "Y"):
```

If the user selects **Yes** or **Yes to All** to the previous message, a call to the System.Management.Automation.Cmdlet.ShouldContinue method is made, which causes a second confirmation message to be displayed.

Output

```
Confirm
Are you sure you want to perform this action?
Performing operation "MyAction" on Target "MyResource".
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
(default is "Y"): y

Confirm
Continue with this operation?
[Y] Yes  [N] No  [S] Suspend  [?] Help (default is "Y"):
```

See Also

Writing a Windows PowerShell Cmdlet

Windows PowerShell Error Reporting

Article • 09/17/2021

The topics in this section discuss how cmdlets report errors.

In This Section

Error Reporting Concepts Describes the two mechanisms that cmdlets can use to report errors.

Terminating Errors Describes the method used to report terminating errors, where that method can be called from within the cmdlet, and exceptions that can be returned by the Windows PowerShell runtime when the method is called.

Non-Terminating Errors Describes the method used to report non-terminating errors and where that method can be called from within the cmdlet.

Displaying Error Information by Category Discusses the ways that users can display error.

Windows PowerShell Error Records Describes the components of an error record.

Interpreting ErrorRecord Objects Discusses how ErrorRecord objects are interpreted.

See Also

Writing a Windows PowerShell Cmdlet

Error Reporting Concepts

Article • 09/17/2021

Windows PowerShell provides two mechanisms for reporting errors: one mechanism for *terminating errors* and another mechanism for *non-terminating errors*. It is important for your cmdlet to report errors correctly so that the host application that is running your cmdlets can react in an appropriate manner.

Your cmdlet should call the System.Management.Automation.Cmdlet.Throwterminatingerror* method when an error occurs that does not or should not allow the cmdlet to continue to process its input objects. Your cmdlet should call the System.Management.Automation.Cmdlet.WriteError method to report non-terminating errors when the cmdlet can continue processing the input objects. Both methods provide an error record that the host application can use to investigate the cause of the error.

Use the following guidelines to determine whether an error is a terminating or non-terminating error.

- An error is a terminating error if it prevents your cmdlet from continuing to process the current object or from successfully processing any further input objects, regardless of their content.
- An error is a terminating error if you do not want your cmdlet to continue processing the current object or any further input objects, regardless of their content.
- An error is a terminating error if it occurs in a cmdlet that does not accept or return an object or if it occurs in a cmdlet that accepts or returns only one object.
- An error is a non-terminating error if you want your cmdlet to continue processing the current object and any further input objects.
- An error is a non-terminating error if it is related to a specific input object or subset of input objects.

See Also

System.Management.Automation.Cmdlet.Throwterminatingerror*

System.Management.Automation.Cmdlet.WriteError

Windows PowerShell Error Records

Terminating Errors

Article • 09/17/2021

This topic discusses the method used to report terminating errors. It also discusses how to call the method from within the cmdlet, and it discusses the exceptions that can be returned by the Windows PowerShell runtime when the method is called.

When a terminating error occurs, the cmdlet should report the error by calling the System.Management.Automation.Cmdlet.Throwterminatingerror* method. This method allows the cmdlet to send an error record that describes the condition that caused the terminating error. For more information about error records, see Windows PowerShell Error Records.

When the System.Management.Automation.Cmdlet.Throwterminatingerror* method is called, the Windows PowerShell runtime permanently stops the execution of the pipeline and throws a System.Management.Automation.Pipelinestoppedexception exception. Any subsequent attempts to call System.Management.Automation.Cmdlet.WriteObject, System.Management.Automation.Cmdlet.WriteError, or several other APIs causes those calls to throw a System.Management.Automation.Pipelinestoppedexception exception.

The System.Management.Automation.Pipelinestoppedexception exception can also occur if another cmdlet in the pipeline reports a terminating error, if the user has asked to stop the pipeline, or if the pipeline has been halted before completion for any reason. The cmdlet does not need to catch the System.Management.Automation.Pipelinestoppedexception exception unless it must clean up open resources or its internal state.

Cmdlets can write any number of output objects or non-terminating errors before reporting a terminating error. However, the terminating error permanently stops the pipeline, and no further output, terminating errors, or non-terminating errors can be reported.

Cmdlets can call System.Management.Automation.Cmdlet.Throwterminatingerror* only from the thread that called the System.Management.Automation.Cmdlet.BeginProcessing, System.Management.Automation.Cmdlet.ProcessRecord, or System.Management.Automation.Cmdlet.EndProcessing input processing method. Do not attempt to call System.Management.Automation.Cmdlet.Throwterminatingerror* or System.Management.Automation.Cmdlet.WriteError from another thread. Instead, errors must be communicated back to the main thread.

It is possible for a cmdlet to throw an exception in its implementation of the System.Management.Automation.Cmdlet.BeginProcessing, System.Management.Automation.Cmdlet.ProcessRecord, or System.Management.Automation.Cmdlet.EndProcessing method. Any exception thrown from these methods (except for a few severe error conditions that stop the Windows PowerShell host) is interpreted as a terminating error which stops the pipeline, but not Windows PowerShell as a whole. (This applies only to the main cmdlet thread. Uncaught exceptions in threads spawned by the cmdlet, in general, halt the Windows PowerShell host.) We recommend that you use System.Management.Automation.Cmdlet.Throwterminatingerror* rather than throwing an exception because the error record provides additional information about the error condition, which is useful to the end-user. Cmdlets should honor the managed code guideline against catching and handling all exceptions (`catch (Exception e)`). Convert only exceptions of known and expected types into error records.

See Also

System.Management.Automation.Cmdlet.BeginProcessing

System.Management.Automation.Cmdlet.EndProcessing

System.Management.Automation.Cmdlet.ProcessRecord

System.Management.Automation.Pipelinestoppedexception

System.Management.Automation.Cmdlet.Throwterminatingerror*

System.Management.Automation.Cmdlet.WriteError

Windows PowerShell Error Records

Writing a Windows PowerShell Cmdlet

Non-Terminating Errors

Article • 09/17/2021

This topic discusses the method used to report non-terminating errors. It also discusses how to call the method from within the cmdlet.

When a non-terminating error occurs, the cmdlet should report this error by calling the System.Management.Automation.Cmdlet.WriteError method. When the cmdlet reports a non-terminating error, the cmdlet can continue to operate on this input object and on further incoming pipeline objects. If the cmdlet calls the System.Management.Automation.Cmdlet.WriteError method, the cmdlet can write an error record that describes the condition that caused the non-terminating error. For more information about error records, see Windows PowerShell Error Records.

Cmdlets can call System.Management.Automation.Cmdlet.WriteError as necessary from within their input processing methods. However, cmdlets can call System.Management.Automation.Cmdlet.WriteError only from the thread that called the System.Management.Automation.Cmdlet.BeginProcessing, System.Management.Automation.Cmdlet.ProcessRecord, or System.Management.Automation.Cmdlet.EndProcessing input processing method. Do not call System.Management.Automation.Cmdlet.WriteError from another thread. Instead, communicate errors back to the main thread.

See Also

System.Management.Automation.Cmdlet.WriteError

System.Management.Automation.Cmdlet.BeginProcessing

System.Management.Automation.Cmdlet.ProcessRecord

System.Management.Automation.Cmdlet.EndProcessing

Windows PowerShell Error Records

Writing a Windows PowerShell Cmdlet

Displaying Error Information

Article • 09/17/2021

This topic discusses the ways in which users can display error information.

When your cmdlet encounters an error, the presentation of the error information will, by default, resemble the following error output.

PowerShell

```
$ stop-service lanmanworkstation
You do not have sufficient permissions to stop the service Workstation.
```

However, users can view errors by category by setting the `$ErrorView` variable to `"CategoryView"`. Category view displays specific information from the error record rather than a free-text description of the error. This view can be useful if you have a long list of errors to scan. In category view, the previous error message is displayed as follows.

PowerShell

```
$ $ErrorView = "CategoryView"
$ stop-service lanmanworkstation
CloseError: (System.ServiceProcess.ServiceController:ServiceController)
[stop-service], ServiceCommandException
```

For more information about error categories, see Windows PowerShell Error Records.

See Also

Windows PowerShell Error Records

Writing a Windows PowerShell Cmdlet

Windows PowerShell Error Records

Article • 09/17/2021

Cmdlets must pass an System.Management.Automation.ErrorRecord object that identifies the error condition for terminating and non-terminating errors.

The System.Management.Automation.ErrorRecord object contains the following information:

- The exception that describes the error. Often, this is an exception that the cmdlet caught and converted into an error record. Every error record must contain an exception.

If the cmdlet did not catch an exception, it must create a new exception and choose the exception class that best describes the error condition. However, you do not need to throw the exception because it can be accessed through the System.Management.Automation.ErrorRecord.Exception property of the System.Management.Automation.ErrorRecord object.

- An error identifier that provides a targeted designator that can be used for diagnostic purposes and by Windows PowerShell scripts to handle specific error conditions with specific error handlers. Every error record must contain an error identifier (see Error Identifier).
- An error category that provides a general designator that can be used for diagnostic purposes. Every error record must specify an error category (see Error Category).
- An optional replacement error message and a recommended action (see Replacement Error Message).
- Optional invocation information about the cmdlet that threw the error. This information is specified by Windows PowerShell (see Invocation Message).
- The target object that was being processed when the error occurred. This might be the input object, or it might be another object that your cmdlet was processing. For example, for the command `remove-item -recurse c:\somedirectory`, the error might be an instance of a FileInfo object for "c:\somedirectory\lockedfile". The target object information is optional.

Error Identifier

When you create an error record, specify an identifier that designates the error condition within your cmdlet. Windows PowerShell combines the targeted identifier with the name of your cmdlet to create a fully qualified error identifier. The fully qualified error identifier can be accessed through the System.Management.Automation.ErrorRecord.FullyQualifiedErrorId property of the System.Management.Automation.ErrorRecord object. The error identifier is not available by itself. It is available only as part of the fully qualified error identifier.

Use the following guidelines to generate error identifiers when you create error records:

- Make error identifiers specific to an error condition. Target the error identifiers for diagnostic purposes and for scripts that handle specific error conditions with specific error handlers. A user should be able to use the error identifier to identify the error and its source. Error identifiers also enable reporting for specific error conditions from existing exceptions so that new exception subclasses are not required.

- In general, assign different error identifiers to different code paths. The end-user benefits from specific identifiers. Often, each code path that calls System.Management.Automation.Cmdlet.WriteError or System.Management.Automation.Cmdlet.Throwterminatingerror* has its own identifier. As a rule, define a new identifier when you define a new template string for the error message, and vice-versa. Do not use the error message as an identifier.

- When you publish code using a particular error identifier, you establish the semantics of errors with that identifier for your complete product support lifecycle. Do not reuse it in a context that is semantically different from the original context. If the semantics of this error change, create and then use a new identifier.

- You should generally use a particular error identifier only for exceptions of a particular CLR type. If the type of the exception or the type of the target object changes, create and then use a new identifier.

- Choose text for your error identifier that concisely corresponds to the error that you are reporting. Use standard .NET Framework naming and capitalization conventions. Do not use white space or punctuation. Do not localize error identifiers.

- Do not dynamically generate error identifiers in a non-reproducible way. For example, do not incorporate error information such as a process ID. Error identifiers are useful only if they correspond to the error identifiers seen by other users who are experiencing the same error condition.

Error Category

When you create an error record, specify the category of the error using one of the constants defined by the System.Management.Automation.ErrorCategory enumeration. Windows PowerShell uses the error category to display error information when users set the `$ErrorView` variable to `"CategoryView"`.

Avoid using the System.Management.Automation.ErrorCategory **NotSpecified** constant. If you have any information about the error or about the operation that caused the error, choose the category that best describes the error or the operation, even if the category is not a perfect match.

The information displayed by Windows PowerShell is referred to as the category-view string and is built from the properties of the System.Management.Automation.Errorcategoryinfo class. (This class is accessed through the error System.Management.Automation.ErrorRecord.CategoryInfo property.)

```
{Category}: ({TargetName}:{TargetType}):[{Activity}], {Reason}
```

The following list describes the information displayed:

- Category: A Windows PowerShell-defined System.Management.Automation.ErrorCategory constant.
- TargetName: By default, the name of the object the cmdlet was processing when the error occurred. Or, another cmdlet-defined string.
- TargetType: By default, the type of the target object. Or, another cmdlet-defined string.
- Activity: By default, the name of the cmdlet that created the error record. Or, some other cmdlet-defined string.
- Reason: By default, the exception type. Or, another cmdlet-defined string.

Replacement Error Message

When you develop an error record for a cmdlet, the default error message for the error comes from the default message text in the System.Exception.Message property. This is a read-only property whose message text is intended only for debugging purposes (according to the .NET Framework guidelines). We recommend that you create an error

message that replaces or augments the default message text. Make the message more user-friendly and more specific to the cmdlet.

The replacement message is provided by an System.Management.Automation.ErrorDetails object. Use one of the following constructors of this object because they provide additional localization information that can be used by Windows PowerShell.

- ErrorDetails(Cmdlet, String, String, Object[]): Use this constructor if your template string is a resource string in the same assembly in which the cmdlet is implemented or if you want to load the template string through an override of the System.Management.Automation.Cmdlet.GetResourceString method.
- ErrorDetails(Assembly, String, String, Object[]): Use this constructor if the template string is in another assembly and you do not load it through an override of System.Management.Automation.Cmdlet.GetResourceString.

The replacement message should conform to the .NET Framework design guidelines for writing exception messages with a small difference. The guidelines state that exception messages should be written for developers. These replacement messages should be written for the cmdlet user.

The replacement error message must be added before the System.Management.Automation.Cmdlet.WriteError or System.Management.Automation.Cmdlet.Throwterminatingerror* methods are called. To add a replacement message, set the System.Management.Automation.ErrorRecord.ErrorDetails property of the error record. When this property is set, Windows PowerShell displays the System.Management.Automation.ErrorDetails.Message* property instead of the default message text.

Recommended Action Information

The System.Management.Automation.ErrorDetails object can also provide information about what actions are recommended when the error occurs.

Invocation information

When a cmdlet uses System.Management.Automation.Cmdlet.WriteError or System.Management.Automation.Cmdlet.Throwterminatingerror* to report an error record, Windows PowerShell automatically adds information that describes the command that was invoked when the error occurred. This information is provided by a

System.Management.Automation.Invocationinfo object that contains the name of the cmdlet that was invoked by the command, the command itself, and information about the pipeline or script. This property is read-only.

See Also

System.Management.Automation.Cmdlet.WriteError

System.Management.Automation.Cmdlet.Throwterminatingerror*

System.Management.Automation.ErrorCategory

System.Management.Automation.Errorcategoryinfo

System.Management.Automation.ErrorRecord

System.Management.Automation.ErrorDetails

System.Management.Automation.Invocationinfo

Windows PowerShell Error Reporting

Writing a Windows PowerShell Cmdlet

Interpreting ErrorRecord Objects

Article • 09/17/2021

In most cases, an System.Management.Automation.ErrorRecord object represents a non-terminating error generated by a command or script. Terminating errors can also specify the additional information in an ErrorRecord via the System.Management.Automation.Icontainserrorrecord interface.

If you want to write an error handler in your script or a host to handle specific errors that occur during command or script execution, you must interpret the System.Management.Automation.ErrorRecord object to determine whether it represents the class of error that you want to handle.

When a cmdlet encounters a terminating or non-terminating error, it should create an error record that describes the error condition. The host application must investigate these error records and perform whatever action will mitigate the error. The host application must also investigate error records for nonterminating errors that failed to process a record but were able to continue, and it must investigate error records for terminating errors that caused the pipeline to stop.

> ⓘ **Note**
>
> For terminating errors, the cmdlet calls the **System.Management.Automation.Cmdlet.Throwterminatingerror*** method. For non-terminating errors, the cmdlet calls the **System.Management.Automation.Cmdlet.WriteError** method.

Error Record Design

Error records are designed to provide additional error information that is not available in exceptions while ensuring that the combined information in each error record is unique. This uniqueness allows the host application to inspect the different parts of the error record so that it can identify the error condition and the action the host must take.

Interpreting Error Records

You can review several parts of the error record to identify the error. These parts include the following:

- The error category
- The error exception
- The fully qualified error identifier (FQID)
- Other information

The Error Category

The error category of the error record is one of the predefined constants provided by the System.Management.Automation.Errorcategory enumeration. This information is available through the System.Management.Automation.ErrorRecord.CategoryInfo property of the System.Management.Automation.ErrorRecord object.

The cmdlet can specify the CloseError, OpenError, InvalidType, ReadError, and WriteError categories, and other error categories. The host application can use the error category to capture groups of errors.

The Exception

The exception included in the error record is provided by the cmdlet and can be accessed through the System.Management.Automation.ErrorRecord.Exception* property of the System.Management.Automation.ErrorRecord object.

Host applications can use the `is` keyword to identify that the exception is of a specific class or of a derived class. It is better to branch on the exception type, as shown in the following example.

```
if (MyNonTerminatingError.Exception is AccessDeniedException)
```

This way, you catch the derived classes. However, there are problems if the exception is deserialized.

The FQID

The FQID is the most specific information you can use to identify the error. It is a string that includes a cmdlet-defined identifier, the name of the cmdlet class, and the source that reported the error. In general, an error record is analogous to an event record of a Windows Event log. The FQID is analogous to the following tuple, which identifies the class of the event record: (*log name*, *source*, *event ID*).

The FQID is designed to be inspected as a single string. However, cases exist in which the error identifier is designed to be parsed by the host application. The following example is a well-formed fully qualified error identifier.

```
CommandNotFoundException,Microsoft.PowerShell.Commands.GetCommandCommand.
```

In the previous example, the first token is the error identifier, which is followed by the name of the cmdlet class. The error identifier can be a single token, or it can be a dot-separated identifier that allows for branching on inspection of the identifier. Do not use white space or punctuation in the error identifier. It is especially important not to use a comma; a comma is used by Windows PowerShell to separate the identifier and the cmdlet class name.

Other Information

The System.Management.Automation.ErrorRecord object might also provide information that describes the environment in which the error occurred. This information includes items such as error details, invocation information, and the target object that was being processed when the error occurred. Although this information might be useful to the host application, it is not typically used to identify the error. This information is available through the following properties:

System.Management.Automation.ErrorRecord.ErrorDetails

System.Management.Automation.ErrorRecord.InvocationInfo

System.Management.Automation.ErrorRecord.TargetObject

See Also

System.Management.Automation.ErrorRecord

System.Management.Automation.Errorcategory

System.Management.Automation.Errorcategoryinfo

System.Management.Automation.Cmdlet.WriteError

System.Management.Automation.Cmdlet.Throwterminatingerror*

Adding Non-Terminating Error Reporting to Your Cmdlet

Windows PowerShell Error Reporting

Background Jobs

Article • 09/17/2021

Cmdlets can perform their action internally or as a Windows PowerShell*background job*. When a cmdlet runs as a background job, the work is done asynchronously in its own thread separate from the pipeline thread that the cmdlet is using. From the user perspective, when a cmdlet runs as a background job, the command prompt returns immediately even if the job takes an extended amount of time to complete, and the user can continue without interruption while the job runs.

Background Jobs, Child Jobs, and the Job Repository

The job object that is returned by the cmdlets that support background jobs defines the job. (The Start-Job cmdlet also returns a job object.) The name of the job, an identifier that is used to specify the job, the state information, and the child jobs are included in this definition. The job does not perform any of the work. Each background job has at least one child job because the child job performs the actual work. When you run a cmdlet so that the work is performed as a background job, the cmdlet must add the job and the child jobs to a common repository, referred to as the *job repository*.

For more information about how background jobs are handled at the command line, see the following:

- about_Jobs
- about_Job_Details
- about_Remote_Jobs

Writing a Cmdlet That Runs as a Background Job

To write a cmdlet that can be run as a background job, you must complete the following tasks:

- Define an `asJob` switch parameter so that the user can decide whether to run the cmdlet as a background job.

- Create an object that derives from the System.Management.Automation.Job class. This object can be a custom job object or a job object provided by Windows PowerShell, such as a System.Management.Automation.Pseventjob object.
- In a record processing method, add an `if` statement that detects whether the cmdlet should run as a background job.
- For custom job objects, implement the job class.
- Return the appropriate objects, depending on whether the cmdlet is run as a background job.

For a code example, see How to Support Jobs.

Background Job-Related APIs

The following APIs are provided by Windows PowerShell to manage background jobs.

System.Management.Automation.Job Derives custom job objects. This is an abstract class.

System.Management.Automation.Jobrepository Manages and provides information about the current active background jobs.

System.Management.Automation.Jobstate Defines the state of the background job. States include Started, Running, and Stopped.

System.Management.Automation.Jobstateinfo Provides information about the state of a background job and, if the last state change was caused by an error, the reason the job entered its current state.

System.Management.Automation.Jobstateeventargs Provides the arguments for an event that is raised when a background job changes state.

Windows PowerShell Job Cmdlets

The following cmdlets are provided by Windows PowerShell to manage background jobs.

Get-Job

Gets Windows PowerShell background jobs that are running in the current session.

Receive-Job

Gets the results of the Windows PowerShell background jobs in the current session.

Remove-Job

Deletes a Windows PowerShell background job.

Start-Job

Starts a Windows PowerShell background job.

Stop-Job

Stops a Windows PowerShell background job.

Wait-Job

Suppresses the command prompt until one or all of the Windows PowerShell background jobs running in the session are complete.

See Also

Writing a Windows PowerShell Cmdlet

Invoking Cmdlets and Scripts Within a Cmdlet

Article • 09/17/2021

A cmdlet can invoke other cmdlets and scripts from within the input processing method of the cmdlet. This allows you to add the functionality of existing cmdlets and scripts to your cmdlet without having to rewrite the code.

The Invoke Method

All cmdlets can invoke an existing cmdlet by calling the System.Management.Automation.Cmdlet.Invoke method from within an input processing method, such as System.Management.Automation.Cmdlet.BeginProcessing, that is overridden by the cmdlet. However, you can invoke only those cmdlets that derive directly from the System.Management.Automation.Cmdlet class. You cannot invoke a cmdlet that derives from the System.Management.Automation.PSCmdlet class.

The System.Management.Automation.Cmdlet.Invoke* method has the following variants.

System.Management.Automation.Cmdlet.Invoke This variant invokes the cmdlet object and returns a collection of "T" type objects.

System.Management.Automation.Cmdlet.Invoke This variant invokes the cmdlet object and returns a strongly typed emumerator. This variant allows the user to use the objects in the collection to perform custom operations.

Examples

Example	Description
Invoking Cmdlets Within a Cmdlet	This example shows how to invoke a cmdlet from within another cmdlet.
Invoking Scripts Within a Cmdlet	This example shows how to invoke a script that is supplied to the cmdlet from within another cmdlet.

See Also

Writing a Windows PowerShell Cmdlet

Cmdlet Sets

Article • 09/17/2021

When you design your cmdlets, you might encounter cases in which you need to perform several actions on the same piece of data. For example, you might need to get and set data or start and stop a process. Although you will need to create separate cmdlets to perform each action, your cmdlet design should include a base class from which the classes for the individual cmdlets are derived.

Keep the following things in mind when implementing a base class.

- Declare any common parameters used by all the derived cmdlets in the base class.
- Add cmdlet-specific parameters to the appropriate cmdlet class.
- Override the appropriate input processing method in the base class.
- Declare the System.Management.Automation.CmdletAttribute attribute on all cmdlet classes, but do not declare it on the base class.
- Implement a System.Management.Automation.PSSnapIn or System.Management.Automation.Custompssnapin class whose name and description reflects the set of cmdlets.

Example

The following example shows the implementation of a base class that is used by Get-Proc and Stop-Proc cmdlet that derive from the same base class.

C#

```
using System;
using System.Diagnostics;
using System.Management.Automation;             //Windows PowerShell
namespace.

namespace Microsoft.Samples.PowerShell.Commands
{

  #region ProcessCommands

  /// <summary>
  /// This class implements a Stop-Proc cmdlet. The parameters
  /// for this cmdlet are defined by the BaseProcCommand class.
  /// </summary>
  [Cmdlet(VerbsLifecycle.Stop, "Proc", SupportsShouldProcess = true)]
```

```
public class StopProcCommand : BaseProcCommand
{
  public override void ProcessObject(Process process)
  {
    if (ShouldProcess(process.ProcessName, "Stop-Proc"))
    {
      process.Kill();
    }
  }
}

/// <summary>
/// This class implements a Get-Proc cmdlet. The parameters
/// for this cmdlet are defined by the BaseProcCommand class.
/// </summary>

[Cmdlet(VerbsCommon.Get, "Proc")]
public class GetProcCommand : BaseProcCommand
{
  public override void ProcessObject(Process process)
  {
    WriteObject(process);
  }
}

/// <summary>
/// This class is the base class that defines the common
/// functionality used by the Get-Proc and Stop-Proc
/// cmdlets.
/// </summary>
public class BaseProcCommand : Cmdlet
{
  #region Parameters

  // Defines the Name parameter that is used to
  // specify a process by its name.
  [Parameter(
             Position = 0,
             Mandatory = true,
             ValueFromPipeline = true,
             ValueFromPipelineByPropertyName = true
  )]
  public string[] Name
  {
    get { return processNames; }
    set { processNames = value; }
  }
  private string[] processNames;

  // Defines the Exclude parameter that is used to
  // specify which processes should be excluded when
  // the cmdlet performs its action.
  [Parameter()]
  public string[] Exclude
  {
```

```
      get { return excludeNames; }
      set { excludeNames = value; }
    }
    private string[] excludeNames = new string[0];
    #endregion Parameters

    public virtual void ProcessObject(Process process)
    {
      throw new NotImplementedException("This method should be
overridden.");
    }

    #region Cmdlet Overrides
    // <summary>
    // For each of the requested process names, retrieve and write
    // the associated processes.
    // </summary>
    protected override void ProcessRecord()
    {
      // Set up the wildcard characters used in resolving
      // the process names.
      WildcardOptions options = WildcardOptions.IgnoreCase |
                                WildcardOptions.Compiled;

      WildcardPattern[] include = new WildcardPattern[Name.Length];
      for (int i = 0; i < Name.Length; i++)
      {
        include[i] = new WildcardPattern(Name[i], options);
      }

      WildcardPattern[] exclude = new WildcardPattern[Exclude.Length];
      for (int i = 0; i < Exclude.Length; i++)
      {
        exclude[i] = new WildcardPattern(Exclude[i], options);
      }

      foreach (Process p in Process.GetProcesses())
      {
        foreach (WildcardPattern wIn in include)
        {
          if (wIn.IsMatch(p.ProcessName))
          {
            bool processThisOne = true;
            foreach (WildcardPattern wOut in exclude)
            {
              if (wOut.IsMatch(p.ProcessName))
              {
                processThisOne = false;
                break;
              }
            }
            if (processThisOne)
            {
              ProcessObject(p);
            }
```

```
            break;
          }
        }
      }
    }
    #endregion Cmdlet Overrides
  }
    #endregion ProcessCommands
}
```

See Also

Writing a Windows PowerShell Cmdlet

Windows PowerShell Session State

Article • 09/17/2021

Session state refers to the current configuration of a Windows PowerShell session or module. A Windows PowerShell session is the operational environment that is used interactively by the command-line user or programmatically by a host application. The session state for a session is referred to as the global session state.

From a developer perspective, a Windows PowerShell session refers to the time between when a host application opens a Windows PowerShell runspace and when it closes the runspace. Looked at another way, the session is the lifetime of an instance of the Windows PowerShell engine that is invoked while the runspace exists.

Module Session State

Module session states are created whenever the module or one of its nested modules is imported into the session. When a module exports an element such as a cmdlet, function, or script, a reference to that element is added to the global session state of the session. However, when the element is run, it is executed within the session state of the module.

Session-State Data

Session state data can be public or private. Public data is available to calls from outside the session state while private data is available only to calls from within the session state. For example, a module can have a private function that can be called only by the module or only internally by a public element that has been exported. This is similar to the private and public members of a .NET Framework type.

Session-state data is stored by the current instance of the execution engine within the context of the current Windows PowerShell session. Session-state data consists of the following items:

- Path information
- Drive information
- Windows PowerShell provider information
- Information about the imported modules and references to the module elements (such as cmdlets, functions, and scripts) that are exported by the module. This

information and these references are for the global session state only.

- Session-state variable information

Accessing Session-State Data Within Cmdlets

Cmdlets can access session-state data either indirectly through the System.Management.Automation.PSCmdlet.Sessionstate* property of the cmdlet class or directly through the System.Management.Automation.Sessionstate class. The System.Management.Automation.Sessionstate class provides properties that can be used to investigate different types of session-state data.

See Also

System.Management.Automation.PSCmdlet.Sessionstate

System.Management.Automation.Sessionstate?Displayproperty=Fullname

Windows PowerShell Cmdlets

Writing a Windows PowerShell Cmdlet

Windows PowerShell Shell SDK

Examples of Cmdlet Code

Article • 09/17/2021

This section contains examples of cmdlet code that you can use to start writing your own cmdlets.

> **ⓘ Important**
>
> If you want step-by-step instructions for writing cmdlets, see **Tutorials for Writing Cmdlets**.

In This Section

How to Write a Simple Cmdlet This example shows the basic structure of cmdlet code.

How to Declare Cmdlet Parameters This example shows how to declare the different types of parameters.

How to Declare Parameter Sets This example shows how to declare sets of parameters that can change the action a cmdlet performs.

How to Validate Parameter Input These examples show how to validate parameter input.

How to Declare Dynamic Parameters This example shows how to declare a parameter that is added at runtime.

How to Invoke Scripts Within a Cmdlet This example shows how to invoke a script that is supplied to a cmdlet.

How To Override Input Processing Methods These examples show the basic structure used to override the BeginProcessing, ProcessRecord, and EndProcessing methods.

How to Support ShouldProcess Calls This example shows how the System.Management.Automation.Cmdlet.ShouldProcess and System.Management.Automation.Cmdlet.ShouldContinue methods should be called from within a cmdlet.

How to Support Transactions This example shows how to indicate that the cmdlet supports transactions and how to implement the action that is taken when the cmdlet is used within a transaction.

How to Support Jobs This example shows how to support jobs when you write cmdlets.

How to Invoke a Cmdlet From Within a Cmdlet This example shows how to invoke a cmdlet from within another cmdlet, which allows you to add the functionality of the invoked cmdlet to the cmdlet you are developing.

See Also

Writing a Windows PowerShell Cmdlet

How to write a cmdlet

Article • 09/17/2021

This article shows how to write a cmdlet. The `Send-Greeting` cmdlet takes a single user name as input and then writes a greeting to that user. Although the cmdlet does not do much work, this example demonstrates the major sections of a cmdlet.

Steps to write a cmdlet

1. To declare the class as a cmdlet, use the **Cmdlet** attribute. The **Cmdlet** attribute specifies the verb and the noun for the cmdlet name.

   For more information about the **Cmdlet** attribute, see CmdletAttribute Declaration.

2. Specify the name of the class.

3. Specify that the cmdlet derives from either of the following classes:

   - System.Management.Automation.Cmdlet
   - System.Management.Automation.PSCmdlet

4. To define the parameters for the cmdlet, use the **Parameter** attribute. In this case, only one required parameter is specified.

   For more information about the **Parameter** attribute, see ParameterAttribute Declaration.

5. Override the input processing method that processes the input. In this case, the System.Management.Automation.Cmdlet.ProcessRecord method is overridden.

6. To write the greeting, use the method System.Management.Automation.Cmdlet.WriteObject. The greeting is displayed in the following format:

   Output

   ```
   Hello <UserName>!
   ```

Example

C#

```
using System.Management.Automation;  // Windows PowerShell assembly.

namespace SendGreeting
{
  // Declare the class as a cmdlet and specify the
  // appropriate verb and noun for the cmdlet name.
  [Cmdlet(VerbsCommunications.Send, "Greeting")]
  public class SendGreetingCommand : Cmdlet
  {
    // Declare the parameters for the cmdlet.
    [Parameter(Mandatory=true)]
    public string Name
    {
      get { return name; }
      set { name = value; }
    }
    private string name;

    // Override the ProcessRecord method to process
    // the supplied user name and write out a
    // greeting to the user by calling the WriteObject
    // method.
    protected override void ProcessRecord()
    {
      WriteObject("Hello " + name + "!");
    }
  }
}
```

See also

System.Management.Automation.Cmdlet

System.Management.Automation.PSCmdlet

System.Management.Automation.Cmdlet.ProcessRecord

System.Management.Automation.Cmdlet.WriteObject

CmdletAttribute Declaration

ParameterAttribute Declaration

Writing a Windows PowerShell Cmdlet

How to Declare Cmdlet Parameters

Article • 09/17/2021

These examples show how to declare named, positional, required, optional, and switch parameters. These examples also show how to define a parameter alias.

How to Declare a Named Parameter

- Define a public property as shown in the following code. When you add the Parameter attribute, omit the `Position` keyword from the attribute.

```
C#
```

```
[Parameter()]
public string UserName
{
  get { return userName; }
  set { userName = value; }
}
private string userName;
```

For more information about the Parameter attribute, see Parameter Attribute Declaration.

How to Declare a Positional Parameter

- Define a public property as shown in the following code. When you add the Parameter attribute, set the `Position` keyword to the argument position. A value of 0 indicates the first position.

```
C#
```

```
[Parameter(Position = 0)]
public string UserName
{
  get { return userName; }
  set { userName = value; }
}
private string userName;
```

For more information about the Parameter attribute, see Parameter Attribute Declaration.

How to Declare a Mandatory Parameter

- Define a public property as shown in the following code. When you add the Parameter attribute, set the `Mandatory` keyword to `true`.

```
C#

[Parameter(Position = 0, Mandatory = true)]
public string UserName
{
  get { return userName; }
  set { userName = value; }
}
private string userName;
```

For more information about the Parameter attribute, see Parameter Attribute Declaration.

How to Declare an Optional Parameter

- Define a public property as shown in the following code. When you add the Parameter attribute, omit the `Mandatory` keyword.

```
C#

[Parameter(Position = 0)]
public string UserName
{
  get { return userName; }
  set { userName = value; }
}
private string userName;
```

How to Declare a Switch Parameter

- Define a public property as type System.Management.Automation.SwitchParameter, and then declare the Parameter attribute.

```
C#

[Parameter(Position = 1)]
public SwitchParameter GoodBye
{
  get { return goodbye; }
```

```
  set { goodbye = value; }
}
private bool goodbye;
```

For more information about the Parameter attribute, see Parameter Attribute Declaration.

How to Declare a Parameter with Aliases

- Define a public property as shown in the following code. Add an Alias attribute that lists the aliases for the parameter. In this example, three aliases are defined for the same parameter. The first alias provides a shortcut. The second and third aliases provide names you can use for different scenarios.

```
C#

[Alias("UN","Writer","Editor")]
[Parameter()]
public string UserName
{
  get { return userName; }
  set { userName = value; }
}
private string userName;
```

For more information about the Alias attribute, see Alias Attribute Declaration.

See Also

System.Management.Automation.SwitchParameter

Parameter Attribute Declaration

Alias Attribute Declaration

Writing a Windows PowerShell Cmdlet

How to Declare Parameter Sets

Article • 09/17/2021

This example shows how to define two parameter sets when you declare the parameters for a cmdlet. Each parameter set has both a unique parameter and a shared parameter that is used by both parameter sets. For more information about parameters sets, including how to specify the default parameter set, see Cmdlet Parameter Sets.

> **ⓘ Important**
>
> Whenever possible, define the unique parameter of a parameter set as a required parameter. However, if you want your cmdlet to run without specifying any parameters, the unique parameter can be an optional parameter. For example, the unique parameter of the `Get-Command` cmdlet is optional.

How to Define Two Parameter Sets

1. Add the `ParameterSet` keyword to the Parameter attribute for the unique parameter of the first parameter set.

   C#

   ```
   [Parameter(Position = 0, Mandatory = true,
              ParameterSetName = "Test01")]
   public string UserName
   {
     get { return userName; }
     set { userName = value; }
   }
   private string userName;
   ```

2. Add the `ParameterSet` keyword to the Parameter attribute for the unique parameter of the second parameter set.

   C#

   ```
   [Parameter(Position = 0, Mandatory = true,
              ParameterSetName = "Test02")]
   public string ComputerName
   {
     get { return computerName; }
     set { computerName = value; }
   ```

```
}
private string computerName;
```

3. For the parameter that belongs to both parameter sets, add a Parameter attribute for each parameter set and then add the `ParameterSet` keyword to each set. In each Parameter attribute, you can specify how that parameter is defined. A parameter can be optional in one set and mandatory in another.

```
C#

[Parameter(Mandatory= true, ParameterSetName = "Test01")]
[Parameter(ParameterSetName = "Test02")]
public string SharedParam
{
    get { return sharedParam; }
    set { sharedParam = value; }
}
private string sharedParam;
```

See Also

Cmdlet Parameter Sets

Writing a Windows PowerShell Cmdlet

How to Validate Parameter Input

Article • 09/17/2021

This section contains examples that show how to validate parameter input by using various attributes to implement validation rules.

In This Section

How to Validate an Argument with a Script Describes how to validate an argument set by using the ArgumentSet attribute.

How to Validate an Argument Set Describes how to validate an argument set by using the ArgumentSet attribute.

How to Validate an Argument Range Describes how to validate an argument range by using the ArgumentRange attribute.

How to Validate an Argument Pattern Describes how to validate an argument pattern by using the ArgumentPattern attribute.

How to Validate the Argument Length Describes how to validate the length of an argument by using the ArgumentLength attribute.

How to Validate an Argument Count Describes how to validate an argument count by using the ArgumentCount attribute.

The way a parameter is declared can affect validation. For more information, see How to Declare Cmdlet Parameters.

Reference

See Also

Writing a Windows PowerShell Cmdlet

How to validate an argument using a script

Article • 09/17/2021

This example shows how to specify a validation rule that uses a script to check the parameter argument before the cmdlet is run. The value of the parameter is piped to the script. The script must return `$true` for every value piped to it.

> **Note**
>
> For more information about the class that defines this attribute, see **System.Management.Automation.ValidateScriptAttribute**.

To validate an argument using a script

- Add the ValidateScript attribute as shown in the following code. This example specifies a set of three possible values for the `UserName` parameter.

```
C#
```

```
[ValidateScript("$_ % 2", ErrorMessage = "The item '{0}' did not pass
validation of script '{1}'")]
[Parameter(Position = 0, Mandatory = true)]
public int32 OddNumber
{
   get { return oddNumber; }
   set { oddNumber = value; }
}

private int32 oddNumber;
```

For more information about how to declare this attribute, see ValidateScript Attribute Declaration.

See Also

System.Management.Automation.ValidateScriptAttribute

ValidateScript Attribute Declaration

Writing a Windows PowerShell Cmdlet

How to Validate an Argument Set

Article • 09/17/2021

This example shows how to specify a validation rule that the Windows PowerShell runtime can use to check the parameter argument before the cmdlet is run. This validation rule provides a set of the valid values for the parameter argument.

> ⓘ **Note**
>
> For more information about the class that defines this attribute, see **System.Management.Automation.Validatesetattribute**.

To validate an argument set

- Add the ValidateSet attribute as shown in the following code. This example specifies a set of three possible values for the `UserName` parameter.

```
C#
```

```
[ValidateSet("Steve", "Mary", "Carl", IgnoreCase = true)]
[Parameter(Position = 0, Mandatory = true)]
public string UserName
{
  get { return userName; }
  set { userName = value; }
}

private string userName;
```

For more information about how to declare this attribute, see ValidateSet Attribute Declaration.

See Also

System.Management.Automation.Validatesetattribute

ValidateSet Attribute Declaration

Writing a Windows PowerShell Cmdlet

How to Validate an Argument Range

Article • 09/17/2021

This example shows how to specify a validation rule that the Windows PowerShell runtime can use to check the minimum and maximum values of the parameter argument before the cmdlet is run. You set this validation rule by declaring the ValidateRange attribute.

> ⓘ Note
>
> For more information about the class that defines this attribute, see **System.Management.Automation.Validaterangeattribute**.

To validate an argument range

- Add the ValidateRange attribute as shown in the following code. This example specifies a range of 0 to 5 for the `InputData` parameter.

```
C#
```

```
[ValidateRange(0, 5)]
[Parameter(Position = 0, Mandatory = true)]
public int InputData
{
  get { return inputData; }
  set { inputData = value; }
}
private int inputData;
```

For more information about how to declare this attribute, see ValidateRange Attribute Declaration.

See Also

ValidateRange Attribute Declaration

Writing a Windows PowerShell Cmdlet

How to Validate an Argument Pattern

Article • 09/17/2021

This example shows how to specify a validation rule that the Windows PowerShell runtime can use to check the character pattern of the parameter argument before the cmdlet is run. You set this validation rule by declaring the ValidatePattern attribute.

> **Note**
>
> For more information about the class that defines this attribute, see **System.Management.Automation.Validatepatternattribute**.

To validate an argument pattern

- Add the Validate attribute as shown in the following code. This example specifies a pattern of four digits, where each digit has a value of 0 through 9.

```
C#
```

```
[ValidatePattern("[0-9][0-9][0-9][0-9]")]
[Parameter(Position = 0, Mandatory = true)]
public int InputData
{
  get { return inputData; }
  set { inputData = value; }
}

private int inputData;
```

For more information about how to declare this attribute, see ValidatePattern Attribute Declaration.

See Also

ValidatePattern Attribute Declaration

Writing a Windows PowerShell Cmdlet

How to Validate the Argument Length

Article • 09/17/2021

This example shows how to specify a validation rule that the Windows PowerShell runtime can use to check the number of characters (the length) of the parameter argument before the cmdlet is run. You set this validation rule by declaring the ValidateLength attribute.

> ⓘ Note
>
> For more information about the class that defines this attribute, see **System.Management.Automation.Validatelengthattribute**.

To validate the argument length

- Add the Validate attribute as shown in the following code. This example specifies that the length of the argument should have a length of 0 to 10 characters.

```
C#
```

```
[ValidateLength(0, 10)]
[Parameter(Position = 0, Mandatory = true)]
public string UserName
{
  get { return userName; }
  set { userName = value; }
}
private string userName;
```

For more information about how to declare this attribute, see ValidateLength Attribute Declaration.

See Also

ValidateLength Attribute Declaration

Writing a Windows PowerShell Cmdlet

How to Validate an Argument Count

Article • 09/17/2021

This example shows how to specify a validation rule that the Windows PowerShell runtime can use to check the number of arguments (the count) that a parameter accepts before the cmdlet is run. You set this validation rule by declaring the ValidateCount attribute.

> **Note**
>
> For more information about the class that defines this attribute, see **System.Management.Automation.Validatecountattribute**.

To validate an argument count

- Add the Validate attribute as shown in the following code. This example specifies that the parameter will accept one argument or as many as three arguments.

```
C#
```

```
[ValidateCount(1, 3)]
[Parameter(Position = 0, Mandatory = true)]
public string[] UserNames
{
  get { return userNames; }
  set { userNames = value; }
}

private string[] userNames;
```

For more information about how to declare this attribute, see ValidateCount Attribute Declaration.

See Also

ValidateCount Attribute Declaration

Writing a Windows PowerShell Cmdlet

How to Declare Dynamic Parameters

Article • 09/17/2021

This example shows how to define dynamic parameters that are added to the cmdlet at runtime. In this example, the `Department` parameter is added to the cmdlet whenever the user specifies the `Employee` switch parameter. For more information about dynamic parameters, see Cmdlet Dynamic Parameters.

To define dynamic parameters

1. In the cmdlet class declaration, add the System.Management.Automation.Idynamicparameters interface as shown.

   C#

   ```
   public class SendGreetingCommand : Cmdlet, IDynamicParameters
   ```

2. Call the System.Management.Automation.Idynamicparameters.Getdynamicparameters* method, which returns the object in which the dynamic parameters are defined. In this example, the method is called when the `Employee` parameter is specified.

   C#

   ```
   public object GetDynamicParameters()
   {
       if (employee)
       {
         context= new SendGreetingCommandDynamicParameters();
         return context;
       }
       return null;
   }
   private SendGreetingCommandDynamicParameters context;
   ```

3. Declare a class that defines the dynamic parameters to be added. You can use the attributes that you used to declare the static cmdlet parameters to declare the dynamic parameters.

   C#

   ```
   public class SendGreetingCommandDynamicParameters
   {
   ```

```
    [Parameter]
    [ValidateSet ("Marketing", "Sales", "Development")]
    public string Department
    {
      get { return department; }
      set { department = value; }
    }
    private string department;
  }
```

Example

In this example, the `Department` parameter is added whenever the user specifies the `Employee` parameter. The `Department` parameter is an optional parameter, and the ValidateSet attribute is used to specify the allowed arguments.

C#

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Management.Automation;     // PowerShell assembly.

namespace SendGreeting
{
  // Declare the cmdlet class that supports the
  // IDynamicParameters interface.
  [Cmdlet(VerbsCommunications.Send, "Greeting")]
  public class SendGreetingCommand : Cmdlet, IDynamicParameters
  {
    // Declare the parameters for the cmdlet.
    [Parameter(Mandatory = true)]
    public string Name
    {
      get { return name; }
      set { name = value; }
    }
    private string name;

    [Parameter]
    [Alias ("FTE")]
    public SwitchParameter Employee
    {
      get { return employee; }
      set { employee = value; }
    }
    private Boolean employee;

    // Implement GetDynamicParameters to
    // retrieve the dynamic parameter.
```

```
    public object GetDynamicParameters()
    {
      if (employee)
      {
        context= new SendGreetingCommandDynamicParameters();
        return context;
      }
      return null;
   }
   private SendGreetingCommandDynamicParameters context;

    // Overide the ProcessRecord method to process the
    // supplied user name and write out a greeting to
    // the user by calling the WriteObject method.
    protected override void ProcessRecord()
    {
      WriteObject("Hello " + name + "! ");
      if (employee)
      {
        WriteObject("Department: " + context.Department);
      }
    }
  }

  // Define the dynamic parameters to be added
  public class SendGreetingCommandDynamicParameters
  {
    [Parameter]
    [ValidateSet ("Marketing", "Sales", "Development")]
    public string Department
    {
      get { return department; }
      set { department = value; }
    }
    private string department;
  }
}
```

See Also

System.Management.Automation.Runtimedefinedparameterdictionary

System.Management.Automation.Idynamicparameters.Getdynamicparameters*

Cmdlet Dynamic Parameters

Windows PowerShell SDK

How to Invoke Scripts Within a Cmdlet

Article • 09/17/2021

This example shows how to invoke a script that is supplied to a cmdlet. The script is executed by the cmdlet, and its results are returned to the cmdlet as a collection of System.Management.Automation.PSObject objects.

To invoke a script block

1. The command verifies that a script block was supplied to the cmdlet. If a script block was supplied, the command invokes the script block with its required parameters.

   C#

   ```
   if (script != null)
   {
     WriteDebug("Executing script block.");

     // Invoke the script block with the required arguments.
     Collection<PSObject> PSObjects =
                    script.Invoke(
                                  line,
                                  simpleMatch,
                                  caseSensitive
                                 );
   ```

2. Then, the script iterates through the returned collection of System.Management.Automation.PSObject objects and perform the necessary operations.

   C#

   ```
   foreach (PSObject psObject in psObjects)
   {
     if (LanguagePrimitives.IsTrue(psObject))
     {
       result = new MatchInfo();
       result.Line = line;
       result.IgnoreCase = !caseSensitive;

       break;
     }
   }
   ```

See Also

Writing a Windows PowerShell Cmdlet

How to Override Input Processing Methods

Article • 09/17/2021

These examples show how to overwrite the input processing methods within a cmdlet. These methods are used to perform the following operations:

- The System.Management.Automation.Cmdlet.BeginProcessing method is used to perform one-time startup operations that are valid for all the objects processed by the cmdlet. The Windows PowerShell runtime calls this method only once.
- The System.Management.Automation.Cmdlet.ProcessRecord method is used to process the objects passed to the cmdlet. The Windows PowerShell runtime calls this method for each object passed to the cmdlet.
- The System.Management.Automation.Cmdlet.EndProcessing method is used to perform one-time post processing operations. The Windows PowerShell runtime calls this method only once.

To override the BeginProcessing method

- Declare a protected override of the System.Management.Automation.Cmdlet.BeginProcessing method.

The following class prints a sample message. To use this class, change the verb and noun in the Cmdlet attribute, change the name of the class to reflect the new verb and noun, and then add the functionality you require to the override of the System.Management.Automation.Cmdlet.BeginProcessing method.

C#

```
[Cmdlet(VerbsDiagnostic.Test, "BeginProcessingClass")]
public class TestBeginProcessingClassTemplate : Cmdlet
{
  // Override the BeginProcessing method to add preprocessing
  //operations to the cmdlet.
  protected override void BeginProcessing()
  {
    // Replace the WriteObject method with the logic required
    // by your cmdlet. It is used here to generate the following
    // output:
    // "This is a test of the BeginProcessing template."
    WriteObject("This is a test of the BeginProcessing template.");
```

```
  }
}
```

To override the ProcessRecord method

- Declare a protected override of the System.Management.Automation.Cmdlet.ProcessRecord method.

The following class prints a sample message. To use this class, change the verb and noun in the Cmdlet attribute, change the name of the class to reflect the new verb and noun, and then add the functionality you require to the override of the System.Management.Automation.Cmdlet.ProcessRecord method.

C#

```
[Cmdlet(VerbsDiagnostic.Test, "ProcessRecordClass")]
public class TestProcessRecordClassTemplate : Cmdlet
{
    // Override the ProcessRecord method to add processing
    //operations to the cmdlet.
    protected override void ProcessRecord()
    {
        // Replace the WriteObject method with the logic required
        // by your cmdlet. It is used here to generate the following
        // output:
        // "This is a test of the ProcessRecord template."
        WriteObject("This is a test of the ProcessRecord template.");
    }
}
```

To override the EndProcessing method

- Declare a protected override of the System.Management.Automation.Cmdlet.EndProcessing method.

The following class prints a sample. To use this class, change the verb and noun in the Cmdlet attribute, change the name of the class to reflect the new verb and noun, and then add the functionality you require to the override of the System.Management.Automation.Cmdlet.EndProcessing method.

C#

```
[Cmdlet(VerbsDiagnostic.Test, "EndProcessingClass")]
public class TestEndProcessingClassTemplate : Cmdlet
```

```
{
  // Override the EndProcessing method to add postprocessing
  //operations to the cmdlet.
  protected override void EndProcessing()
  {
    // Replace the WriteObject method with the logic required
    // by your cmdlet. It is used here to generate the following
    // output:
    // "This is a test of the BeginProcessing template."
    WriteObject("This is a test of the EndProcessing template.");
  }
}
```

See Also

System.Management.Automation.Cmdlet.BeginProcessing

System.Management.Automation.Cmdlet.EndProcessing

System.Management.Automation.Cmdlet.ProcessRecord

Writing a Windows PowerShell Cmdlet

Requesting Confirmation from Cmdlets

Article • 09/17/2021

Cmdlets should request confirmation when they are about to make a change to the system that is outside of the Windows PowerShell environment. For example, if a cmdlet is about to add a user account or stop a process, the cmdlet should require confirmation from the user before it proceeds. In contrast, if a cmdlet is about to change a Windows PowerShell variable, the cmdlet does not need to require confirmation.

In order to make a confirmation request, the cmdlet must indicate that it supports confirmation requests, and it must call the System.Management.Automation.Cmdlet.ShouldProcess and System.Management.Automation.Cmdlet.ShouldContinue (optional) methods to display a confirmation request message.

Supporting Confirmation Requests

To support confirmation requests, the cmdlet must set the `SupportsShouldProcess` parameter of the Cmdlet attribute to `true`. This enables the `Confirm` and `WhatIf` cmdlet parameters that are provided by Windows PowerShell. The `Confirm` parameter allows the user to control whether the confirmation request is displayed. The `WhatIf` parameter allows the user to determine whether the cmdlet should display a message or perform its action. Do not manually add the `Confirm` and `WhatIf` parameters to a cmdlet.

The following example shows a Cmdlet attribute declaration that supports confirmation requests.

C#

```
[Cmdlet(VerbsDiagnostic.Test, "RequestConfirmationTemplate1",
        SupportsShouldProcess = true)]
```

Calling the Confirmation request methods

In the cmdlet code, call the System.Management.Automation.Cmdlet.ShouldProcess method before the operation that changes the system is performed. Design the cmdlet so that if the call returns a value of `false`, the operation is not performed, and the cmdlet processes the next operation.

Calling the ShouldContinue Method

Most cmdlets request confirmation using only the System.Management.Automation.Cmdlet.ShouldProcess method. However, some cases might require additional confirmation. For these cases, supplement the System.Management.Automation.Cmdlet.ShouldProcess call with a call to the System.Management.Automation.Cmdlet.ShouldContinue method. This allows the cmdlet or provider to more finely control the scope of the **Yes to all** response to the confirmation prompt.

If a cmdlet calls the System.Management.Automation.Cmdlet.ShouldContinue method, the cmdlet must also provide a `Force` switch parameter. If the user specifies `Force` when the user invokes the cmdlet, the cmdlet should still call System.Management.Automation.Cmdlet.ShouldProcess, but it should bypass the call to System.Management.Automation.Cmdlet.ShouldContinue.

System.Management.Automation.Cmdlet.ShouldContinue will throw an exception when it is called from a non-interactive environment where the user cannot be prompted. Adding a `Force` parameter ensures that the command can still be performed when it is invoked in a non-interactive environment.

The following example shows how to call System.Management.Automation.Cmdlet.ShouldProcess and System.Management.Automation.Cmdlet.ShouldContinue.

C#

```
if (ShouldProcess (...) )
{
  if (Force || ShouldContinue(...))
  {
     // Add code that performs the operation.
  }
}
```

The behavior of a System.Management.Automation.Cmdlet.ShouldProcess call can vary depending on the environment in which the cmdlet is invoked. Using the previous guidelines will help ensure that the cmdlet behaves consistently with other cmdlets, regardless of the host environment.

For an example of calling the System.Management.Automation.Cmdlet.ShouldProcess method, see How to Request Confirmations.

Specify the Impact Level

When you create the cmdlet, specify the impact level (the severity) of the change. To do this, set the value of the `ConfirmImpact` parameter of the Cmdlet attribute to High, Medium, or Low. You can specify a value for `ConfirmImpact` only when you also specify the `SupportsShouldProcess` parameter for the cmdlet.

For most cmdlets, you do not have to explicitly specify `ConfirmImpact`. Instead, use the default setting of the parameter, which is Medium. If you set `ConfirmImpact` to High, the operation will be confirmed by default. Reserve this setting for highly disruptive actions, such as reformatting a hard-disk volume.

Calling Non-Confirmation Methods

If the cmdlet or provider must send a message but not request confirmation, it can call the following three methods. Avoid using the System.Management.Automation.Cmdlet.WriteObject method to send messages of these types because System.Management.Automation.Cmdlet.WriteObject output is intermingled with the normal output of your cmdlet or provider, which makes script writing difficult.

- To caution the user and continue with the operation, the cmdlet or provider can call the System.Management.Automation.Cmdlet.WriteWarning method.
- To provide additional information that the user can retrieve using the `Verbose` parameter, the cmdlet or provider can call the System.Management.Automation.Cmdlet.WriteVerbose method.
- To provide debugging-level detail for other developers or for product support, the cmdlet or provider can call the System.Management.Automation.Cmdlet.WriteDebug method. The user can retrieve this information using the `Debug` parameter.

Cmdlets and providers first call the following methods to request confirmation before they attempt to perform an operation that changes a system outside of Windows PowerShell:

- System.Management.Automation.Cmdlet.Shouldprocess
- System.Management.Automation.Provider.Cmdletprovider.Shouldprocess

They do so by calling the System.Management.Automation.Cmdlet.Shouldprocess method, which prompts the user to confirm the operation based on how the user

invoked the command.

See Also

Writing a Windows PowerShell Cmdlet

How to Support Transactions

Article • 09/17/2021

This example shows the basic code elements that add support for transactions to a cmdlet.

> **ⓘ Important**
>
> For more information about how Windows PowerShell handles transactions, see **About Transactions**.

To support transactions

1. When you declare the Cmdlet attribute, specify that the cmdlet supports transactions. When the cmdlet supports transactions, Windows PowerShell adds the `UseTransaction` parameter to the cmdlet when it is run.

   C#

   ```
   [Cmdlet(VerbsCommunications.Send, "GreetingTx",
           SupportsTransactions=true )]
   ```

2. Within one of the input processing methods, add an `if` block to determine if a transaction is available. If the `if` statement resolves to `true`, the actions within this statement can be performed within the context of the current transaction.

   C#

   ```
   if (TransactionAvailable())
   {
     using (CurrentPSTransaction)
     {
       WriteObject("Hello " + name + "  from within a transaction.");
     }
   }
   ```

See Also

Writing a Windows PowerShell Cmdlet

How to Support Jobs

Article • 09/23/2021

This example shows how to support jobs when you write cmdlets. If you want users to run your cmdlet as a background job, you must include the code described in the following procedure. For more information about background jobs, see Background Jobs.

To support jobs

1. Define an `AsJob` switch parameter so that the user can decide whether to run the cmdlet as a job.

   The following example shows an AsJob parameter declaration.

   C#

   ```
   [Parameter()]
   public SwitchParameter AsJob
   {
     get { return asjob; }
     set { asjob = value; }
   }
   private bool asjob;
   ```

2. Create an object that derives from the System.Management.Automation.Job class. This object can be a custom job object or one of the job objects provided by Windows PowerShell, such a System.Management.Automation.Pseventjob object.

   The following example shows a custom job object.

   C#

   ```
   private SampleJob job = new SampleJob("Get-ProcAsJob");
   ```

3. In a record processing method, add an `if` statement to detect whether the cmdlet should run as a job. The following code uses the System.Management.Automation.Cmdlet.ProcessRecord method.

   C#

   ```
   protected override void ProcessRecord()
   {
   ```

```
  if (asjob)
  {
    // Add the job definition to the job repository,
    // return the job object, and then create the thread
    // used to run the job.
    JobRepository.Add(job);
    WriteObject(job);
    ThreadPool.QueueUserWorkItem(WorkItem);
  }
  else
  {
    job.ProcessJob();
    foreach (PSObject p in job.Output)
    {
      WriteObject(p);
    }
  }
}
```

4. For custom job objects, implement the job class.

C#

```
private class SampleJob : Job
{
  internal SampleJob(string command)
      : base(command)
  {
    SetJobState(JobState.NotStarted);
  }
  public override string StatusMessage
  {
    get { throw new NotImplementedException(); }
  }

  public override bool HasMoreData
  {
    get
    {
      return hasMoreData;
    }
  }
  private bool hasMoreData = true;

  public override string Location
  {
    get { throw new NotImplementedException(); }
  }

  public override void StopJob()
  {
    throw new NotImplementedException();
  }
```

```
  internal void ProcessJob()
  {
    SetJobState(JobState.Running);
    DoProcessLogic();
    SetJobState(JobState.Completed);
  }

  // Retrieve the processes of the local computer.
  void DoProcessLogic()
  {
    Process[] p = Process.GetProcesses();

    foreach (Process pl in p)
    {
      Output.Add(PSObject.AsPSObject(pl));
    }
    Output.Complete();
  } // End DoProcessLogic.
} // End SampleJob class.
```

5. If the cmdlet performs the work, call the System.Management.Automation.Cmdlet.WriteObject method to return a process object to the pipeline. If the work is performed as a job, add child job to the job.

C#

```
void DoProcessLogic(bool asJob)
{
  Process[] p = Process.GetProcesses();

  foreach (Process pl in p)
  {
    if (!asjob)
    {
      WriteObject(pl);
    }
    else
    {
      job.ChildJobs[0].Output.Add(PSObject.AsPSObject(pl));
    }
  }
} // End DoProcessLogic.
```

Example

The following sample code shows the code for a `Get-Proc` cmdlet that can retrieve processes internally or by using a background job.

C#

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Management.Automation;  // Windows PowerShell namespace.
using System.Threading;              // Thread pool namespace for posting
work.
using System.Diagnostics;            // Diagnostics namespace for retrieving
                                     // process objects.

// This sample shows a cmdlet whose work can be done by the cmdlet or by
using
// a background job. Background jobs are executed in their own thread,
// independent of the pipeline thread in which the cmdlet is executed.
//
// To load this cmdlet, create a module folder and copy the
GetProcessSample06.dll
// assembly into the module folder. Make sure that the path to the module
folder
// is added to the $PSModulePath environment variable.
// Module folder path:
//    user/documents/WindowsPowerShell/modules/GetProcessSample06
//
// To import the module, run the following command: Import-Module
GetProcessSample06.
// To test the cmdlet, run the following command: Get-Proc -name <process
name>
//

//
namespace Microsoft.Samples.PowerShell.Commands
{
  /// <summary>
  ///  This cmdlet retrieves process internally or returns
  ///  a job that retrieves the processes.
  /// </summary>
  [Cmdlet(VerbsCommon.Get, "Proc")]
  public sealed class GetProcCommand : PSCmdlet
  {

    #region Parameters
    /// <summary>
    /// Specify the Name parameter. This parameter accepts
    /// process names from the command line.
    /// </summary>
    [Parameter(
               Position = 0,
               ValueFromPipeline = true,
               ValueFromPipelineByPropertyName = true)]
    [ValidateNotNullOrEmpty]
    public string[] Name
    {
```

```
      get { return processNames; }
      set { processNames = value; }
    }
    private string[] processNames;

    /// <summary>
    /// Specify the AsJob parameter. This parameter indicates
    /// whether the cmdlet should retrieve the processes internally
    /// or return a Job object that retrieves the processes.
    /// </summary>
    [Parameter()]
    public SwitchParameter AsJob
    {
      get { return asjob; }
      set { asjob = value; }
    }
    private bool asjob;

    #endregion Parameters

    #region Cmdlet Overrides

    // Create a custom job object.
    private SampleJob job = new SampleJob("Get-ProcAsJob");

    /// <summary>
    /// Determines if the processes should be retrieved
    /// internally or if a Job object should be returned.
    /// </summary>
    protected override void ProcessRecord()
    {
      if (asjob)
      {
        // Add the job definition to the job repository,
        // return the job object, and then create the thread
        // used to run the job.
        JobRepository.Add(job);
        WriteObject(job);
        ThreadPool.QueueUserWorkItem(WorkItem);
      }
      else
      {
        job.ProcessJob();
        foreach (PSObject p in job.Output)
        {
          WriteObject(p);
        }
      }
    }
    #endregion Overrides

    // Implement a custom job that derives
    // from the System.Management.Automation.Job class.
    private class SampleJob : Job
    {
```

```
        internal SampleJob(string command)
            : base(command)
        {
          SetJobState(JobState.NotStarted);
        }
        public override string StatusMessage
        {
          get { throw new NotImplementedException(); }
        }

        public override bool HasMoreData
        {
          get
          {
            return hasMoreData;
          }
        }
        private bool hasMoreData = true;

        public override string Location
        {
          get { throw new NotImplementedException(); }
        }

        public override void StopJob()
        {
          throw new NotImplementedException();
        }

        internal void ProcessJob()
        {
          SetJobState(JobState.Running);
          DoProcessLogic();
          SetJobState(JobState.Completed);
        }

        // Retrieve the processes of the local computer.
        void DoProcessLogic()
        {
          Process[] p = Process.GetProcesses();

          foreach (Process pl in p)
          {
            Output.Add(PSObject.AsPSObject(pl));
          }
          Output.Complete();
        } // End DoProcessLogic.
      } // End SampleJob class.

      void WorkItem(object dummy)
      {
         job.ProcessJob();
      }

      // Display the results of the work. If not a job,
```

```
    // process objects are returned. If a job, the
    // output is added to the job as a child job.
    void DoProcessLogic(bool asJob)
    {
      Process[] p = Process.GetProcesses();

      foreach (Process pl in p)
      {
        if (!asjob)
        {
          WriteObject(pl);
        }
        else
        {
          job.ChildJobs[0].Output.Add(PSObject.AsPSObject(pl));
        }
      }
    } // End DoProcessLogic.
  } //End GetProcCommand
}
```

How to Invoke a Cmdlet from Within a Cmdlet

Article • 10/20/2022

This example shows how to invoke a binary cmdlet that derives from `[System.Management.Automation.Cmdlet]` directly from within another binary cmdlet, which allows you to add the functionality of the invoked cmdlet to the binary cmdlet you are developing. In this example, the `Get-Process` cmdlet is invoked to get the processes that are running on the local computer. The call to the `Get-Process` cmdlet is equivalent to the following command. This command retrieves all the processes whose names start with the characters "a" through "t".

PowerShell

```
Get-Process -name [a-t]*
```

> **Important**
>
> You can invoke only those cmdlets that derive directly from the **System.Management.Automation.Cmdlet** class. You can't invoke a cmdlet that derives from the **System.Management.Automation.PSCmdlet** class. For an example, see **How to invoke a PSCmdlet from within a PSCmdlet**.

To invoke a cmdlet from within a cmdlet

1. Ensure that the assembly that defines the cmdlet to be invoked is referenced and that the appropriate `using` statement is added. In this example, the following namespaces are added.

   C#

   ```
   using System.Diagnostics;
   using System.Management.Automation;   // PowerShell assembly.
   using Microsoft.PowerShell.Commands;  // PowerShell cmdlets assembly
   you want to call.
   ```

2. In the input processing method of the cmdlet, create a new instance of the cmdlet to be invoked. In this example, an object of type

Microsoft.PowerShell.Commands.GetProcessCommand is created along with the string that contains the arguments that are used when the cmdlet is invoked.

```
C#

GetProcessCommand gp = new GetProcessCommand();
gp.Name = new string[] { "[a-t]*" };
```

3. Call the System.Management.Automation.Cmdlet.Invoke* method to invoke the `Get-Process` cmdlet.

```
C#

  foreach (Process p in gp.Invoke<Process>())
  {
    Console.WriteLine(p.ToString());
  }
}
```

Example

In this example, the `Get-Process` cmdlet is invoked from within the System.Management.Automation.Cmdlet.BeginProcessing method of a cmdlet.

```
C#

using System;
using System.Diagnostics;
using System.Management.Automation;   // PowerShell assembly.
using Microsoft.PowerShell.Commands;  // PowerShell cmdlets assembly you
want to call.

namespace SendGreeting
{
  // Declare the class as a cmdlet and specify an
  // appropriate verb and noun for the cmdlet name.
  [Cmdlet(VerbsCommunications.Send, "GreetingInvoke")]
  public class SendGreetingInvokeCommand : Cmdlet
  {
    // Declare the parameters for the cmdlet.
    [Parameter(Mandatory = true)]
    public string Name { get; set; }

    // Override the BeginProcessing method to invoke
    // the Get-Process cmdlet.
    protected override void BeginProcessing()
    {
      GetProcessCommand gp = new GetProcessCommand();
```

```
        gp.Name = new string[] { "[a-t]*" };
        foreach (Process p in gp.Invoke<Process>())
        {
          WriteVerbose(p.ToString());
        }
      }

      // Override the ProcessRecord method to process
      // the supplied user name and write out a
      // greeting to the user by calling the WriteObject
      // method.
      protected override void ProcessRecord()
      {
        WriteObject("Hello " + Name + "!");
      }
    }
}
```

See Also

Writing a Windows PowerShell Cmdlet

How to invoke a PSCmdlet from within a PSCmdlet

Article • 10/20/2022

This example shows how to invoke a script based cmdlet or binary cmdlet inheriting from `[System.Management.Automation.PSCmdlet]` from within a binary cmdlet. In this example, the new cmdlet `Get-ClipboardReverse` calls `Get-Clipboard` to get the contents of the clipboard. The `Get-ClipboardReverse` reverses the order of the characters and returns the reversed string.

> **Note**
>
> The `[PSCmdlet]` class differs from the `[Cmdlet]` class. `[PSCmdlet]` implementations use runspace context information so you must invoke another cmdlet using the PowerShell pipeline API. In `[Cmdlet]` implementations you can call the cmdlet's .NET API directly. For an example, see **How to invoke a Cmdlet from within a Cmdlet**.

To invoke a cmdlet from within a PSCmdlet

1. Ensure that the namespace for the `[System.Management.Automation.PowerShell]` API is referenced. In this example, the following namespaces are added.

   C#

   ```
   using System.Management.Automation;   // PowerShell assembly.
   using System.Text;
   ```

2. To invoke a command from within another binary cmdlet you must use the `[PowerShell]` API to construct a new pipeline and add the cmdlet to be invoked. Call the System.Management.Automation.PowerShell.Invoke<T>() method to invoke the pipeline.

   C#

   ```
   using var ps = PowerShell.Create(RunspaceMode.CurrentRunspace);
   ps.AddCommand("Get-Clipboard").AddParameter("Raw");
   var output = ps.Invoke<string>();
   ```

Example

To invoke a script based cmdlet or binary cmdlet inheriting from `[PSCmdlet]` you must build a PowerShell pipeline with the command and parameters you want to execute, then invoke the pipeline.

C#

```
using System;
using System.Management.Automation;   // PowerShell assembly.
using System.Text;

namespace ClipboardReverse
{
    [Cmdlet(VerbsCommon.Get,"ClipboardReverse")]
    [OutputType(typeof(string))]
    public class ClipboardReverse : PSCmdlet
    {
        protected override void EndProcessing()
        {
            using var ps = PowerShell.Create(RunspaceMode.CurrentRunspace);
            ps.AddCommand("Get-Clipboard").AddParameter("Raw");
            var output = ps.Invoke<string>();
            if (ps.HadErrors)
            {
                WriteError(new ErrorRecord(ps.Streams.Error[0].Exception,
                           "Get-Clipboard Error",
ErrorCategory.NotSpecified, null));
            }
            else
            {
                var sb = new StringBuilder();
                foreach (var text in output)
                {
                    sb.Append(text);
                }

                var reversed = sb.ToString().ToCharArray();
                Array.Reverse(reversed);
                WriteObject(new string(reversed));
            }
        }
    }
}
```

See Also

Writing a Windows PowerShell Cmdlet

Tutorials for Writing Cmdlets

Article • 09/17/2021

This section contains tutorials for writing cmdlets. These tutorials include the code needed to write the cmdlets, plus an explanation of why the code is needed. These topics will be very helpful for those who are just starting to write cmdlets.

> **ⓘ Important**
>
> For those who want code examples with less description, see **Cmdlet Samples**.

In This Section

GetProc Tutorial - This tutorial describes how to define a cmdlet class and add basic functionality such as adding parameters and reporting errors. The cmdlet described in this tutorial is very similar to the Get-Process cmdlet provided by Windows PowerShell.

StopProc Tutorial - This tutorial describes how to define a cmdlet and add functionality such as user prompts, wildcard support, and the use of parameter sets. The cmdlet described here performs the same task as the Stop-Process cmdlet provided by Windows PowerShell.

SelectStr Tutorial - This tutorial describes how to define a cmdlet that accesses a data store. The cmdlet described here performs the same task as the Select-String cmdlet provided by Windows PowerShell.

See Also

GetProc Tutorial

StopProc Tutorial

SelectStr Tutorial

Windows PowerShell SDK

GetProc Tutorial

Article • 09/17/2021

This section provides a tutorial for creating a Get-Proc cmdlet that is very similar to the Get-Process cmdlet provided by Windows PowerShell. This tutorial provides fragments of code that illustrate how cmdlets are implemented, and an explanation of the code.

Topics in this Tutorial

The topics in this tutorial are designed to be read sequentially, with each topic building on what was discussed in the previous topic.

Creating a Cmdlet without Parameters This section describes how to create a cmdlet that retrieves information from the local computer without the use of parameters, and then writes the information to the pipeline.

Adding Parameters that Process Command-Line Input This section describes how to add a parameter to the Get-Proc cmdlet so that the cmdlet can process input based on explicit objects passed to the cmdlet. The implementation described here retrieves processes based on their name, and then writes the information to the pipeline.

Adding Parameters that Process Pipeline Input This section describes how to add a parameter to the Get-Proc cmdlet so that the cmdlet can process objects passed to it through the pipeline. The implementation cmdlet described here retrieves processes based on objects passed to the cmdlet, and then writes the information to the pipeline.

Adding Nonterminating Error Reporting to Your Cmdlet This section describes how to add nonterminating error reporting to a cmdlet. The implementation described here detects nonterminating errors that occur when processing input, and writes an error record to the error stream.

See Also

Creating a Cmdlet without Parameters

Adding Parameters that Process Command-Line Input

Adding Parameters that Process Pipeline Input

Adding Nonterminating Error Reporting to Your Cmdlet

Windows PowerShell SDK

Creating a Cmdlet without Parameters

Article • 09/17/2021

This section describes how to create a cmdlet that retrieves information from the local computer without the use of parameters, and then writes the information to the pipeline. The cmdlet described here is a Get-Proc cmdlet that retrieves information about the processes of the local computer, and then displays that information at the command line.

> **Note**
>
> Be aware that when writing cmdlets, the Windows PowerShell® reference assemblies are downloaded onto disk (by default at C:\Program Files\Reference Assemblies\Microsoft\WindowsPowerShell\v1.0). They are not installed in the Global Assembly Cache (GAC).

Naming the Cmdlet

A cmdlet name consists of a verb that indicates the action the cmdlet takes and a noun that indicates the items that the cmdlet acts upon. Because this sample Get-Proc cmdlet retrieves process objects, it uses the verb "Get", defined by the System.Management.Automation.Verbscommon enumeration, and the noun "Proc" to indicate that the cmdlet works on process items.

When naming cmdlets, do not use any of the following characters: # , () {} [] & - /\ $; : " '<> | ? @ ` .

Choosing a Noun

You should choose a noun that is specific. It is best to use a singular noun prefixed with a shortened version of the product name. An example cmdlet name of this type is "`Get-SQLServer`".

Choosing a Verb

You should use a verb from the set of approved cmdlet verb names. For more information about the approved cmdlet verbs, see Cmdlet Verb Names.

Defining the Cmdlet Class

Once you have chosen a cmdlet name, define a .NET class to implement the cmdlet. Here is the class definition for this sample Get-Proc cmdlet:

C#

```
[Cmdlet(VerbsCommon.Get, "Proc")]
  public class GetProcCommand : Cmdlet
```

VB

```
<Cmdlet(VerbsCommon.Get, "Proc")> _
Public Class GetProcCommand
    Inherits Cmdlet
```

Notice that previous to the class definition, the System.Management.Automation.CmdletAttribute attribute, with the syntax `[Cmdlet(verb, noun, ...)]`, is used to identify this class as a cmdlet. This is the only required attribute for all cmdlets, and it allows the Windows PowerShell runtime to call them correctly. You can set attribute keywords to further declare the class if necessary. Be aware that the attribute declaration for our sample GetProcCommand class declares only the noun and verb names for the Get-Proc cmdlet.

> ⓘ **Note**
>
> For all Windows PowerShell attribute classes, the keywords that you can set correspond to properties of the attribute class.

When naming the class of the cmdlet, it is a good practice to reflect the cmdlet name in the class name. To do this, use the form "VerbNounCommand" and replace "Verb" and "Noun" with the verb and noun used in the cmdlet name. As is shown in the previous class definition, the sample Get-Proc cmdlet defines a class called GetProcCommand, which derives from the System.Management.Automation.Cmdlet base class.

> ⓘ **Important**
>
> If you want to define a cmdlet that accesses the Windows PowerShell runtime directly, your .NET class should derive from the **System.Management.Automation.PSCmdlet** base class. For more information about this class, see **Creating a Cmdlet that Defines Parameter Sets**.

> **Note**
>
> The class for a cmdlet must be explicitly marked as public. Classes that are not marked as public will default to internal and will not be found by the Windows PowerShell runtime.

Windows PowerShell uses the Microsoft.PowerShell.Commands namespace for its cmdlet classes. It is recommended to place your cmdlet classes in a Commands namespace of your API namespace, for example, xxx.PS.Commands.

Overriding an Input Processing Method

The System.Management.Automation.Cmdlet class provides three main input processing methods, at least one of which your cmdlet must override. For more information about how Windows PowerShell processes records, see How Windows PowerShell Works.

For all types of input, the Windows PowerShell runtime calls System.Management.Automation.Cmdlet.BeginProcessing to enable processing. If your cmdlet must perform some preprocessing or setup, it can do this by overriding this method.

> **Note**
>
> Windows PowerShell uses the term "record" to describe the set of parameter values supplied when a cmdlet is called.

If your cmdlet accepts pipeline input, it must override the System.Management.Automation.Cmdlet.ProcessRecord method, and optionally the System.Management.Automation.Cmdlet.EndProcessing method. For example, a cmdlet might override both methods if it gathers all input using System.Management.Automation.Cmdlet.ProcessRecord and then operates on the input as a whole rather than one element at a time, as the `Sort-Object` cmdlet does.

If your cmdlet does not take pipeline input, it should override the System.Management.Automation.Cmdlet.EndProcessing method. Be aware that this method is frequently used in place of System.Management.Automation.Cmdlet.BeginProcessing when the cmdlet cannot operate on one element at a time, as is the case for a sorting cmdlet.

Because this sample Get-Proc cmdlet must receive pipeline input, it overrides the System.Management.Automation.Cmdlet.ProcessRecord method and uses the default implementations for System.Management.Automation.Cmdlet.BeginProcessing and System.Management.Automation.Cmdlet.EndProcessing. The System.Management.Automation.Cmdlet.ProcessRecord override retrieves processes and writes them to the command line using the System.Management.Automation.Cmdlet.WriteObject method.

C#

```
protected override void ProcessRecord()
{
  // Get the current processes
  Process[] processes = Process.GetProcesses();

  // Write the processes to the pipeline making them available
  // to the next cmdlet. The second parameter of this call tells
  // PowerShell to enumerate the array, and send one process at a
  // time to the pipeline.
  WriteObject(processes, true);
}
```

VB

```
Protected Overrides Sub ProcessRecord()

    '/ Get the current processes.
    Dim processes As Process()
    processes = Process.GetProcesses()

    '/ Write the processes to the pipeline making them available
    '/ to the next cmdlet. The second parameter of this call tells
    '/ PowerShell to enumerate the array, and send one process at a
    '/ time to the pipeline.
    WriteObject(processes, True)

End Sub 'ProcessRecord
```

Things to Remember About Input Processing

- The default source for input is an explicit object (for example, a string) provided by the user on the command line. For more information, see Creating a Cmdlet to Process Command Line Input.
- An input processing method can also receive input from the output object of an upstream cmdlet on the pipeline. For more information, see Creating a Cmdlet to

Process Pipeline Input. Be aware that your cmdlet can receive input from a combination of command-line and pipeline sources.

- The downstream cmdlet might not return for a long time, or not at all. For that reason, the input processing method in your cmdlet should not hold locks during calls to System.Management.Automation.Cmdlet.WriteObject, especially locks for which the scope extends beyond the cmdlet instance.

> **Important**
>
> Cmdlets should never call **System.Console.Writeline*** or its equivalent.

- Your cmdlet might have object variables to clean up when it is finished processing (for example, if it opens a file handle in the System.Management.Automation.Cmdlet.BeginProcessing method and keeps the handle open for use by System.Management.Automation.Cmdlet.ProcessRecord). It is important to remember that the Windows PowerShell runtime does not always call the System.Management.Automation.Cmdlet.EndProcessing method, which should perform object cleanup.

For example, System.Management.Automation.Cmdlet.EndProcessing might not be called if the cmdlet is canceled midway or if a terminating error occurs in any part of the cmdlet. Therefore, a cmdlet that requires object cleanup should implement the complete System.IDisposable pattern, including the finalizer, so that the runtime can call both System.Management.Automation.Cmdlet.EndProcessing and System.IDisposable.Dispose* at the end of processing.

Code Sample

For the complete C# sample code, see GetProcessSample01 Sample.

Defining Object Types and Formatting

Windows PowerShell passes information between cmdlets using .NET objects. Consequently, a cmdlet might need to define its own type, or the cmdlet might need to extend an existing type provided by another cmdlet. For more information about defining new types or extending existing types, see Extending Object Types and Formatting.

Building the Cmdlet

After implementing a cmdlet, you must register it with Windows PowerShell through a Windows PowerShell snap-in. For more information about registering cmdlets, see How to Register Cmdlets, Providers, and Host Applications.

Testing the Cmdlet

When your cmdlet has been registered with Windows PowerShell, you can test it by running it on the command line. The code for our sample Get-Proc cmdlet is small, but it still uses the Windows PowerShell runtime and an existing .NET object, which is enough to make it useful. Let's test it to better understand what Get-Proc can do and how its output can be used. For more information about using cmdlets from the command line, see the Getting Started with Windows PowerShell.

1. Start Windows PowerShell, and get the current processes running on the computer.

   PowerShell

   ```
   get-proc
   ```

   The following output appears.

   Output

   ```
   Handles  NPM(K)  PM(K)  WS(K)  VS(M)  CPU(s)  Id   ProcessName
   -------  ------  -----  -----  -----  ------  --   -----------
   254      7       7664   12048  66     173.75  1200  QCTRAY
   32       2       1372   2628   31       0.04  1860  DLG
   271      6       1216   3688   33       0.03  3816  lg
   27       2       560    1920   24       0.01  1768  TpScrex
   ...
   ```

2. Assign a variable to the cmdlet results for easier manipulation.

   PowerShell

   ```
   $p=get-proc
   ```

3. Get the number of processes.

   PowerShell

   ```
   $p.length
   ```

The following output appears.

Output

```
63
```

4. Retrieve a specific process.

PowerShell

```
$p[6]
```

The following output appears.

Output

```
Handles  NPM(K)  PM(K)  WS(K)  VS(M)  CPU(s)  Id    ProcessName
-------  ------  -----  -----  -----  ------  --    -----------
1033     3       2400   3336   35     0.53    1588  rundll32
```

5. Get the start time of this process.

PowerShell

```
$p[6].starttime
```

The following output appears.

Output

```
Tuesday, July 26, 2005 9:34:15 AM
```

PowerShell

```
$p[6].starttime.dayofyear
```

Output

```
207
```

6. Get the processes for which the handle count is greater than 500, and sort the result.

```
```

PowerShell

```
$p | Where-Object {$_.HandleCount -gt 500 } | Sort-Object HandleCount
```

The following output appears.

Output

```
Handles  NPM(K)  PM(K)  WS(K)  VS(M)  CPU(s)  Id   ProcessName
-------  ------  -----  -----  -----  ------  --   -----------
568      14      2164   4972   39      5.55    824  svchost
716       7      2080   5332   28     25.38    468  csrss
761      21      33060  56608  440   393.56    3300 WINWORD
791      71      7412   4540   59      3.31    492  winlogon
...
```

7. Use the `Get-Member` cmdlet to list the properties available for each process.

PowerShell

```
$p | Get-Member -MemberType property
```

Output

```
    TypeName: System.Diagnostics.Process
```

The following output appears.

Output

```
Name                       MemberType Definition
----                       ---------- ----------
BasePriority               Property   System.Int32 BasePriority {get;}
Container                  Property   System.ComponentModel.IContainer
Conta...
EnableRaisingEvents        Property   System.Boolean EnableRaisingEvents
{ge...
...
```

See Also

Creating a Cmdlet to Process Command Line Input

Creating a Cmdlet to Process Pipeline Input

How to Create a Windows PowerShell Cmdlet

Extending Object Types and Formatting

How Windows PowerShell Works

How to Register Cmdlets, Providers, and Host Applications

Windows PowerShell Reference

Cmdlet Samples

Adding Parameters That Process Command-Line Input

Article • 09/17/2021

One source of input for a cmdlet is the command line. This topic describes how to add a parameter to the `Get-Proc` cmdlet (which is described in Creating Your First Cmdlet) so that the cmdlet can process input from the local computer based on explicit objects passed to the cmdlet. The `Get-Proc` cmdlet described here retrieves processes based on their names, and then displays information about the processes at a command prompt.

Defining the Cmdlet Class

The first step in cmdlet creation is cmdlet naming and the declaration of the .NET Framework class that implements the cmdlet. This cmdlet retrieves process information, so the verb name chosen here is "Get." (Almost any sort of cmdlet that is capable of retrieving information can process command-line input.) For more information about approved cmdlet verbs, see Cmdlet Verb Names.

Here's the class declaration for the `Get-Proc` cmdlet. Details about this definition are provided in Creating Your First Cmdlet.

C#

```
[Cmdlet(VerbsCommon.Get, "proc")]
public class GetProcCommand: Cmdlet
```

VB

```
<Cmdlet(VerbsCommon.Get, "Proc")> _
Public Class GetProcCommand
    Inherits Cmdlet
```

Declaring Parameters

A cmdlet parameter enables the user to provide input to the cmdlet. In the following example, `Get-Proc` and `Get-Member` are the names of pipelined cmdlets, and `MemberType` is a parameter for the `Get-Member` cmdlet. The parameter has the argument "property."

PS> get-proc ; `get-member` -membertype property

To declare parameters for a cmdlet, you must first define the properties that represent the parameters. In the `Get-Proc` cmdlet, the only parameter is `Name`, which in this case represents the name of the .NET Framework process object to retrieve. Therefore, the cmdlet class defines a property of type string to accept an array of names.

Here's the parameter declaration for the `Name` parameter of the `Get-Proc` cmdlet.

C#

```
/// <summary>
/// Specify the cmdlet Name parameter.
/// </summary>
  [Parameter(Position = 0)]
  [ValidateNotNullOrEmpty]
  public string[] Name
  {
    get { return processNames; }
    set { processNames = value; }
  }
  private string[] processNames;

  #endregion Parameters
```

VB

```
<Parameter(Position:=0), ValidateNotNullOrEmpty()> _
Public Property Name() As String()
    Get
        Return processNames
    End Get

    Set(ByVal value As String())
        processNames = value
    End Set

End Property
```

To inform the Windows PowerShell runtime that this property is the `Name` parameter, a System.Management.Automation.Parameterattribute attribute is added to the property definition. The basic syntax for declaring this attribute is `[Parameter()]`.

> **Note**
>
> A parameter must be explicitly marked as public. Parameters that are not marked as public default to internal and are not found by the Windows PowerShell runtime.

This cmdlet uses an array of strings for the `Name` parameter. If possible, your cmdlet should also define a parameter as an array, because this allows the cmdlet to accept more than one item.

Things to Remember About Parameter Definitions

- Predefined Windows PowerShell parameter names and data types should be reused as much as possible to ensure that your cmdlet is compatible with Windows PowerShell cmdlets. For example, if all cmdlets use the predefined `Id` parameter name to identify a resource, user will easily understand the meaning of the parameter, regardless of what cmdlet they are using. Basically, parameter names follow the same rules as those used for variable names in the common language runtime (CLR). For more information about parameter naming, see Cmdlet Parameter Names.

- Windows PowerShell reserves a few parameter names to provide a consistent user experience. Do not use these parameter names: `WhatIf`, `Confirm`, `Verbose`, `Debug`, `Warn`, `ErrorAction`, `ErrorVariable`, `OutVariable`, and `OutBuffer`. Additionally, the following aliases for these parameter names are reserved: `vb`, `db`, `ea`, `ev`, `ov`, and `ob`.

- `Name` is a simple and common parameter name, recommended for use in your cmdlets. It is better to choose a parameter name like this than a complex name that is unique to a specific cmdlet and hard to remember.

- Parameters are case-insensitive in Windows PowerShell, although by default the shell preserves case. Case-sensitivity of the arguments depends on the operation of the cmdlet. Arguments are passed to a parameter as specified at the command line.

- For examples of other parameter declarations, see Cmdlet Parameters.

Declaring Parameters as Positional or Named

A cmdlet must set each parameter as either a positional or named parameter. Both kinds of parameters accept single arguments, multiple arguments separated by commas, and Boolean settings. A Boolean parameter, also called a *switch*, handles only Boolean settings. The switch is used to determine the presence of the parameter. The recommended default is `false`.

The sample `Get-Proc` cmdlet defines the `Name` parameter as a positional parameter with position 0. This means that the first argument the user enters on the command line is automatically inserted for this parameter. If you want to define a named parameter, for which the user must specify the parameter name from the command line, leave the `Position` keyword out of the attribute declaration.

> **Note**
>
> Unless parameters must be named, we recommend that you make the most-used parameters positional so that users will not have to type the parameter name.

Declaring Parameters as Mandatory or Optional

A cmdlet must set each parameter as either an optional or a mandatory parameter. In the sample `Get-Proc` cmdlet, the `Name` parameter is defined as optional because the `Mandatory` keyword is not set in the attribute declaration.

Supporting Parameter Validation

The sample `Get-Proc` cmdlet adds an input validation attribute, System.Management.Automation.Validatenotnulloremptyattribute, to the `Name` parameter to enable validation that the input is neither `null` nor empty. This attribute is one of several validation attributes provided by Windows PowerShell. For examples of other validation attributes, see Validating Parameter Input.

```
[Parameter(Position = 0)]
[ValidateNotNullOrEmpty]
public string[] Name
```

Overriding an Input Processing Method

If your cmdlet is to handle command-line input, it must override the appropriate input processing methods. The basic input processing methods are introduced in Creating Your First Cmdlet.

The `Get-Proc` cmdlet overrides the System.Management.Automation.Cmdlet.ProcessRecord method to handle the `Name` parameter input provided by the user or a script. This method gets the processes for each requested process name, or all for processes if no name is provided. Notice that in System.Management.Automation.Cmdlet.ProcessRecord, the call to System.Management.Automation.Cmdlet.WriteObject%28System.Object%2CSystem.Boolean%29 is the output mechanism for sending output objects to the pipeline. The second parameter of this call, `enumerateCollection`, is set to `true` to inform the Windows PowerShell runtime to enumerate the output array of process objects and write one process at a time to the command line.

C#

```
protected override void ProcessRecord()
{
  // If no process names are passed to the cmdlet, get all processes.
  if (processNames == null)
  {
    // Write the processes to the pipeline making them available
    // to the next cmdlet. The second argument of this call tells
    // PowerShell to enumerate the array, and send one process at a
    // time to the pipeline.
    WriteObject(Process.GetProcesses(), true);
  }
  else
  {
    // If process names are passed to the cmdlet, get and write
    // the associated processes.
    foreach (string name in processNames)
    {
      WriteObject(Process.GetProcessesByName(name), true);
    }
  }
}
```

VB

```
Protected Overrides Sub ProcessRecord()

    '/ If no process names are passed to the cmdlet, get all processes.
    If processNames Is Nothing Then
        Dim processes As Process()
        processes = Process.GetProcesses()
    End If

    '/ If process names are specified, write the processes to the
    '/ pipeline to display them or make them available to the next cmdlet.

    For Each name As String In processNames
```

```
        '/ The second parameter of this call tells PowerShell to enumerate
the
        '/ array, and send one process at a time to the pipeline.
        WriteObject(Process.GetProcessesByName(name), True)
    Next

End Sub 'ProcessRecord
```

Code Sample

For the complete C# sample code, see GetProcessSample02 Sample.

Defining Object Types and Formatting

Windows PowerShell passes information between cmdlets by using .NET Framework objects. Consequently, a cmdlet might need to define its own type, or a cmdlet might need to extend an existing type provided by another cmdlet. For more information about defining new types or extending existing types, see Extending Object Types and Formatting.

Building the Cmdlet

After you implement a cmdlet, you must register it with Windows PowerShell by using a Windows PowerShell snap-in. For more information about registering cmdlets, see How to Register Cmdlets, Providers, and Host Applications.

Testing the Cmdlet

When your cmdlet is registered with Windows PowerShell, you can test it by running it on the command line. Here are two ways to test the code for the sample cmdlet. For more information about using cmdlets from the command line, see Getting Started with Windows PowerShell.

- At the Windows PowerShell prompt, use the following command to list the Internet Explorer process, which is named "IEXPLORE."

  PowerShell

  ```
  get-proc -name iexplore
  ```

  The following output appears.

Output

```
Handles  NPM(K)  PM(K)   WS(K)  VS(M)  CPU(s)   Id   ProcessName
-------  ------  -----   -----  -----   ------ --   -----------
    354      11  10036   18992    85   0.67   3284   iexplore
```

- To list the Internet Explorer, Outlook, and Notepad processes named "IEXPLORE," "OUTLOOK," and "NOTEPAD," use the following command. If there are multiple processes, all of them are displayed.

  PowerShell

  ```
  get-proc -name iexplore, outlook, notepad
  ```

  The following output appears.

  ```
  Handles  NPM(K)  PM(K)   WS(K)  VS(M)  CPU(s)   Id   ProcessName
  -------  ------  -----   -----  -----  ------   --   -----------
      732      21  24696    5000    138   2.25  2288   iexplore
      715      19  20556   14116    136   1.78  3860   iexplore
     3917      62  74096   58112    468 191.56  1848   OUTLOOK
       39       2   1024    3280     30   0.09  1444   notepad
       39       2   1024     356     30   0.08  3396   notepad
  ```

See Also

Adding Parameters that Process Pipeline Input

Creating Your First Cmdlet

Extending Object Types and Formatting

How to Register Cmdlets, Providers, and Host Applications

Windows PowerShell Reference

Cmdlet Samples

Adding Parameters that Process Pipeline Input

Article • 09/17/2021

One source of input for a cmdlet is an object on the pipeline that originates from an upstream cmdlet. This section describes how to add a parameter to the Get-Proc cmdlet (described in Creating Your First Cmdlet) so that the cmdlet can process pipeline objects.

This Get-Proc cmdlet uses a `Name` parameter that accepts input from a pipeline object, retrieves process information from the local computer based on the supplied names, and then displays information about the processes at the command line.

Defining the Cmdlet Class

The first step in cmdlet creation is always naming the cmdlet and declaring the .NET class that implements the cmdlet. This cmdlet retrieves process information, so the verb name chosen here is "Get". (Almost any sort of cmdlet that is capable of retrieving information can process command-line input.) For more information about approved cmdlet verbs, see Cmdlet Verb Names.

The following is the definition for this Get-Proc cmdlet. Details of this definition are given in Creating Your First Cmdlet.

C#

```
[Cmdlet(VerbsCommon.Get, "proc")]
public class GetProcCommand : Cmdlet
```

VB

```
<Cmdlet(VerbsCommon.Get, "Proc")> _
Public Class GetProcCommand
    Inherits Cmdlet
```

Defining Input from the Pipeline

This section describes how to define input from the pipeline for a cmdlet. This Get-Proc cmdlet defines a property that represents the `Name` parameter as described in Adding Parameters that Process Command Line Input. (See that topic for general information about declaring parameters.)

However, when a cmdlet needs to process pipeline input, it must have its parameters bound to input values by the Windows PowerShell runtime. To do this, you must add the `ValueFromPipeline` keyword or add the `ValueFromPipelineByProperty` keyword to the System.Management.Automation.Parameterattribute attribute declaration. Specify the `ValueFromPipeline` keyword if the cmdlet accesses the complete input object. Specify the `ValueFromPipelineByProperty` if the cmdlet accesses only a property of the object.

Here is the parameter declaration for the `Name` parameter of this Get-Proc cmdlet that accepts pipeline input.

C#

```
[Parameter(
   Position = 0,
   ValueFromPipeline = true,
   ValueFromPipelineByPropertyName = true)]
[ValidateNotNullOrEmpty]
public string[] Name
{
   get { return this.processNames; }
   set { this.processNames = value; }
}
```

VB

```
<Parameter(Position:=0, ValueFromPipeline:=True, _
ValueFromPipelineByPropertyName:=True), ValidateNotNullOrEmpty()> _
Public Property Name() As String()
    Get
        Return processNames
    End Get

    Set(ByVal value As String())
        processNames = value
    End Set

End Property
```

The previous declaration sets the `ValueFromPipeline` keyword to `true` so that the Windows PowerShell runtime will bind the parameter to the incoming object if the object is the same type as the parameter, or if it can be coerced to the same type. The `ValueFromPipelineByPropertyName` keyword is also set to `true` so that the Windows PowerShell runtime will check the incoming object for a `Name` property. If the incoming object has such a property, the runtime will bind the `Name` parameter to the `Name` property of the incoming object.

> **Note**
>
> The setting of the `ValueFromPipeline` attribute keyword for a parameter takes precedence over the setting for the `ValueFromPipelineByPropertyName` keyword.

Overriding an Input Processing Method

If your cmdlet is to handle pipeline input, it needs to override the appropriate input processing methods. The basic input processing methods are introduced in Creating Your First Cmdlet.

This Get-Proc cmdlet overrides the System.Management.Automation.Cmdlet.ProcessRecord method to handle the `Name` parameter input provided by the user or a script. This method will get the processes for each requested process name or all processes if no name is provided. Notice that within System.Management.Automation.Cmdlet.ProcessRecord, the call to WriteObject(System.Object,System.Boolean) is the output mechanism for sending output objects to the pipeline. The second parameter of this call, `enumerateCollection`, is set to `true` to tell the Windows PowerShell runtime to enumerate the array of process objects, and write one process at a time to the command line.

C#

```
protected override void ProcessRecord()
{
  // If no process names are passed to the cmdlet, get all processes.
  if (processNames == null)
  {
      // Write the processes to the pipeline making them available
      // to the next cmdlet. The second argument of this call tells
      // PowerShell to enumerate the array, and send one process at a
      // time to the pipeline.
      WriteObject(Process.GetProcesses(), true);
  }
  else
  {
    // If process names are passed to the cmdlet, get and write
    // the associated processes.
    foreach (string name in processNames)
    {
      WriteObject(Process.GetProcessesByName(name), true);
    } // End foreach (string name...).
  }
}
```

VB

```
Protected Overrides Sub ProcessRecord()
    Dim processes As Process()

    '/ If no process names are passed to the cmdlet, get all processes.
    If processNames Is Nothing Then
        processes = Process.GetProcesses()
    Else

        '/ If process names are specified, write the processes to the
        '/ pipeline to display them or make them available to the next
cmdlet.
        For Each name As String In processNames
            '/ The second parameter of this call tells PowerShell to
enumerate the
            '/ array, and send one process at a time to the pipeline.
            WriteObject(Process.GetProcessesByName(name), True)
        Next
    End If

End Sub 'ProcessRecord
```

Code Sample

For the complete C# sample code, see GetProcessSample03 Sample.

Defining Object Types and Formatting

Windows PowerShell passes information between cmdlets using .Net objects. Consequently, a cmdlet may need to define its own type, or the cmdlet may need to extend an existing type provided by another cmdlet. For more information about defining new types or extending existing types, see Extending Object Types and Formatting.

Building the Cmdlet

After implementing a cmdlet it must be registered with Windows PowerShell through a Windows PowerShell snap-in. For more information about registering cmdlets, see How to Register Cmdlets, Providers, and Host Applications.

Testing the Cmdlet

When your cmdlet has been registered with Windows PowerShell, test it by running it on the command line. For example, test the code for the sample cmdlet. For more information about using cmdlets from the command line, see the Getting Started with Windows PowerShell.

- At the Windows PowerShell prompt, enter the following commands to retrieve the process names through the pipeline.

  PowerShell

  ```
  PS> type ProcessNames | get-proc
  ```

  The following output appears.

  ```
  Handles  NPM(K)  PM(K)   WS(K)  VS(M)  CPU(s)    Id  ProcessName
  -------  ------  -----   -----  -----  ------    --  -----------
      809      21  40856    4448    147    9.50  2288  iexplore
      737      21  26036   16348    144   22.03  3860  iexplore
       39       2   1024     388     30    0.08  3396  notepad
     3927      62  71836   26984    467  195.19  1848  OUTLOOK
  ```

- Enter the following lines to get the process objects that have a `Name` property from the processes called "IEXPLORE". This example uses the `Get-Process` cmdlet (provided by Windows PowerShell) as an upstream command to retrieve the "IEXPLORE" processes.

  PowerShell

  ```
  PS> get-process iexplore | get-proc
  ```

  The following output appears.

  ```
  Handles  NPM(K)  PM(K)   WS(K)  VS(M)  CPU(s)    Id  ProcessName
  -------  ------  -----   -----  -----  ------    --  -----------
      801      21  40720    6544    142    9.52  2288  iexplore
      726      21  25872   16652    138   22.09  3860  iexplore
      801      21  40720    6544    142    9.52  2288  iexplore
      726      21  25872   16652    138   22.09  3860  iexplore
  ```

See Also

Adding Parameters that Process Command Line Input

Creating Your First Cmdlet

Extending Object Types and Formatting

How to Register Cmdlets, Providers, and Host Applications

Windows PowerShell Reference

Cmdlet Samples

Adding Non-Terminating Error Reporting to Your Cmdlet

Article • 09/17/2021

Cmdlets can report nonterminating errors by calling the System.Management.Automation.Cmdlet.WriteError method and still continue to operate on the current input object or on further incoming pipeline objects. This section explains how to create a cmdlet that reports nonterminating errors from its input processing methods.

For nonterminating errors (as well as terminating errors), the cmdlet must pass an System.Management.Automation.ErrorRecord object identifying the error. Each error record is identified by a unique string called the "error identifier". In addition to the identifier, the category of each error is specified by constants defined by a System.Management.Automation.ErrorCategory enumeration. The user can view errors based on their category by setting the `$ErrorView` variable to "CategoryView".

For more information about error records, see Windows PowerShell Error Records.

Defining the Cmdlet

The first step in cmdlet creation is always naming the cmdlet and declaring the .NET class that implements the cmdlet. This cmdlet retrieves process information, so the verb name chosen here is "Get". (Almost any sort of cmdlet that is capable of retrieving information can process command-line input.) For more information about approved cmdlet verbs, see Cmdlet Verb Names.

The following is the definition for this `Get-Proc` cmdlet. Details of this definition are given in Creating Your First Cmdlet.

C#

```
[Cmdlet(VerbsCommon.Get, "proc")]
public class GetProcCommand: Cmdlet
```

VB

```
<Cmdlet(VerbsCommon.Get, "Proc")> _
Public Class GetProcCommand
    Inherits Cmdlet
```

Defining Parameters

If necessary, your cmdlet must define parameters for processing input. This Get-Proc cmdlet defines a **Name** parameter as described in Adding Parameters that Process Command-Line Input.

Here is the parameter declaration for the **Name** parameter of this Get-Proc cmdlet.

C#

```
[Parameter(
           Position = 0,
           ValueFromPipeline = true,
           ValueFromPipelineByPropertyName = true
)]
[ValidateNotNullOrEmpty]
public string[] Name
{
  get { return processNames; }
  set { processNames = value; }
}
private string[] processNames;
```

VB

```
<Parameter(Position:=0, ValueFromPipeline:=True, _
ValueFromPipelineByPropertyName:=True), ValidateNotNullOrEmpty()> _
Public Property Name() As String()
    Get
        Return processNames
    End Get

    Set(ByVal value As String())
        processNames = value
    End Set

End Property
```

Overriding Input Processing Methods

All cmdlets must override at least one of the input processing methods provided by the System.Management.Automation.Cmdlet class. These methods are discussed in Creating Your First Cmdlet.

> ⓘ **Note**

Your cmdlet should handle each record as independently as possible.

This Get-Proc cmdlet overrides the System.Management.Automation.Cmdlet.ProcessRecord method to handle the **Name** parameter for input provided by the user or a script. This method will get the processes for each requested process name or all processes if no name is provided. Details of this override are given in Creating Your First Cmdlet.

Things to Remember When Reporting Errors

The System.Management.Automation.ErrorRecord object that the cmdlet passes when writing an error requires an exception at its core. Follow the .NET guidelines when determining the exception to use. Basically, if the error is semantically the same as an existing exception, the cmdlet should use or derive from that exception. Otherwise, it should derive a new exception or exception hierarchy directly from the System.Exception class.

When creating error identifiers (accessed through the FullyQualifiedErrorId property of the ErrorRecord class) keep the following in mind.

- Use strings that are targeted for diagnostic purposes so that when inspecting the fully qualified identifier you can determine what the error is and where the error came from.
- A well formed fully qualified error identifier might be as follows.

  ```
  CommandNotFoundException,Microsoft.PowerShell.Commands.GetCommandCommand
  ```

Notice that in the previous example, the error identifier (the first token) designates what the error is and the remaining part indicates where the error came from.

- For more complex scenarios, the error identifier can be a dot separated token that can be parsed on inspection. This allows you too branch on the parts of the error identifier as well as the error identifier and error category.

The cmdlet should assign specific error identifiers to different code paths. Keep the following information in mind for assignment of error identifiers:

- An error identifier should remain constant throughout the cmdlet life cycle. Do not change the semantics of an error identifier between cmdlet versions.
- Use text for an error identifier that tersely corresponds to the error being reported. Do not use white space or punctuation.

- Have your cmdlet generate only error identifiers that are reproducible. For example, it should not generate an identifier that includes a process identifier. Error identifiers are useful to a user only when they correspond to identifiers that are seen by other users experiencing the same problem.

Unhandled exceptions are not caught by PowerShell in the following conditions:

- If a cmdlet creates a new thread and code running in that thread throws an unhandled exception, PowerShell will not catch the error and will terminate the process.
- If an object has code in its destructor or Dispose methods that causes an unhandled exception, PowerShell will not catch the error and will terminate the process.

Reporting Nonterminating Errors

Any one of the input processing methods can report a nonterminating error to the output stream using the System.Management.Automation.Cmdlet.WriteError method.

Here is a code example from this Get-Proc cmdlet that illustrates the call to System.Management.Automation.Cmdlet.WriteError from within the override of the System.Management.Automation.Cmdlet.ProcessRecord method. In this case, the call is made if the cmdlet cannot find a process for a specified process identifier.

C#

```
protected override void ProcessRecord()
{
  // If no name parameter passed to cmdlet, get all processes.
  if (processNames == null)
  {
    WriteObject(Process.GetProcesses(), true);
  }
    else
    {
      // If a name parameter is passed to cmdlet, get and write
      // the associated processes.
      // Write a nonterminating error for failure to retrieve
      // a process.
      foreach (string name in processNames)
      {
        Process[] processes;

        try
        {
          processes = Process.GetProcessesByName(name);
        }
```

```
        catch (InvalidOperationException ex)
        {
          WriteError(new ErrorRecord(
                     ex,
                     "NameNotFound",
                     ErrorCategory.InvalidOperation,
                     name));
          continue;
        }

        WriteObject(processes, true);
      } // foreach (...
    } // else
  }
```

Things to Remember About Writing Nonterminating Errors

For a nonterminating error, the cmdlet must generate a specific error identifier for each specific input object.

A cmdlet frequently needs to modify the PowerShell action produced by a nonterminating error. It can do this by defining the `ErrorAction` and `ErrorVariable` parameters. If defining the `ErrorAction` parameter, the cmdlet presents the user options System.Management.Automation.ActionPreference, you can also directly influence the action by setting the `$ErrorActionPreference` variable.

The cmdlet can save nonterminating errors to a variable using the `ErrorVariable` parameter, which is not affected by the setting of `ErrorAction`. Failures can be appended to an existing error variable by adding a plus sign (+) to the front of the variable name.

Code Sample

For the complete C# sample code, see GetProcessSample04 Sample.

Define Object Types and Formatting

PowerShell passes information between cmdlets using .NET objects. Consequently, a cmdlet might need to define its own type, or the cmdlet might need to extend an existing type provided by another cmdlet. For more information about defining new types or extending existing types, see Extending Object Types and Formatting.

Building the Cmdlet

After implementing a cmdlet, you must register it with Windows PowerShell through a Windows PowerShell snap-in. For more information about registering cmdlets, see How to Register Cmdlets, Providers, and Host Applications.

Testing the Cmdlet

When your cmdlet has been registered with PowerShell, you can test it by running it on the command line. Let's test the sample Get-Proc cmdlet to see whether it reports an error:

- Start PowerShell, and use the Get-Proc cmdlet to retrieve the processes named "TEST".

  PowerShell

  ```
  get-proc -name test
  ```

  The following output appears.

  ```
  get-proc : Operation is not valid due to the current state of the
  object.
  At line:1 char:9
  + get-proc  <<<< -name test
  ```

See Also

Adding Parameters that Process Pipeline Input

Adding Parameters that Process Command-Line Input

Creating Your First Cmdlet

Extending Object Types and Formatting

How to Register Cmdlets, Providers, and Host Applications

Windows PowerShell Reference

Cmdlet Samples

StopProc Tutorial

Article • 09/17/2021

This section provides a tutorial for creating the Stop-Proc cmdlet, which is very similar to the Stop-Process cmdlet provided by Windows PowerShell. This tutorial provides fragments of code that illustrate how cmdlets are implemented, and an explanation of the code.

Topics in this Tutorial

The topics in this tutorial are designed to be read sequentially, with each topic building on what was discussed in the previous topic.

Creating a Cmdlet that Modifies the System This section describes how to create a cmdlet that supports system modifications, such as stopping a process running on the computer.

Adding User Messages to Your Cmdlet This section describes how to add the ability to write user messages, debug messages, warning messages, and progress information to your cmdlet.

Adding Aliases, Wildcard Expansion, and Help to Cmdlet Parameters This section describes how to create a cmdlet that supports parameter aliases, Help, and wildcard expansion.

Adding Parameter Sets to Cmdlets This section describes how to add parameter sets to a cmdlet. Parameter sets allow the cmdlet to operate differently based on what parameters are specified by the user.

See Also

Creating a Cmdlet that Modifies the System

Adding User Messages to Your Cmdlet

Adding Aliases, Wildcard Expansion, and Help to Cmdlet Parameters

Adding Parameter Sets to Cmdlets

Windows PowerShell SDK

Creating a Cmdlet that Modifies the System

Article • 09/17/2021

Sometimes a cmdlet must modify the running state of the system, not just the state of the Windows PowerShell runtime. In these cases, the cmdlet should allow the user a chance to confirm whether or not to make the change.

To support confirmation a cmdlet must do two things.

- Declare that the cmdlet supports confirmation when you specify the System.Management.Automation.CmdletAttribute attribute by setting the SupportsShouldProcess keyword to `true`.
- Call System.Management.Automation.Cmdlet.ShouldProcess during the execution of the cmdlet (as shown in the following example).

By supporting confirmation, a cmdlet exposes the `Confirm` and `WhatIf` parameters that are provided by Windows PowerShell, and also meets the development guidelines for cmdlets (For more information about cmdlet development guidelines, see Cmdlet Development Guidelines.).

Changing the System

The act of "changing the system" refers to any cmdlet that potentially changes the state of the system outside Windows PowerShell. For example, stopping a process, enabling or disabling a user account, or adding a row to a database table are all changes to the system that should be confirmed. In contrast, operations that read data or establish transient connections do not change the system and generally do not require confirmation. Confirmation is also not needed for actions whose effect is limited to inside the Windows PowerShell runtime, such as `set-variable`. Cmdlets that might or might not make a persistent change should declare `SupportsShouldProcess` and call System.Management.Automation.Cmdlet.ShouldProcess only if they are about to make a persistent change.

> **Note**
>
> ShouldProcess confirmation applies only to cmdlets. If a command or script modifies the running state of a system by directly calling .NET methods or

properties, or by calling applications outside of Windows PowerShell, this form of confirmation will not be available.

The StopProc Cmdlet

This topic describes a Stop-Proc cmdlet that attempts to stop processes that are retrieved using the Get-Proc cmdlet (described in Creating Your First Cmdlet).

Defining the Cmdlet

The first step in cmdlet creation is always naming the cmdlet and declaring the .NET class that implements the cmdlet. Because you are writing a cmdlet to change the system, it should be named accordingly. This cmdlet stops system processes, so the verb name chosen here is "Stop", defined by the System.Management.Automation.Verbslifecycle class, with the noun "Proc" to indicate that the cmdlet stops processes. For more information about approved cmdlet verbs, see Cmdlet Verb Names.

The following is the class definition for this Stop-Proc cmdlet.

C#

```
[Cmdlet(VerbsLifecycle.Stop, "Proc",
        SupportsShouldProcess = true)]
public class StopProcCommand : Cmdlet
```

Be aware that in the System.Management.Automation.CmdletAttribute declaration, the `SupportsShouldProcess` attribute keyword is set to `true` to enable the cmdlet to make calls to System.Management.Automation.Cmdlet.ShouldProcess and System.Management.Automation.Cmdlet.ShouldContinue. Without this keyword set, the `Confirm` and `WhatIf` parameters will not be available to the user.

Extremely Destructive Actions

Some operations are extremely destructive, such as reformatting an active hard disk partition. In these cases, the cmdlet should set `ConfirmImpact` = `ConfirmImpact.High` when declaring the System.Management.Automation.CmdletAttribute attribute. This setting forces the cmdlet to request user confirmation even when the user has not specified the `Confirm` parameter. However, cmdlet developers should avoid overusing `ConfirmImpact` for operations that are just potentially destructive, such as deleting a

user account. Remember that if `ConfirmImpact` is set to System.Management.Automation.ConfirmImpact **High**.

Similarly, some operations are unlikely to be destructive, although they do in theory modify the running state of a system outside Windows PowerShell. Such cmdlets can set `ConfirmImpact` to System.Management.Automation.Confirmimpact.Low. This will bypass confirmation requests where the user has asked to confirm only medium-impact and high-impact operations.

Defining Parameters for System Modification

This section describes how to define the cmdlet parameters, including those that are needed to support system modification. See Adding Parameters that Process CommandLine Input if you need general information about defining parameters.

The Stop-Proc cmdlet defines three parameters: `Name`, `Force`, and `PassThru`.

The `Name` parameter corresponds to the `Name` property of the process input object. Be aware that the `Name` parameter in this sample is mandatory, as the cmdlet will fail if it does not have a named process to stop.

The `Force` parameter allows the user to override calls to System.Management.Automation.Cmdlet.ShouldContinue. In fact, any cmdlet that calls System.Management.Automation.Cmdlet.ShouldContinue should have a `Force` parameter so that when `Force` is specified, the cmdlet skips the call to System.Management.Automation.Cmdlet.ShouldContinue and proceeds with the operation. Be aware that this does not affect calls to System.Management.Automation.Cmdlet.ShouldProcess.

The `PassThru` parameter allows the user to indicate whether the cmdlet passes an output object through the pipeline, in this case, after a process is stopped. Be aware that this parameter is tied to the cmdlet itself instead of to a property of the input object.

Here is the parameter declaration for the Stop-Proc cmdlet.

C#

```
[Parameter(
           Position = 0,
           Mandatory = true,
           ValueFromPipeline = true,
           ValueFromPipelineByPropertyName = true
)]
public string[] Name
```

```
{
  get { return processNames; }
  set { processNames = value; }
}
private string[] processNames;

/// <summary>
/// Specify the Force parameter that allows the user to override
/// the ShouldContinue call to force the stop operation. This
/// parameter should always be used with caution.
/// </summary>
[Parameter]
public SwitchParameter Force
{
  get { return force; }
  set { force = value; }
}
private bool force;

/// <summary>
/// Specify the PassThru parameter that allows the user to specify
/// that the cmdlet should pass the process object down the pipeline
/// after the process has been stopped.
/// </summary>
[Parameter]
public SwitchParameter PassThru
{
  get { return passThru; }
  set { passThru = value; }
}
private bool passThru;
```

Overriding an Input Processing Method

The cmdlet must override an input processing method. The following code illustrates the System.Management.Automation.Cmdlet.ProcessRecord override used in the sample Stop-Proc cmdlet. For each requested process name, this method ensures that the process is not a special process, tries to stop the process, and then sends an output object if the `PassThru` parameter is specified.

C#

```
protected override void ProcessRecord()
{
  foreach (string name in processNames)
  {
    // For every process name passed to the cmdlet, get the associated
    // process(es). For failures, write a non-terminating error
    Process[] processes;
```

```
    try
    {
      processes = Process.GetProcessesByName(name);
    }
    catch (InvalidOperationException ioe)
    {
      WriteError(new ErrorRecord(ioe,"Unable to access the target process by
name",
                 ErrorCategory.InvalidOperation, name));
      continue;
    }

    // Try to stop the process(es) that have been retrieved for a name
    foreach (Process process in processes)
    {
      string processName;

      try
      {
        processName = process.ProcessName;
      }

      catch (Win32Exception e)
        {
          WriteError(new ErrorRecord(e, "ProcessNameNotFound",
                     ErrorCategory.ReadError, process));
          continue;
        }

        // Call Should Process to confirm the operation first.
        // This is always false if WhatIf is set.
        if (!ShouldProcess(string.Format("{0} ({1})", processName,
                           process.Id)))
        {
          continue;
        }
        // Call ShouldContinue to make sure the user really does want
        // to stop a critical process that could possibly stop the computer.
        bool criticalProcess =
             criticalProcessNames.Contains(processName.ToLower());

        if (criticalProcess &&!force)
        {
          string message = String.Format
                ("The process \"{0}\" is a critical process and should not
be stopped. Are you sure you wish to stop the process?",
                processName);

          // It is possible that ProcessRecord is called multiple times
          // when the Name parameter receives objects as input from the
          // pipeline. So to retain YesToAll and NoToAll input that the
          // user may enter across multiple calls to ProcessRecord, this
          // information is stored as private members of the cmdlet.
          if (!ShouldContinue(message, "Warning!",
                              ref yesToAll,
```

```
                                ref noToAll))
          {
            continue;
          }
        } // if (criticalProcess...
        // Stop the named process.
        try
        {
          process.Kill();
        }
        catch (Exception e)
        {
          if ((e is Win32Exception) || (e is SystemException) ||
              (e is InvalidOperationException))
          {
            // This process could not be stopped so write
            // a non-terminating error.
            string message = String.Format("{0} {1} {2}",
                            "Could not stop process \"", processName,
                            "\".");
            WriteError(new ErrorRecord(e, message,
                       ErrorCategory.CloseError, process));
                       continue;
          } // if ((e is...
          else throw;
        } // catch

        // If the PassThru parameter argument is
        // True, pass the terminated process on.
        if (passThru)
        {
          WriteObject(process);
        }
    } // foreach (Process...
  } // foreach (string...
} // ProcessRecord
```

Calling the ShouldProcess Method

The input processing method of your cmdlet should call the System.Management.Automation.Cmdlet.ShouldProcess method to confirm execution of an operation before a change (for example, deleting files) is made to the running state of the system. This allows the Windows PowerShell runtime to supply the correct "WhatIf" and "Confirm" behavior within the shell.

> **Note**
>
> If a cmdlet states that it supports should process and fails to make the **System.Management.Automation.Cmdlet.ShouldProcess** call, the user might

modify the system unexpectedly.

The call to System.Management.Automation.Cmdlet.ShouldProcess sends the name of the resource to be changed to the user, with the Windows PowerShell runtime taking into account any command-line settings or preference variables in determining what should be displayed to the user.

The following example shows the call to System.Management.Automation.Cmdlet.ShouldProcess from the override of the System.Management.Automation.Cmdlet.ProcessRecord method in the sample Stop-Proc cmdlet.

C#

```
if (!ShouldProcess(string.Format("{0} ({1})", processName,
                   process.Id)))
{
  continue;
}
```

Calling the ShouldContinue Method

The call to the System.Management.Automation.Cmdlet.ShouldContinue method sends a secondary message to the user. This call is made after the call to System.Management.Automation.Cmdlet.ShouldProcess returns `true` and if the `Force` parameter was not set to `true`. The user can then provide feedback to say whether the operation should be continued. Your cmdlet calls System.Management.Automation.Cmdlet.ShouldContinue as an additional check for potentially dangerous system modifications or when you want to provide yes-to-all and no-to-all options to the user.

The following example shows the call to System.Management.Automation.Cmdlet.ShouldContinue from the override of the System.Management.Automation.Cmdlet.ProcessRecord method in the sample Stop-Proc cmdlet.

C#

```
if (criticalProcess &&!force)
{
  string message = String.Format
        ("The process \"{0}\" is a critical process and should not be
stopped. Are you sure you wish to stop the process?",
        processName);
```

```
    // It is possible that ProcessRecord is called multiple times
    // when the Name parameter receives objects as input from the
    // pipeline. So to retain YesToAll and NoToAll input that the
    // user may enter across multiple calls to ProcessRecord, this
    // information is stored as private members of the cmdlet.
    if (!ShouldContinue(message, "Warning!",
                        ref yesToAll,
                        ref noToAll))
    {
      continue;
    }
  } // if (criticalProcess...
```

Stopping Input Processing

The input processing method of a cmdlet that makes system modifications must provide a way of stopping the processing of input. In the case of this Stop-Proc cmdlet, a call is made from the System.Management.Automation.Cmdlet.ProcessRecord method to the System.Diagnostics.Process.Kill* method. Because the `PassThru` parameter is set to `true`, System.Management.Automation.Cmdlet.ProcessRecord also calls System.Management.Automation.Cmdlet.WriteObject to send the process object to the pipeline.

Code Sample

For the complete C# sample code, see StopProcessSample01 Sample.

Defining Object Types and Formatting

Windows PowerShell passes information between cmdlets using .Net objects. Consequently, a cmdlet may need to define its own type, or the cmdlet may need to extend an existing type provided by another cmdlet. For more information about defining new types or extending existing types, see Extending Object Types and Formatting.

Building the Cmdlet

After implementing a cmdlet, it must be registered with Windows PowerShell through a Windows PowerShell snap-in. For more information about registering cmdlets, see How to Register Cmdlets, Providers, and Host Applications.

Testing the Cmdlet

When your cmdlet has been registered with Windows PowerShell, you can test it by running it on the command line. Here are several tests that test the Stop-Proc cmdlet. For more information about using cmdlets from the command line, see the Getting Started with Windows PowerShell.

- Start Windows PowerShell and use the Stop-Proc cmdlet to stop processing as shown below. Because the cmdlet specifies the `Name` parameter as mandatory, the cmdlet queries for the parameter.

  PowerShell

  ```
  PS> stop-proc
  ```

  The following output appears.

  ```
  Cmdlet stop-proc at command pipeline position 1
  Supply values for the following parameters:
  Name[0]:
  ```

- Now let's use the cmdlet to stop the process named "NOTEPAD". The cmdlet asks you to confirm the action.

  PowerShell

  ```
  PS> stop-proc -Name notepad
  ```

  The following output appears.

  ```
  Confirm
  Are you sure you want to perform this action?
  Performing operation "stop-proc" on Target "notepad (4996)".
  [Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
  (default is "Y"): Y
  ```

- Use Stop-Proc as shown to stop the critical process named "WINLOGON". You are prompted and warned about performing this action because it will cause the operating system to reboot.

PowerShell

```
PS> stop-proc -Name Winlogon
```

The following output appears.

Output

```
Confirm
Are you sure you want to perform this action?
Performing operation "stop-proc" on Target "winlogon (656)".
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
(default is "Y"): Y
Warning!
The process " winlogon " is a critical process and should not be
stopped. Are you sure you wish to stop the process?
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
(default is "Y"): N
```

- Let's now try to stop the WINLOGON process without receiving a warning. Be aware that this command entry uses the `Force` parameter to override the warning.

PowerShell

```
PS> stop-proc -Name winlogon -Force
```

The following output appears.

Output

```
Confirm
Are you sure you want to perform this action?
Performing operation "stop-proc" on Target "winlogon (656)".
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
(default is "Y"): N
```

See Also

Adding Parameters that Process Command-Line Input

Extending Object Types and Formatting

How to Register Cmdlets, Providers, and Host Applications

Windows PowerShell SDK

Cmdlet Samples

Adding User Messages to Your Cmdlet

Article • 09/17/2021

Cmdlets can write several kinds of messages that can be displayed to the user by the Windows PowerShell runtime. These messages include the following types:

- Verbose messages that contain general user information.
- Debug messages that contain troubleshooting information.
- Warning messages that contain a notification that the cmdlet is about to perform an operation that can have unexpected results.
- Progress report messages that contain information about how much work the cmdlet has completed when performing an operation that takes a long time.

There are no limits to the number of messages that your cmdlet can write or the type of messages that your cmdlet writes. Each message is written by making a specific call from within the input processing method of your cmdlet.

Defining the Cmdlet

The first step in cmdlet creation is always naming the cmdlet and declaring the .NET class that implements the cmdlet. Any sort of cmdlet can write user notifications from its input processing methods; so, in general, you can name this cmdlet using any verb that indicates what system modifications the cmdlet performs. For more information about approved cmdlet verbs, see Cmdlet Verb Names.

The Stop-Proc cmdlet is designed to modify the system; therefore, the System.Management.Automation.CmdletAttribute declaration for the .NET class must include the `SupportsShouldProcess` attribute keyword and be set to `true`.

The following code is the definition for this Stop-Proc cmdlet class. For more information about this definition, see Creating a Cmdlet that Modifies the System.

C#

```
[Cmdlet(VerbsLifecycle.Stop, "proc",
        SupportsShouldProcess = true)]
public class StopProcCommand : Cmdlet
```

Defining Parameters for System Modification

The Stop-Proc cmdlet defines three parameters: `Name`, `Force`, and `PassThru`. For more information about defining these parameters, see Creating a Cmdlet that Modifies the System.

Here is the parameter declaration for the Stop-Proc cmdlet.

C#

```
[Parameter(
           Position = 0,
           Mandatory = true,
           ValueFromPipeline = true,
           ValueFromPipelineByPropertyName = true
)]
public string[] Name
{
  get { return processNames; }
  set { processNames = value; }
}
private string[] processNames;

/// <summary>
/// Specify the Force parameter that allows the user to override
/// the ShouldContinue call to force the stop operation. This
/// parameter should always be used with caution.
/// </summary>
[Parameter]
public SwitchParameter Force
{
  get { return force; }
  set { force = value; }
}
private bool force;

/// <summary>
/// Specify the PassThru parameter that allows the user to specify
/// that the cmdlet should pass the process object down the pipeline
/// after the process has been stopped.
/// </summary>
[Parameter]
public SwitchParameter PassThru
{
  get { return passThru; }
  set { passThru = value; }
}
private bool passThru;
```

Overriding an Input Processing Method

Your cmdlet must override an input processing method, most often it will be System.Management.Automation.Cmdlet.ProcessRecord. This Stop-Proc cmdlet overrides the System.Management.Automation.Cmdlet.ProcessRecord input processing method. In this implementation of the Stop-Proc cmdlet, calls are made to write verbose messages, debug messages, and warning messages.

> ⓘ **Note**
>
> For more information about how this method calls the **System.Management.Automation.Cmdlet.ShouldProcess** and **System.Management.Automation.Cmdlet.ShouldContinue** methods, see **Creating a Cmdlet that Modifies the System**.

Writing a Verbose Message

The System.Management.Automation.Cmdlet.WriteVerbose method is used to write general user-level information that is unrelated to specific error conditions. The system administrator can then use that information to continue processing other commands. In addition, any information written using this method should be localized as needed.

The following code from this Stop-Proc cmdlet shows two calls to the System.Management.Automation.Cmdlet.WriteVerbose method from the override of the System.Management.Automation.Cmdlet.ProcessRecord method.

C#

```
message = String.Format("Attempting to stop process \"{0}\".", name);
WriteVerbose(message);
```

C#

```
message = String.Format("Stopped process \"{0}\", pid {1}.",
                        processName, process.Id);

WriteVerbose(message);
```

Writing a Debug Message

The System.Management.Automation.Cmdlet.WriteDebug method is used to write debug messages that can be used to troubleshoot the operation of the cmdlet. The call is made from an input processing method.

> **Note**
>
> Windows PowerShell also defines a `Debug` parameter that presents both verbose and debug information. If your cmdlet supports this parameter, it does not need to call **System.Management.Automation.Cmdlet.WriteDebug** in the same code that calls **System.Management.Automation.Cmdlet.WriteVerbose**.

The following two sections of code from the sample Stop-Proc cmdlet show calls to the System.Management.Automation.Cmdlet.WriteDebug method from the override of the System.Management.Automation.Cmdlet.ProcessRecord method.

This debug message is written immediately before System.Management.Automation.Cmdlet.ShouldProcess is called.

```
C#

message =
          String.Format("Acquired name for pid {0} : \"{1}\"",
                        process.Id, processName);
WriteDebug(message);
```

This debug message is written immediately before System.Management.Automation.Cmdlet.WriteObject is called.

```
C#

message =
         String.Format("Writing process \"{0}\" to pipeline",
         processName);
WriteDebug(message);
WriteObject(process);
```

Windows PowerShell automatically routes any System.Management.Automation.Cmdlet.WriteDebug calls to the tracing infrastructure and cmdlets. This allows the method calls to be traced to the hosting application, a file, or a debugger without your having to do any extra development work within the cmdlet. The following command-line entry implements a tracing operation.

PS> trace-expression stop-proc -file proc.log -command stop-proc notepad

Writing a Warning Message

The System.Management.Automation.Cmdlet.WriteWarning method is used to write a warning when the cmdlet is about to perform an operation that might have an unexpected result, for example, overwriting a read-only file.

The following code from the sample Stop-Proc cmdlet shows the call to the System.Management.Automation.Cmdlet.WriteWarning method from the override of the System.Management.Automation.Cmdlet.ProcessRecord method.

C#

```
 if (criticalProcess)
 {
   message =
             String.Format("Stopping the critical process \"{0}\".",
                           processName);
   WriteWarning(message);
} // if (criticalProcess...
```

Writing a Progress Message

The System.Management.Automation.Cmdlet.WriteProgress is used to write progress messages when cmdlet operations take an extended amount of time to complete. A call to System.Management.Automation.Cmdlet.WriteProgress passes a System.Management.Automation.Progressrecord object that is sent to the hosting application for rendering to the user.

> ⓘ **Note**
>
> This Stop-Proc cmdlet does not include a call to the **System.Management.Automation.Cmdlet.WriteProgress** method.

The following code is an example of a progress message written by a cmdlet that is attempting to copy an item.

C#

```
int myId = 0;
string myActivity = "Copy-item: Copying *.* to c:\abc";
string myStatus = "Copying file bar.txt";
ProgressRecord pr = new ProgressRecord(myId, myActivity, myStatus);
WriteProgress(pr);

pr.RecordType = ProgressRecordType.Completed;
WriteProgress(pr);
```

Code Sample

For the complete C# sample code, see StopProcessSample02 Sample.

Define Object Types and Formatting

Windows PowerShell passes information between cmdlets using .NET objects. Consequently, a cmdlet might need to define its own type, or the cmdlet might need to extend an existing type provided by another cmdlet. For more information about defining new types or extending existing types, see Extending Object Types and Formatting.

Building the Cmdlet

After implementing a cmdlet, it must be registered with Windows PowerShell through a Windows PowerShell snap-in. For more information about registering cmdlets, see How to Register Cmdlets, Providers, and Host Applications.

Testing the Cmdlet

When your cmdlet has been registered with Windows PowerShell, you can test it by running it on the command line. Let's test the sample Stop-Proc cmdlet. For more information about using cmdlets from the command line, see the Getting Started with Windows PowerShell.

- The following command-line entry uses Stop-Proc to stop the process named "NOTEPAD", provide verbose notifications, and print debug information.

  PowerShell

  ```
  PS> stop-proc -Name notepad -Verbose -Debug
  ```

  The following output appears.

  ```
  VERBOSE: Attempting to stop process " notepad ".
  DEBUG: Acquired name for pid 5584 : "notepad"

  Confirm
  Continue with this operation?
  [Y] Yes  [A] Yes to All  [H] Halt Command  [S] Suspend  [?] Help
  ```

```
(default is "Y"): Y

Confirm
Are you sure you want to perform this action?
Performing operation "stop-proc" on Target "notepad (5584)".
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
(default is "Y"): Y
VERBOSE: Stopped process "notepad", pid 5584.
```

See Also

Create a Cmdlet that Modifies the System

How to Create a Windows PowerShell Cmdlet

Extending Object Types and Formatting

How to Register Cmdlets, Providers, and Host Applications

Windows PowerShell SDK

Adding Aliases, Wildcard Expansion, and Help to Cmdlet Parameters

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This section describes how to add aliases, wildcard expansion, and Help messages to the parameters of the `Stop-Proc` cmdlet (described in Creating a Cmdlet that Modifies the System).

This `Stop-Proc` cmdlet attempts to stop processes that are retrieved using the `Get-Proc` cmdlet (described in Creating Your First Cmdlet).

Defining the Cmdlet

The first step in cmdlet creation is always naming the cmdlet and declaring the .NET class that implements the cmdlet. Because you are writing a cmdlet to change the system, it should be named accordingly. Because this cmdlet stops system processes, it uses the verb **Stop**, defined by the System.Management.Automation.Verbslifecycle class, with the noun **Proc** to indicate process. For more information about approved cmdlet verbs, see Cmdlet Verb Names.

The following code is the class definition for this `Stop-Proc` cmdlet.

C#

```
[Cmdlet(VerbsLifecycle.Stop, "proc",
        SupportsShouldProcess = true)]
public class StopProcCommand : Cmdlet
```

Defining Parameters for System Modification

Your cmdlet needs to define parameters that support system modifications and user feedback. The cmdlet should define a **Name** parameter or equivalent so that the cmdlet will be able to modify the system by some sort of identifier. In addition, the cmdlet should define the **Force** and **PassThru** parameters. For more information about these parameters, see Creating a Cmdlet that Modifies the System.

Defining a Parameter Alias

A parameter alias can be an alternate name or a well-defined 1-letter or 2-letter short name for a cmdlet parameter. In both cases, the goal of using aliases is to simplify user entry from the command line. Windows PowerShell supports parameter aliases through the System.Management.Automation.Aliasattribute attribute, which uses the declaration syntax `[Alias()]`.

The following code shows how an alias is added to the **Name** parameter.

C#

```
/// <summary>
/// Specify the mandatory Name parameter used to identify the
/// processes to be stopped.
/// </summary>
[Parameter(
           Position = 0,
           Mandatory = true,
           ValueFromPipeline = true,
           ValueFromPipelineByPropertyName = true,
           HelpMessage = "The name of one or more processes to stop.
Wildcards are permitted."
)]
[Alias("ProcessName")]
public string[] Name
{
  get { return processNames; }
  set { processNames = value; }
}
private string[] processNames;
```

In addition to using the System.Management.Automation.Aliasattribute attribute, the Windows PowerShell runtime performs partial name matching, even if no aliases are specified. For example, if your cmdlet has a **FileName** parameter and that is the only parameter that starts with `F`, the user could enter `Filename`, `Filenam`, `File`, `Fi`, or `F` and still recognize the entry as the **FileName** parameter.

Creating Help for Parameters

Windows PowerShell allows you to create Help for cmdlet parameters. Do this for any parameter used for system modification and user feedback. For each parameter to support Help, you can set the **HelpMessage** attribute keyword in the System.Management.Automation.Parameterattribute attribute declaration. This keyword defines the text to display to the user for assistance in using the parameter. You can also set the **HelpMessageBaseName** keyword to identify the base name of a resource to use

for the message. If you set this keyword, you must also set the **HelpMessageResourceId** keyword to specify the resource identifier.

The following code from this `Stop-Proc` cmdlet defines the **HelpMessage** attribute keyword for the **Name** parameter.

C#

```
/// <summary>
/// Specify the mandatory Name parameter used to identify the
/// processes to be stopped.
/// </summary>
[Parameter(
           Position = 0,
           Mandatory = true,
           ValueFromPipeline = true,
           ValueFromPipelineByPropertyName = true,
           HelpMessage = "The name of one or more processes to stop.
Wildcards are permitted."
)]
```

Overriding an Input Processing Method

Your cmdlet must override an input processing method, most often this will be System.Management.Automation.Cmdlet.ProcessRecord. When modifying the system, the cmdlet should call the System.Management.Automation.Cmdlet.ShouldProcess and System.Management.Automation.Cmdlet.ShouldContinue methods to allow the user to provide feedback before a change is made. For more information about these methods, see Creating a Cmdlet that Modifies the System.

Supporting Wildcard Expansion

To allow the selection of multiple objects, your cmdlet can use the System.Management.Automation.WildcardPattern and System.Management.Automation.WildcardOptions classes to provide wildcard expansion support for parameter input. Examples of wildcard patterns are `lsa*`, `*.txt`, and `[a-c]*`. Use the back-quote character (`` ` ``) as an escape character when the pattern contains a character that should be used literally.

Wildcard expansions of file and path names are examples of common scenarios where the cmdlet may want to allow support for path inputs when the selection of multiple objects is required. A common case is in the file system, where a user wants to see all files residing in the current folder.

You should need a customized wildcard pattern matching implementation only rarely. In this case, your cmdlet should support either the full POSIX 1003.2, 3.13 specification for wildcard expansion or the following simplified subset:

- **Question mark (`?`).** Matches any character at the specified location.
- **Asterisk (`*`).** Matches zero or more characters starting at the specified location.
- **Open bracket (`[`).** Introduces a pattern bracket expression that can contain characters or a range of characters. If a range is required, a hyphen (`-`) is used to indicate the range.
- **Close bracket (`]`).** Ends a pattern bracket expression.
- **Back-quote escape character (`` ` ``).** Indicates that the next character should be taken literally. Be aware that when specifying the back-quote character from the command line (as opposed to specifying it programmatically), the back-quote escape character must be specified twice.

> ⓘ **Note**
>
> For more information about wildcard patterns, see **Supporting Wildcards in Cmdlet Parameters**.

The following code shows how to set wildcard options and define the wildcard pattern used for resolving the **Name** parameter for this cmdlet.

C#

```
WildcardOptions options = WildcardOptions.IgnoreCase |
                          WildcardOptions.Compiled;
WildcardPattern wildcard = new WildcardPattern(name,options);
```

The following code shows how to test whether the process name matches the defined wildcard pattern. Notice that, in this case, if the process name does not match the pattern, the cmdlet continues on to get the next process name.

C#

```
if (!wildcard.IsMatch(processName))
{
  continue;
}
```

Code Sample

For the complete C# sample code, see StopProcessSample03 Sample.

Define Object Types and Formatting

Windows PowerShell passes information between cmdlets using .Net objects. Consequently, a cmdlet may need to define its own type, or the cmdlet may need to extend an existing type provided by another cmdlet. For more information about defining new types or extending existing types, see Extending Object Types and Formatting.

Building the Cmdlet

After implementing a cmdlet, it must be registered with Windows PowerShell through a Windows PowerShell snap-in. For more information about registering cmdlets, see How to Register Cmdlets, Providers, and Host Applications.

Testing the Cmdlet

When your cmdlet has been registered with Windows PowerShell, you can test it by running it on the command line. Let's test the sample Stop-Proc cmdlet. For more information about using cmdlets from the command line, see the Getting Started with Windows PowerShell.

- Start Windows PowerShell and use `Stop-Proc` to stop a process using the **ProcessName** alias for the **Name** parameter.

  PowerShell

  ```
  PS> Stop-Proc -ProcessName notepad
  ```

  The following output appears.

  ```

  Confirm
  Are you sure you want to perform this action?
  Performing operation "Stop-Proc" on Target "notepad (3496)".
  [Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
  (default is "Y"): Y
  ```

- Make the following entry on the command line. Because the Name parameter is mandatory, you are prompted for it. Entering `!?` brings up the help text associated with the parameter.

  PowerShell

  ```
  PS> Stop-Proc
  ```

  The following output appears.

  ```
  Cmdlet Stop-Proc at command pipeline position 1
  Supply values for the following parameters:
  (Type !? for Help.)
  Name[0]: !?
  The name of one or more processes to stop. Wildcards are permitted.
  Name[0]: notepad
  ```

- Now make the following entry to stop all processes that match the wildcard pattern `*note*`. You are prompted before stopping each process that matches the pattern.

  PowerShell

  ```
  PS> Stop-Proc -Name *note*
  ```

  The following output appears.

  ```
  Confirm
  Are you sure you want to perform this action?
  Performing operation "Stop-Proc" on Target "notepad (1112)".
  [Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
  (default is "Y"): Y
  ```

  The following output appears.

  ```
  Confirm
  Are you sure you want to perform this action?
  Performing operation "Stop-Proc" on Target "ONENOTEM (3712)".
  [Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
  (default is "Y"): N
  ```

The following output appears.

```
Confirm
Are you sure you want to perform this action?
Performing operation "Stop-Proc" on Target "ONENOTE (3592)".
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
(default is "Y"): N
```

See Also

- Create a Cmdlet that Modifies the System
- How to Create a Windows PowerShell Cmdlet
- Extending Object Types and Formatting
- How to Register Cmdlets, Providers, and Host Applications
- Supporting Wildcards in Cmdlet Parameters
- Windows PowerShell SDK

Adding Parameter Sets to a Cmdlet

Article • 09/17/2021

Things to Know About Parameter Sets

Windows PowerShell defines a parameter set as a group of parameters that operate together. By grouping the parameters of a cmdlet, you can create a single cmdlet that can change its functionality based on what group of parameters the user specifies.

An example of a cmdlet that uses two parameter sets to define different functionalities is the `Get-EventLog` cmdlet that is provided by Windows PowerShell. This cmdlet returns different information when the user specifies the `List` or `LogName` parameter. If the `LogName` parameter is specified, the cmdlet returns information about the events in a given event log. If the `List` parameter is specified, the cmdlet returns information about the log files themselves (not the event information they contain). In this case, the `List` and `LogName` parameters identify two separate parameter sets.

Two important things to remember about parameter sets is that the Windows PowerShell runtime uses only one parameter set for a particular input, and that each parameter set must have at least one parameter that is unique for that parameter set.

To illustrate that last point, this Stop-Proc cmdlet uses three parameter sets: `ProcessName`, `ProcessId`, and `InputObject`. Each of these parameter sets has one parameter that is not in the other parameter sets. The parameter sets could share other parameters, but the cmdlet uses the unique parameters `ProcessName`, `ProcessId`, and `InputObject` to identify which set of parameters that the Windows PowerShell runtime should use.

Declaring the Cmdlet Class

The first step in cmdlet creation is always naming the cmdlet and declaring the .NET class that implements the cmdlet. For this cmdlet, the lifecycle verb "Stop" is used because the cmdlet stops system processes. The noun name "Proc" is used because the cmdlet works on processes. In the declaration below, note that the cmdlet verb and noun name are reflected in the name of the cmdlet class.

> **Note**

For more information about approved cmdlet verb names, see **Cmdlet Verb Names**.

The following code is the class definition for this Stop-Proc cmdlet.

C#

```
[Cmdlet(VerbsLifecycle.Stop, "Proc",
        DefaultParameterSetName = "ProcessId",
        SupportsShouldProcess = true)]
public class StopProcCommand : PSCmdlet
```

VB

```
<Cmdlet(VerbsLifecycle.Stop, "Proc", DefaultParameterSetName:="ProcessId", _
SupportsShouldProcess:=True)> _
Public Class StopProcCommand
    Inherits PSCmdlet
```

Declaring the Parameters of the Cmdlet

This cmdlet defines three parameters needed as input to the cmdlet (these parameters also define the parameter sets), as well as a `Force` parameter that manages what the cmdlet does and a `PassThru` parameter that determines whether the cmdlet sends an output object through the pipeline. By default, this cmdlet does not pass an object through the pipeline. For more information about these last two parameters, see Creating a Cmdlet that Modifies the System.

Declaring the Name Parameter

This input parameter allows the user to specify the names of the processes to be stopped. Note that the `ParameterSetName` attribute keyword of the System.Management.Automation.Parameterattribute attribute specifies the `ProcessName` parameter set for this parameter.

C#

```
[Parameter(
   Position = 0,
   ParameterSetName = "ProcessName",
   Mandatory = true,
   ValueFromPipeline = true,
   ValueFromPipelineByPropertyName = true,
```

```
   HelpMessage = "The name of one or more processes to stop. Wildcards are
permitted."
)]
[Alias("ProcessName")]
public string[] Name
{
    get { return processNames; }
    set { processNames = value; }
}
private string[] processNames;
```

VB

```
<Parameter(Position:=0, ParameterSetName:="ProcessName", _
Mandatory:=True, _
ValueFromPipeline:=True, ValueFromPipelineByPropertyName:=True, _
HelpMessage:="The name of one or more processes to stop. " & _
    "Wildcards are permitted."), [Alias]("ProcessName")> _
Public Property Name() As String()
    Get
        Return processNames
    End Get
    Set(ByVal value As String())
        processNames = value
    End Set
End Property

Private processNames() As String
```

Note also that the alias "ProcessName" is given to this parameter.

Declaring the Id Parameter

This input parameter allows the user to specify the identifiers of the processes to be stopped. Note that the `ParameterSetName` attribute keyword of the System.Management.Automation.Parameterattribute attribute specifies the `ProcessId` parameter set.

C#

```
[Parameter(
           ParameterSetName = "ProcessId",
           Mandatory = true,
           ValueFromPipelineByPropertyName = true,
           ValueFromPipeline = true
)]
[Alias("ProcessId")]
public int[] Id
{
```

```
  get { return processIds; }
  set { processIds = value; }
}
private int[] processIds;
```

VB

```
<Parameter(ParameterSetName:="ProcessId", _
Mandatory:=True, _
ValueFromPipelineByPropertyName:=True, _
ValueFromPipeline:=True), [Alias]("ProcessId")> _
Public Property Id() As Integer()
    Get
        Return processIds
    End Get
    Set(ByVal value As Integer())
        processIds = value
    End Set
End Property
Private processIds() As Integer
```

Note also that the alias "ProcessId" is given to this parameter.

Declaring the InputObject Parameter

This input parameter allows the user to specify an input object that contains information about the processes to be stopped. Note that the `ParameterSetName` attribute keyword of the System.Management.Automation.Parameterattribute attribute specifies the `InputObject` parameter set for this parameter.

C#

```
[Parameter(
           ParameterSetName = "InputObject",
           Mandatory = true,
           ValueFromPipeline = true)]
public Process[] InputObject
{
  get { return inputObject; }
  set { inputObject = value; }
}
private Process[] inputObject;
```

VB

```
<Parameter(ParameterSetName:="InputObject", _
Mandatory:=True, ValueFromPipeline:=True)> _
Public Property InputObject() As Process()
```

```
    Get
        Return myInputObject
    End Get
    Set(ByVal value As Process())
        myInputObject = value
    End Set
End Property
Private myInputObject() As Process
```

Note also that this parameter has no alias.

Declaring Parameters in Multiple Parameter Sets

Although there must be a unique parameter for each parameter set, parameters can belong to more than one parameter set. In these cases, give the shared parameter a System.Management.Automation.Parameterattribute attribute declaration for each set to which that the parameter belongs. If a parameter is in all parameter sets, you only have to declare the parameter attribute once and do not need to specify the parameter set name.

Overriding an Input Processing Method

Every cmdlet must override an input processing method, most often this will be the System.Management.Automation.Cmdlet.ProcessRecord method. In this cmdlet, the System.Management.Automation.Cmdlet.ProcessRecord method is overridden so that the cmdlet can process any number of processes. It contains a Select statement that calls a different method based on which parameter set the user has specified.

C#

```
protected override void ProcessRecord()
{
  switch (ParameterSetName)
  {
    case "ProcessName":
         ProcessByName();
         break;

    case "ProcessId":
         ProcessById();
         break;

    case "InputObject":
         foreach (Process process in inputObject)
         {
           SafeStopProcess(process);
         }
```

```
            break;

        default:
            throw new ArgumentException("Bad ParameterSet Name");
      } // switch (ParameterSetName...
    } // ProcessRecord
```

VB

```
Protected Overrides Sub ProcessRecord()
    Select Case ParameterSetName
        Case "ProcessName"
            ProcessByName()

        Case "ProcessId"
            ProcessById()

        Case "InputObject"
            Dim process As Process
            For Each process In myInputObject
                SafeStopProcess(process)
            Next process

        Case Else
            Throw New ArgumentException("Bad ParameterSet Name")
    End Select

End Sub 'ProcessRecord ' ProcessRecord
```

The Helper methods called by the Select statement are not described here, but you can see their implementation in the complete code sample in the next section.

Code Sample

For the complete C# sample code, see StopProcessSample04 Sample.

Defining Object Types and Formatting

Windows PowerShell passes information between cmdlets using .NET objects. Consequently, a cmdlet might need to define its own type, or the cmdlet might need to extend an existing type provided by another cmdlet. For more information about defining new types or extending existing types, see Extending Object Types and Formatting.

Building the Cmdlet

After implementing a cmdlet, you must register it with Windows PowerShell through a Windows PowerShell snap-in. For more information about registering cmdlets, see How to Register Cmdlets, Providers, and Host Applications.

Testing the Cmdlet

When your cmdlet has been registered with Windows PowerShell, test it by running it on the command line. Here are some tests that show how the `ProcessId` and `InputObject` parameters can be used to test their parameter sets to stop a process.

- With Windows PowerShell started, run the Stop-Proc cmdlet with the `ProcessId` parameter set to stop a process based on its identifier. In this case, the cmdlet is using the `ProcessId` parameter set to stop the process.

```
PS> stop-proc -Id 444
Confirm
Are you sure you want to perform this action?
Performing operation "stop-proc" on Target "notepad (444)".
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
(default is "Y"): Y
```

- With Windows PowerShell started, run the Stop-Proc cmdlet with the `InputObject` parameter set to stop processes on the Notepad object retrieved by the `Get-Process` command.

```
PS> get-process notepad | stop-proc
Confirm
Are you sure you want to perform this action?
Performing operation "stop-proc" on Target "notepad (444)".
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help
(default is "Y"): N
```

See Also

Creating a Cmdlet that Modifies the System

How to Create a Windows PowerShell Cmdlet

Extending Object Types and Formatting

How to Register Cmdlets, Providers, and Host Applications

Windows PowerShell SDK

SelectStr Tutorial

Article • 09/17/2021

This section provides a tutorial for creating the Select-Str cmdlet, which is very similar to the Select-String cmdlet provided by Windows PowerShell. This tutorial provides fragments of code that illustrate how cmdlets are implemented, and an explanation of the code.

Topic in this Tutorial

Creating a Cmdlet to Access a Data Store This section describes how to create a cmdlet that selects strings that are in a file or object.

See Also

Creating a Cmdlet to Access a Data Store

Windows PowerShell SDK

Creating a Cmdlet to Access a Data Store

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This section describes how to create a cmdlet that accesses stored data by way of a Windows PowerShell provider. This type of cmdlet uses the Windows PowerShell provider infrastructure of the Windows PowerShell runtime and, therefore, the cmdlet class must derive from the System.Management.Automation.PSCmdlet base class.

The Select-Str cmdlet described here can locate and select strings in a file or object. The patterns used to identify the string can be specified explicitly through the `Path` parameter of the cmdlet or implicitly through the `Script` parameter.

The cmdlet is designed to use any Windows PowerShell provider that derives from System.Management.Automation.Provider.Icontentcmdletprovider. For example, the cmdlet can specify the FileSystem provider or the Variable provider that is provided by Windows PowerShell. For more information aboutWindows PowerShell providers, see Designing Your Windows PowerShell provider.

Defining the Cmdlet Class

The first step in cmdlet creation is always naming the cmdlet and declaring the .NET class that implements the cmdlet. This cmdlet detects certain strings, so the verb name chosen here is "Select", defined by the System.Management.Automation.Verbscommon class. The noun name "Str" is used because the cmdlet acts upon strings. In the declaration below, note that the cmdlet verb and noun name are reflected in the name of the cmdlet class. For more information about approved cmdlet verbs, see Cmdlet Verb Names.

The .NET class for this cmdlet must derive from the System.Management.Automation.PSCmdlet base class, because it provides the support needed by the Windows PowerShell runtime to expose the Windows PowerShell provider infrastructure. Note that this cmdlet also makes use of the .NET Framework regular expressions classes, such as System.Text.Regularexpressions.Regex.

The following code is the class definition for this Select-Str cmdlet.

C#

```
[Cmdlet(VerbsCommon.Select, "Str",
DefaultParameterSetName="PatternParameterSet")]
```

```
public class SelectStringCommand : PSCmdlet
```

This cmdlet defines a default parameter set by adding the `DefaultParameterSetName` attribute keyword to the class declaration. The default parameter set `PatternParameterSet` is used when the `Script` parameter is not specified. For more information about this parameter set, see the `Pattern` and `Script` parameter discussion in the following section.

Defining Parameters for Data Access

This cmdlet defines several parameters that allow the user to access and examine stored data. These parameters include a `Path` parameter that indicates the location of the data store, a `Pattern` parameter that specifies the pattern to be used in the search, and several other parameters that support how the search is performed.

> ⓘ Note
>
> For more information about the basics of defining parameters, see **Adding Parameters that Process Command Line Input**.

Declaring the Path Parameter

To locate the data store, this cmdlet must use a Windows PowerShell path to identify the Windows PowerShell provider that is designed to access the data store. Therefore, it defines a `Path` parameter of type string array to indicate the location of the provider.

C#

```
[Parameter(
           Position = 0,
           ParameterSetName = "ScriptParameterSet",
           Mandatory = true)]
[Parameter(
           Position = 0,
           ParameterSetName = "PatternParameterSet",
           ValueFromPipeline = true,
           Mandatory = true)]
           [Alias("PSPath")]
public string[] Path
{
  get { return paths; }
  set { paths = value; }
}
private string[] paths;
```

Note that this parameter belongs to two different parameter sets and that it has an alias.

Two System.Management.Automation.Parameterattribute attributes declare that the `Path` parameter belongs to the `ScriptParameterSet` and the `PatternParameterSet`. For more information about parameter sets, see Adding Parameter Sets to a Cmdlet.

The System.Management.Automation.Aliasattribute attribute declares a `PSPath` alias for the `Path` parameter. Declaring this alias is strongly recommended for consistency with other cmdlets that access Windows PowerShell providers. For more information aboutWindows PowerShell paths, see "PowerShell Path Concepts" in How Windows PowerShell Works.

Declaring the Pattern Parameter

To specify the patterns to search for, this cmdlet declares a `Pattern` parameter that is an array of strings. A positive result is returned when any of the patterns are found in the data store. Note that these patterns can be compiled into an array of compiled regular expressions or an array of wildcard patterns used for literal searches.

C#

```
[Parameter(
           Position = 1,
           ParameterSetName = "PatternParameterSet",
           Mandatory = true)]
public string[] Pattern
{
  get { return patterns; }
  set { patterns = value; }
}
private string[] patterns;
private Regex[] regexPattern;
private WildcardPattern[] wildcardPattern;
```

When this parameter is specified, the cmdlet uses the default parameter set `PatternParameterSet`. In this case, the cmdlet uses the patterns specified here to select strings. In contrast, the `Script` parameter could also be used to provide a script that contains the patterns. The `Script` and `Pattern` parameters define two separate parameter sets, so they are mutually exclusive.

Declaring Search Support Parameters

This cmdlet defines the following support parameters that can be used to modify the search capabilities of the cmdlet.

The `Script` parameter specifies a script block that can be used to provide an alternate search mechanism for the cmdlet. The script must contain the patterns used for matching and return a System.Management.Automation.PSObject object. Note that this parameter is also the unique parameter that identifies the `ScriptParameterSet` parameter set. When the Windows PowerShell runtime sees this parameter, it uses only parameters that belong to the `ScriptParameterSet` parameter set.

C#

```
[Parameter(
           Position = 1,
           ParameterSetName = "ScriptParameterSet",
           Mandatory = true)]
public ScriptBlock Script
{
  set { script = value; }
  get { return script; }
}
ScriptBlock script;
```

The `SimpleMatch` parameter is a switch parameter that indicates whether the cmdlet is to explicitly match the patterns as they are supplied. When the user specifies the parameter at the command line (`true`), the cmdlet uses the patterns as they are supplied. If the parameter is not specified (`false`), the cmdlet uses regular expressions. The default for this parameter is `false`.

C#

```
[Parameter]
public SwitchParameter SimpleMatch
{
  get { return simpleMatch; }
  set { simpleMatch = value; }
}
private bool simpleMatch;
```

The `CaseSensitive` parameter is a switch parameter that indicates whether a case-sensitive search is performed. When the user specifies the parameter at the command line (`true`), the cmdlet checks for the uppercase and lowercase of characters when comparing patterns. If the parameter is not specified (`false`), the cmdlet does not distinguish between uppercase and lowercase. For example "MyFile" and "myfile" would both be returned as positive hits. The default for this parameter is `false`.

C#

```
[Parameter]
public SwitchParameter CaseSensitive
{
  get { return caseSensitive; }
  set { caseSensitive = value; }
}
private bool caseSensitive;
```

The `Exclude` and `Include` parameters identify items that are explicitly excluded from or included in the search. By default, the cmdlet will search all items in the data store. However, to limit the search performed by the cmdlet, these parameters can be used to explicitly indicate items to be included in the search or omitted.

C#

```
[Parameter]
public SwitchParameter CaseSensitive
{
  get { return caseSensitive; }
  set { caseSensitive = value; }
}
private bool caseSensitive;
```

C#

```
[Parameter]
[ValidateNotNullOrEmpty]
public string[] Include
{
  get
  {
    return includeStrings;
  }
  set
  {
    includeStrings = value;

    this.include = new WildcardPattern[includeStrings.Length];
    for (int i = 0; i < includeStrings.Length; i++)
    {
      this.include[i] = new WildcardPattern(includeStrings[i],
WildcardOptions.IgnoreCase);
    }
  }
}

internal string[] includeStrings = null;
internal WildcardPattern[] include = null;
```

Declaring Parameter Sets

This cmdlet uses two parameter sets (`ScriptParameterSet` and `PatternParameterSet`, which is the default) as the names of two parameter sets used in data access. `PatternParameterSet` is the default parameter set and is used when the `Pattern` parameter is specified. `ScriptParameterSet` is used when the user specifies an alternate search mechanism through the `Script` parameter. For more information about parameter sets, see Adding Parameter Sets to a Cmdlet.

Overriding Input Processing Methods

Cmdlets must override one or more of the input processing methods for the System.Management.Automation.PSCmdlet class. For more information about the input processing methods, see Creating Your First Cmdlet.

This cmdlet overrides the System.Management.Automation.Cmdlet.BeginProcessing method to build an array of compiled regular expressions at startup. This increases performance during searches that do not use simple matching.

C#

```
protected override void BeginProcessing()
{
  WriteDebug("Validating patterns.");
  if (patterns != null)
  {
    foreach(string pattern in patterns)
    {
      if (pattern == null)
      ThrowTerminatingError(new ErrorRecord(
                            new ArgumentNullException(
                            "Search pattern cannot be null."),
                            "NullSearchPattern",
                            ErrorCategory.InvalidArgument,
                            pattern)
                            );
    }

    WriteVerbose("Search pattern(s) are valid.");

    // If a simple match is not specified, then
    // compile the regular expressions once.
    if (!simpleMatch)
    {
      WriteDebug("Compiling search regular expressions.");
```

```
      RegexOptions regexOptions = RegexOptions.Compiled;
      if (!caseSensitive)
         regexOptions |= RegexOptions.Compiled;
      regexPattern = new Regex[patterns.Length];

      for (int i = 0; i < patterns.Length; i++)
      {
        try
        {
          regexPattern[i] = new Regex(patterns[i], regexOptions);
        }
        catch (ArgumentException ex)
        {
          ThrowTerminatingError(new ErrorRecord(
                        ex,
                        "InvalidRegularExpression",
                        ErrorCategory.InvalidArgument,
                        patterns[i]
                      ));
        }
      } //Loop through patterns to create RegEx objects.

      WriteVerbose("Pattern(s) compiled into regular expressions.");
    }// If not a simple match.

    // If a simple match is specified, then compile the
    // wildcard patterns once.
    else
    {
      WriteDebug("Compiling search wildcards.");

      WildcardOptions wildcardOptions = WildcardOptions.Compiled;

      if (!caseSensitive)
      {
        wildcardOptions |= WildcardOptions.IgnoreCase;
      }

      wildcardPattern = new WildcardPattern[patterns.Length];
      for (int i = 0; i < patterns.Length; i++)
      {
        wildcardPattern[i] =
                    new WildcardPattern(patterns[i], wildcardOptions);
      }

      WriteVerbose("Pattern(s) compiled into wildcard expressions.");
    }// If match is a simple match.
  }// If valid patterns are available.
}// End of function BeginProcessing().
```

This cmdlet also overrides the System.Management.Automation.Cmdlet.ProcessRecord method to process the string selections that the user makes on the command line. It

writes the results of string selection in the form of a custom object by calling a private **MatchString** method.

C#

```
protected override void ProcessRecord()
{
  UInt64 lineNumber = 0;
  MatchInfo result;
  ArrayList nonMatches = new ArrayList();

  // Walk the list of paths and search the contents for
  // any of the specified patterns.
  foreach (string psPath in paths)
  {
    // Once the filepaths are expanded, we may have more than one
    // path, so process all referenced paths.
    foreach(PathInfo path in
            SessionState.Path.GetResolvedPSPathFromPSPath(psPath)
           )
    {
      WriteVerbose("Processing path " + path.Path);

      // Check if the path represents one of the items to be
      // excluded. If so, continue to next path.
      if (!MeetsIncludeExcludeCriteria(path.ProviderPath))
         continue;

      // Get the content reader for the item(s) at the
      // specified path.
      Collection<IContentReader> readerCollection = null;
      try
      {
        readerCollection =
                    this.InvokeProvider.Content.GetReader(path.Path);
      }
      catch (PSNotSupportedException ex)
      {
        WriteError(new ErrorRecord(ex,
                   "ContentAccessNotSupported",
                    ErrorCategory.NotImplemented,
                    path.Path)
                   );
        return;
      }

      foreach(IContentReader reader in readerCollection)
      {
        // Reset the line number for this path.
        lineNumber = 0;

        // Read in a single block (line in case of a file)
        // from the object.
        IList items = reader.Read(1);
```

```
        // Read and process one block(line) at a time until
        // no more blocks(lines) exist.
        while (items != null && items.Count == 1)
        {
          // Increment the line number each time a line is
          // processed.
          lineNumber++;

          String message = String.Format("Testing line {0} : {1}",
                                         lineNumber, items[0]);

          WriteDebug(message);

          result = SelectString(items[0]);

          if (result != null)
          {
            result.Path = path.Path;
            result.LineNumber = lineNumber;

            WriteObject(result);
          }
          else
          {
            // Add the block(line) that did not match to the
            // collection of non matches , which will be stored
            // in the SessionState variable $NonMatches
            nonMatches.Add(items[0]);
          }

          // Get the next line from the object.
          items = reader.Read(1);

        }// While loop for reading one line at a time.
      }// Foreach loop for reader collection.
    }// Foreach loop for processing referenced paths.
  }// Foreach loop for walking of path list.

  // Store the list of non-matches in the
  // session state variable $NonMatches.
  try
  {
    this.SessionState.PSVariable.Set("NonMatches", nonMatches);
  }
  catch (SessionStateUnauthorizedAccessException ex)
  {
    WriteError(new ErrorRecord(ex,
               "CannotWriteVariableNonMatches",
               ErrorCategory.InvalidOperation,
               nonMatches)
              );
  }

}// End of protected override void ProcessRecord().
```

Accessing Content

Your cmdlet must open the provider indicated by the Windows PowerShell path so that it can access the data. The System.Management.Automation.Sessionstate object for the runspace is used for access to the provider, while the System.Management.Automation.PSCmdlet.Invokeprovider* property of the cmdlet is used to open the provider. Access to content is provided by retrieval of the System.Management.Automation.Providerintrinsics object for the provider opened.

This sample Select-Str cmdlet uses the System.Management.Automation.Providerintrinsics.Content* property to expose the content to scan. It can then call the System.Management.Automation.Contentcmdletproviderintrinsics.Getreader* method, passing the required Windows PowerShell path.

Code Sample

The following code shows the implementation of this version of this Select-Str cmdlet. Note that this code includes the cmdlet class, private methods used by the cmdlet, and the Windows PowerShell snap-in code used to register the cmdlet. For more information about registering the cmdlet, see Building the Cmdlet.

C#

```
//
// Copyright (c) 2006 Microsoft Corporation. All rights reserved.
//
// THIS CODE AND INFORMATION IS PROVIDED "AS IS" WITHOUT WARRANTY OF
// ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO
// THE IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR A
// PARTICULAR PURPOSE.
//
using System;
using System.Text.RegularExpressions;
using System.Collections;
using System.Collections.ObjectModel;
using System.Management.Automation;
using System.Management.Automation.Provider;
using System.ComponentModel;

namespace Microsoft.Samples.PowerShell.Commands
{
  #region SelectStringCommand
  /// <summary>
  /// This cmdlet searches through PSObjects for particular patterns.
```

```
  /// </summary>
  /// <remarks>
  /// This cmdlet can be used to search any object, such as a file or a
  /// variable, whose provider exposes methods for reading and writing
  /// content.
  /// </remarks>
  [Cmdlet(VerbsCommon.Select, "Str",
DefaultParameterSetName="PatternParameterSet")]
  public class SelectStringCommand : PSCmdlet
  {
    #region Parameters
    /// <summary>
    /// Declare a Path parameter that specifies where the data is stored.
    /// This parameter must specify a PowerShell that indicates the
    /// PowerShell provider that is used to access the objects to be
    /// searched for matching patterns. This parameter should also have
    /// a PSPath alias to provide consistency with other cmdlets that use
    /// PowerShell providers.
    /// </summary>
    /// <value>Path of the object(s) to search.</value>
    [Parameter(
               Position = 0,
               ParameterSetName = "ScriptParameterSet",
               Mandatory = true)]
    [Parameter(
               Position = 0,
               ParameterSetName = "PatternParameterSet",
               ValueFromPipeline = true,
               Mandatory = true)]
               [Alias("PSPath")]
    public string[] Path
    {
      get { return paths; }
      set { paths = value; }
    }
    private string[] paths;

    /// <summary>
    /// Declare a Pattern parameter that specifies the pattern(s)
    /// used to find matching patterns in the string representation
    /// of the objects. A positive result will be returned
    /// if any of the patterns are found in the objects.
    /// </summary>
    /// <remarks>
    /// The patterns will be compiled into an array of wildcard
    /// patterns for a simple match (literal string matching),
    /// or the patterns will be converted into an array of compiled
    /// regular expressions.
    /// </remarks>
    /// <value>Array of patterns to search.</value>
    [Parameter(
               Position = 1,
               ParameterSetName = "PatternParameterSet",
               Mandatory = true)]
    public string[] Pattern
```

```
    {
      get { return patterns; }
      set { patterns = value; }
    }
    private string[] patterns;
    private Regex[] regexPattern;
    private WildcardPattern[] wildcardPattern;

    /// <summary>
    /// Declare a Script parameter that specifies a script block
    /// that is called to perform the matching operations
    /// instead of the matching performed by the cmdlet.
    /// </summary>
    /// <value>Script block that will be called for matching</value>
    [Parameter(
               Position = 1,
               ParameterSetName = "ScriptParameterSet",
               Mandatory = true)]
    public ScriptBlock Script
    {
      set { script = value; }
      get { return script; }
    }
    ScriptBlock script;

    /// <summary>
    /// Declare a switch parameter that specifies if the pattern(s) are used
    /// literally. If not (default), searching is
    /// done using regular expressions.
    /// </summary>
    /// <value>If True, a literal pattern is used.</value>
    [Parameter]
    public SwitchParameter SimpleMatch
    {
      get { return simpleMatch; }
      set { simpleMatch = value; }
    }
    private bool simpleMatch;

    /// <summary>
    /// Declare a switch parameter that specifies if a case-sensitive
    /// search is performed.  If not (default), a case-insensitive search
    /// is performed.
    /// </summary>
    /// <value>If True, a case-sensitive search is made.</value>
    [Parameter]
    public SwitchParameter CaseSensitive
    {
      get { return caseSensitive; }
      set { caseSensitive = value; }
    }
    private bool caseSensitive;

    /// <summary>
    /// Declare an Include parameter that species which
```

```
    /// specific items are searched.  When this parameter
    /// is used, items that are not listed here are omitted
    /// from the search.
    /// </summary>
    [Parameter]
    [ValidateNotNullOrEmpty]
    public string[] Include
    {
      get
      {
        return includeStrings;
      }
      set
      {
        includeStrings = value;

        this.include = new WildcardPattern[includeStrings.Length];
        for (int i = 0; i < includeStrings.Length; i++)
        {
          this.include[i] = new WildcardPattern(includeStrings[i],
WildcardOptions.IgnoreCase);
        }
      }
    }

    internal string[] includeStrings = null;
    internal WildcardPattern[] include = null;

    /// <summary>
    /// Declare an Exclude parameter that species which
    /// specific items are omitted from the search.
    /// </summary>
    ///
    [Parameter]
    [ValidateNotNullOrEmpty]
    public string[] Exclude
    {
      get
      {
        return excludeStrings;
      }
      set
      {
        excludeStrings = value;

        this.exclude = new WildcardPattern[excludeStrings.Length];
        for (int i = 0; i < excludeStrings.Length; i++)
        {
          this.exclude[i] = new WildcardPattern(excludeStrings[i],
WildcardOptions.IgnoreCase);
        }
      }
    }
    internal string[] excludeStrings;
    internal WildcardPattern[] exclude;
```

```
#endregion Parameters

#region Overrides
/// <summary>
/// If regular expressions are used for pattern matching,
/// then build an array of compiled regular expressions
/// at startup. This increases performance during scanning
/// operations when simple matching is not used.
/// </summary>
protected override void BeginProcessing()
{
  WriteDebug("Validating patterns.");
  if (patterns != null)
  {
    foreach(string pattern in patterns)
    {
      if (pattern == null)
      ThrowTerminatingError(new ErrorRecord(
                            new ArgumentNullException(
                            "Search pattern cannot be null."),
                            "NullSearchPattern",
                            ErrorCategory.InvalidArgument,
                            pattern)
                            );
    }

    WriteVerbose("Search pattern(s) are valid.");

    // If a simple match is not specified, then
    // compile the regular expressions once.
    if (!simpleMatch)
    {
      WriteDebug("Compiling search regular expressions.");

      RegexOptions regexOptions = RegexOptions.Compiled;
      if (!caseSensitive)
         regexOptions |= RegexOptions.Compiled;
      regexPattern = new Regex[patterns.Length];

      for (int i = 0; i < patterns.Length; i++)
      {
        try
        {
          regexPattern[i] = new Regex(patterns[i], regexOptions);
        }
        catch (ArgumentException ex)
        {
          ThrowTerminatingError(new ErrorRecord(
                        ex,
                        "InvalidRegularExpression",
                        ErrorCategory.InvalidArgument,
                        patterns[i]
                    ));
        }
```

```
        } //Loop through patterns to create RegEx objects.

        WriteVerbose("Pattern(s) compiled into regular expressions.");
      }// If not a simple match.

      // If a simple match is specified, then compile the
      // wildcard patterns once.
      else
      {
        WriteDebug("Compiling search wildcards.");

        WildcardOptions wildcardOptions = WildcardOptions.Compiled;

        if (!caseSensitive)
        {
          wildcardOptions |= WildcardOptions.IgnoreCase;
        }

        wildcardPattern = new WildcardPattern[patterns.Length];
        for (int i = 0; i < patterns.Length; i++)
        {
          wildcardPattern[i] =
                      new WildcardPattern(patterns[i], wildcardOptions);
        }

        WriteVerbose("Pattern(s) compiled into wildcard expressions.");
      }// If match is a simple match.
    }// If valid patterns are available.
  }// End of function BeginProcessing().

  /// <summary>
  /// Process the input and search for the specified patterns.
  /// </summary>
  protected override void ProcessRecord()
  {
    UInt64 lineNumber = 0;
    MatchInfo result;
    ArrayList nonMatches = new ArrayList();

    // Walk the list of paths and search the contents for
    // any of the specified patterns.
    foreach (string psPath in paths)
    {
      // Once the filepaths are expanded, we may have more than one
      // path, so process all referenced paths.
      foreach(PathInfo path in
              SessionState.Path.GetResolvedPSPathFromPSPath(psPath)
             )
      {
        WriteVerbose("Processing path " + path.Path);

        // Check if the path represents one of the items to be
        // excluded. If so, continue to next path.
        if (!MeetsIncludeExcludeCriteria(path.ProviderPath))
           continue;
```

```
        // Get the content reader for the item(s) at the
        // specified path.
        Collection<IContentReader> readerCollection = null;
        try
        {
          readerCollection =
                      this.InvokeProvider.Content.GetReader(path.Path);
        }
        catch (PSNotSupportedException ex)
        {
          WriteError(new ErrorRecord(ex,
                     "ContentAccessNotSupported",
                      ErrorCategory.NotImplemented,
                      path.Path)
                     );
          return;
        }

        foreach(IContentReader reader in readerCollection)
        {
          // Reset the line number for this path.
          lineNumber = 0;

          // Read in a single block (line in case of a file)
          // from the object.
          IList items = reader.Read(1);

          // Read and process one block(line) at a time until
          // no more blocks(lines) exist.
          while (items != null && items.Count == 1)
          {
            // Increment the line number each time a line is
            // processed.
            lineNumber++;

            String message = String.Format("Testing line {0} : {1}",
                                           lineNumber, items[0]);

            WriteDebug(message);

            result = SelectString(items[0]);

            if (result != null)
            {
              result.Path = path.Path;
              result.LineNumber = lineNumber;

              WriteObject(result);
            }
            else
            {
              // Add the block(line) that did not match to the
              // collection of non matches , which will be stored
              // in the SessionState variable $NonMatches
```

```
                nonMatches.Add(items[0]);
              }

              // Get the next line from the object.
              items = reader.Read(1);

            }// While loop for reading one line at a time.
          }// Foreach loop for reader collection.
        }// Foreach loop for processing referenced paths.
      }// Foreach loop for walking of path list.

      // Store the list of non-matches in the
      // session state variable $NonMatches.
      try
      {
        this.SessionState.PSVariable.Set("NonMatches", nonMatches);
      }
      catch (SessionStateUnauthorizedAccessException ex)
      {
        WriteError(new ErrorRecord(ex,
                   "CannotWriteVariableNonMatches",
                   ErrorCategory.InvalidOperation,
                   nonMatches)
                  );
      }

    }// End of protected override void ProcessRecord().
    #endregion Overrides

    #region PrivateMethods
    /// <summary>
    /// Check for a match using the input string and the pattern(s)
    /// specified.
    /// </summary>
    /// <param name="input">The string to test.</param>
    /// <returns>MatchInfo object containing information about
    /// result of a match</returns>
    private MatchInfo SelectString(object input)
    {
      string line = null;

      try
      {
        // Convert the object to a string type
        // safely using language support methods
        line = (string)LanguagePrimitives.ConvertTo(
                                                  input,
                                                  typeof(string)
                                                  );
        line = line.Trim(' ','\t');
      }
      catch (PSInvalidCastException ex)
      {
        WriteError(new ErrorRecord(
                   ex,
```

```
                "CannotCastObjectToString",
                ErrorCategory.InvalidOperation,
                input)
                );

        return null;
      }

      MatchInfo result = null;

      // If a scriptblock has been specified, call it
      // with the path for processing.  It will return
      // one object.
      if (script != null)
      {
        WriteDebug("Executing script block.");

        Collection<PSObject> psObjects =
                             script.Invoke(
                                          line,
                                          simpleMatch,
                                          caseSensitive
                                         );

        foreach (PSObject psObject in psObjects)
        {
          if (LanguagePrimitives.IsTrue(psObject))
          {
            result = new MatchInfo();
            result.Line = line;
            result.IgnoreCase = !caseSensitive;

            break;
          } //End of If.
        } //End ForEach loop.
      } // End of If if script exists.

      // If script block exists, see if this line matches any
      // of the match patterns.
      else
      {
        int patternIndex = 0;

        while (patternIndex < patterns.Length)
        {
          if ((simpleMatch &&
               wildcardPattern[patternIndex].IsMatch(line))
               || (regexPattern != null
               && regexPattern[patternIndex].IsMatch(line))
              )
          {
            result = new MatchInfo();
            result.IgnoreCase = !caseSensitive;
            result.Line = line;
            result.Pattern = patterns[patternIndex];
```

```
            break;
          }

          patternIndex++;

        }// While loop through patterns.
      }// Else for no script block specified.

      return result;

    }// End of SelectString

    /// <summary>
    /// Check whether the supplied name meets the include/exclude criteria.
    /// That is - it's on the include list if the include list was
    /// specified, and not on the exclude list if the exclude list was
specified.
    /// </summary>
    /// <param name="path">path to validate</param>
    /// <returns>True if the path is acceptable.</returns>
    private bool MeetsIncludeExcludeCriteria(string path)
    {
      bool ok = false;

      // See if the file is on the include list.
      if (this.include != null)
      {
        foreach (WildcardPattern patternItem in this.include)
        {
          if (patternItem.IsMatch(path))
          {
            ok = true;
            break;
          }
        }
      }
      else
      {
        ok = true;
      }

      if (!ok)
         return false;

      // See if the file is on the exclude list.
      if (this.exclude != null)
      {
        foreach (WildcardPattern patternItem in this.exclude)
        {
          if (patternItem.IsMatch(path))
          {
            ok = false;
            break;
          }
```

```
        }
      }

      return ok;
    } //MeetsIncludeExcludeCriteria
    #endregion Private Methods

  }// class SelectStringCommand

  #endregion SelectStringCommand

  #region MatchInfo

  /// <summary>
  /// Class representing the result of a pattern/literal match
  /// that is passed through the pipeline by the Select-Str cmdlet.
  /// </summary>
  public class MatchInfo
  {
    /// <summary>
    /// Indicates if the match was done ignoring case.
    /// </summary>
    /// <value>True if case was ignored.</value>
    public bool IgnoreCase
    {
      get { return ignoreCase; }
      set { ignoreCase = value; }
    }
    private bool ignoreCase;

    /// <summary>
    /// Specifies the number of the matching line.
    /// </summary>
    /// <value>The number of the matching line.</value>
    public UInt64 LineNumber
    {
      get { return lineNumber; }
      set { lineNumber = value; }
    }
    private UInt64 lineNumber;

    /// <summary>
    /// Specifies the text of the matching line.
    /// </summary>
    /// <value>The text of the matching line.</value>
    public string Line
    {
      get { return line; }
      set { line = value; }
    }
    private string line;

    /// <summary>
    /// Specifies the full path of the object(file) containing the
    /// matching line.
```

```
    /// </summary>
    /// <remarks>
    /// It will be "inputStream" if the object came from the input
    /// stream.
    /// </remarks>
    /// <value>The path name</value>
    public string Path
    {
      get { return path; }
      set
      {
        pathSet = true;
        path = value;
      }
    }
    private string path;
    private bool pathSet;

    /// <summary>
    /// Specifies the pattern that was used in the match.
    /// </summary>
    /// <value>The pattern string</value>
    public string Pattern
    {
      get { return pattern; }
      set { pattern = value; }
    }
    private string pattern;

    private const string MatchFormat = "{0}:{1}:{2}";

    /// <summary>
    /// Returns the string representation of this object. The format
    /// depends on whether a path has been set for this object or
    /// not.
    /// </summary>
    /// <remarks>
    /// If the path component is set, as would be the case when
    /// matching in a file, ToString() returns the path, line
    /// number and line text.  If path is not set, then just the
    /// line text is presented.
    /// </remarks>
    /// <returns>The string representation of the match object.</returns>
    public override string ToString()
    {
      if (pathSet)
         return String.Format(
         System.Threading.Thread.CurrentThread.CurrentCulture,
         MatchFormat,
         this.path,
         this.lineNumber,
         this.line
         );
      else
         return this.line;
```

```
    }
}// End class MatchInfo

#endregion

#region PowerShell snap-in

/// <summary>
/// Create a PowerShell snap-in for the Select-Str cmdlet.
/// </summary>
[RunInstaller(true)]
public class SelectStringPSSnapIn : PSSnapIn
{
    /// <summary>
    /// Create an instance of the SelectStrPSSnapin class.
    /// </summary>
    public SelectStringPSSnapIn()
           : base()
    {
    }

    /// <summary>
    /// Specify the name of the PowerShell snap-in.
    /// </summary>
    public override string Name
    {
      get
      {
        return "SelectStrPSSnapIn";
      }
    }

    /// <summary>
    /// Specify the vendor of the PowerShell snap-in.
    /// </summary>
    public override string Vendor
    {
      get
      {
        return "Microsoft";
      }
    }

    /// <summary>
    /// Specify the localization resource information for the vendor.
    /// Use the format: SnapinName,VendorName.
    /// </summary>
    public override string VendorResource
    {
      get
      {
        return "SelectStrSnapIn,Microsoft";
      }
    }
```

```
    /// <summary>
    /// Specify the description of the PowerShell snap-in.
    /// </summary>
    public override string Description
    {
      get
        {
          return "This is a PowerShell snap-in for the Select-Str cmdlet.";
        }
    }

    /// <summary>
    /// Specify the localization resource information for the description.
    /// Use the format: SnapinName,Description.

    /// </summary>
    public override string DescriptionResource
    {
      get
      {
          return "SelectStrSnapIn,This is a PowerShell snap-in for the
Select-Str cmdlet.";
        }
    }
  }
  #endregion PowerShell snap-in

} //namespace Microsoft.Samples.PowerShell.Commands;
```

Building the Cmdlet

After implementing a cmdlet, you must register it with Windows PowerShell through a Windows PowerShell snap-in. For more information about registering cmdlets, see How to Register Cmdlets, Providers, and Host Applications.

Testing the Cmdlet

When your cmdlet has been registered with Windows PowerShell, you can test it by running it on the command line. The following procedure can be used to test the sample Select-Str cmdlet.

1. Start Windows PowerShell, and search the Notes file for occurrences of lines with the expression ".NET". Note that the quotation marks around the name of the path are required only if the path consists of more than one word.

   PowerShell

```
select-str -Path "notes" -Pattern ".NET" -SimpleMatch=$false
```

The following output appears.

Output

```
IgnoreCase   : True
LineNumber   : 8
Line         : Because Windows PowerShell works directly with .NET
objects, there is often a .NET object
Path         : C:\PowerShell-Progs\workspace\Samples\SelectStr\notes
Pattern      : .NET
IgnoreCase   : True
LineNumber   : 21
Line         : You should normally define the class for a cmdlet in a
.NET namespace
Path         : C:\PowerShell-Progs\workspace\Samples\SelectStr\notes
Pattern      : .NET
```

2. Search the Notes file for occurrences of lines with the word "over", followed by any other text. The `SimpleMatch` parameter is using the default value of `false`. The search is case-insensitive because the `CaseSensitive` parameter is set to `false`.

PowerShell

```
select-str -Path notes -Pattern "over*" -SimpleMatch -
CaseSensitive:$false
```

The following output appears.

Output

```
IgnoreCase   : True
LineNumber   : 45
Line         : Override StopProcessing
Path         : C:\PowerShell-Progs\workspace\Samples\SelectStr\notes
Pattern      : over*
IgnoreCase   : True
LineNumber   : 49
Line         : overriding the StopProcessing method
Path         : C:\PowerShell-Progs\workspace\Samples\SelectStr\notes
Pattern      : over*
```

3. Search the Notes file using a regular expression as the pattern. The cmdlet searches for alphabetical characters and blank spaces enclosed in parentheses.

```
```

PowerShell

```
select-str -Path notes -Pattern "\([A-Za-z:blank:]" -SimpleMatch:$false
```

The following output appears.

Output

```
IgnoreCase   : True
LineNumber   : 1
Line         : Advisory Guidelines (Consider Following)
Path         : C:\PowerShell-Progs\workspace\Samples\SelectStr\notes
Pattern      : \([A-Za-z:blank:]
IgnoreCase   : True
LineNumber   : 53
Line         : If your cmdlet has objects that are not disposed of
(written to the pipeline)
Path         : C:\PowerShell-Progs\workspace\Samples\SelectStr\notes
Pattern      : \([A-Za-z:blank:]
```

4. Perform a case-sensitive search of the Notes file for occurrences of the word "Parameter".

PowerShell

```
select-str -Path notes -Pattern Parameter -CaseSensitive
```

The following output appears.

Output

```
IgnoreCase   : False
LineNumber   : 6
Line         : Support an InputObject Parameter
Path         : C:\PowerShell-Progs\workspace\Samples\SelectStr\notes
Pattern      : Parameter
IgnoreCase   : False
LineNumber   : 30
Line         : Support Force Parameter
Path         : C:\PowerShell-Progs\workspace\Samples\SelectStr\notes
Pattern      : Parameter
```

5. Search the variable provider shipped with Windows PowerShell for variables that have numerical values from 0 through 9.

PowerShell

```
select-str -Path * -Pattern "[0-9]"
```

The following output appears.

Output

```
IgnoreCase   : True
LineNumber   : 1
Line         : 64
Path         : Variable:\MaximumHistoryCount
Pattern      : [0-9]
```

6. Use a script block to search the file SelectStrCommandSample.cs for the string "Pos". The **cmatch** function for the script performs a case-insensitive pattern match.

PowerShell

```
select-str -Path "SelectStrCommandSample.cs" -Script { if ($args[0] -
cmatch "Pos"){ return $true } return $false }
```

The following output appears.

Output

```
IgnoreCase   : True
LineNumber   : 37
Line         :    Position = 0.
Path         : C:\PowerShell-
Progs\workspace\Samples\SelectStr\SelectStrCommandSample.cs
Pattern      :
```

See Also

How to Create a Windows PowerShell Cmdlet

Creating Your First Cmdlet

Creating a Cmdlet that Modifies the System

Design Your Windows PowerShell Provider

How Windows PowerShell Works

How to Register Cmdlets, Providers, and Host Applications

Cmdlet Samples

Article • 09/17/2021

This section describes sample code that is provided in the Windows PowerShell 2.0 SDK.

In This Section

GetProcessSample01 Sample This sample shows how to write a cmdlet that retrieves the processes on the local computer.

GetProcessSample02 Sample This sample shows how to write a cmdlet that retrieves the processes on the local computer. It provides a Name parameter that can be used to specify the processes to be retrieved.

GetProcessSample03 Sample This sample shows how to write a cmdlet that retrieves the processes on the local computer. It provides a Name parameter that can accept an object from the pipeline or a value from a property of an object whose property name is the same as the parameter name.

GetProcessSample04 Sample This sample shows how to write a cmdlet that retrieves the processes on the local computer. It generates a nonterminating error if an error occurs while retrieving a process.

GetProcessSample05 Sample This sample shows a complete version of the Get-Proc cmdlet.

StopProcessSample01 Sample This sample shows how to write a cmdlet that requests feedback from the user before it attempts to stop a process, and how to implement a `PassThru` parameter that indicates that the user wants the cmdlet to return an object.

StopProcessSample02 Sample This sample shows how to write a cmdlet that writes debug, verbose, and warning messages while stopping processes on the local computer.

StopProcessSample03 Sample This sample shows how to write a cmdlet whose parameters have aliases and that support wildcard characters.

StopProcessSample04 Sample This sample shows how to write a cmdlet that declares parameter sets, specifies the default parameter set, and can accept an input object.

Events01 Sample This sample shows how to create a cmdlet that allows the user to register for events raised by System.IO.Filesystemwatcher. With this cmdlet users can, for example, register an action to execute when a file is created under a specific directory.

This sample derives from the Microsoft.PowerShell.Commands.Objecteventregistrationbase base class.

See Also

Writing a Windows PowerShell Cmdlet

GetProcessSample01 Sample

Article • 09/17/2021

This sample shows how to implement a cmdlet that retrieves the processes on the local computer. This cmdlet is a simplified version of the `Get-Process` cmdlet that is provided by Windows PowerShell 2.0.

How to build the sample by using Visual Studio.

1. With the Windows PowerShell 2.0 SDK installed, navigate to the GetProcessSample01 folder. The default location is C:\Program Files (x86)\Microsoft SDKs\Windows\v7.0\Samples\sysmgmt\WindowsPowerShell\csharp\GetProcessSample01.
2. Double-click the icon for the solution (.sln) file. This opens the sample project in Microsoft Visual Studio.
3. In the **Build** menu, select **Build Solution**.

The library for the sample will be built in the default \bin or \bin\debug folders.

How to run the sample

1. Open a Command Prompt window.
2. Navigate to the directory containing the sample .dll file.
3. Run installutil "GetProcessSample01.dll".
4. Start Windows PowerShell.
5. Run the following command to add the snap-in to the shell.

   ```
   Add-PSSnapin GetProcPSSnapIn01
   ```

6. Enter the following command to run the cmdlet. `get-proc`

   ```
   get-proc
   ```

   This is a sample output that results from following these steps.

Output

```
Id              Name            State      HasMoreData     Location
Command
--              ----            -----      -----------     --------
-------
1               26932870-d3b... NotStarted False
Write-Host "A f...
```

PowerShell

```
Set-Content $env:temp\test.txt "This is a test file"
```

Output

```
A file was created in the TEMP directory
```

Requirements

This sample requires Windows PowerShell 1.0 or later.

Demonstrates

This sample demonstrates the following.

- Creating a basic sample cmdlet.
- Defining a cmdlet class by using the Cmdlet attribute.
- Creating a snap-in that works with both Windows PowerShell 1.0 and Windows PowerShell 2.0. Subsequent samples use modules instead of snap-ins so they require Windows PowerShell 2.0.

Example

This sample shows how to create a simple cmdlet and its snap-in.

C#

```
using System;
using System.Diagnostics;
using System.Management.Automation;             //Windows PowerShell
```

```
namespace
using System.ComponentModel;

namespace Microsoft.Samples.PowerShell.Commands
{

   #region GetProcCommand

   /// <summary>
   /// This class implements the Get-Proc cmdlet.
   /// </summary>
   [Cmdlet(VerbsCommon.Get, "Proc")]
   public class GetProcCommand : Cmdlet
   {
      #region Cmdlet Overrides

      /// <summary>
      /// The ProcessRecord method calls the Process.GetProcesses
      /// method to retrieve the processes of the local computer.
      /// Then, the WriteObject method writes the associated processes
      /// to the pipeline.
      /// </summary>
      protected override void ProcessRecord()
      {
         // Retrieve the current processes.
         Process[] processes = Process.GetProcesses();

         // Write the processes to the pipeline to make them available
         // to the next cmdlet. The second argument (true) tells Windows
         // PowerShell to enumerate the array and to send one process
         // object at a time to the pipeline.
         WriteObject(processes, true);
      }

      #endregion Overrides

   } //GetProcCommand

   #endregion GetProcCommand

   #region PowerShell snap-in

   /// <summary>
   /// Create this sample as an PowerShell snap-in
   /// </summary>
   [RunInstaller(true)]
   public class GetProcPSSnapIn01 : PSSnapIn
   {
       /// <summary>
       /// Create an instance of the GetProcPSSnapIn01
       /// </summary>
       public GetProcPSSnapIn01()
           : base()
       {
       }
```

```
        /// <summary>
        /// Get a name for this PowerShell snap-in. This name will be used in
registering
        /// this PowerShell snap-in.
        /// </summary>
        public override string Name
        {
            get
            {
                return "GetProcPSSnapIn01";
            }
        }

        /// <summary>
        /// Vendor information for this PowerShell snap-in.
        /// </summary>
        public override string Vendor
        {
            get
            {
                return "Microsoft";
            }
        }

        /// <summary>
        /// Gets resource information for vendor. This is a string of format:
        /// resourceBaseName,resourceName.
        /// </summary>
        public override string VendorResource
        {
            get
            {
                return "GetProcPSSnapIn01,Microsoft";
            }
        }

        /// <summary>
        /// Description of this PowerShell snap-in.
        /// </summary>
        public override string Description
        {
            get
            {
                return "This is a PowerShell snap-in that includes the get-
proc cmdlet.";
            }
        }
    }

    #endregion PowerShell snap-in
}
```

See Also

Writing a Windows PowerShell Cmdlet

GetProcessSample02 Sample

Article • 09/17/2021

This sample shows how to write a cmdlet that retrieves the processes on the local computer. It provides a `Name` parameter that can be used to specify the processes to be retrieved. This cmdlet is a simplified version of the `Get-Process` cmdlet provided by Windows PowerShell 2.0.

How to build the sample using Visual Studio.

1. With the Windows PowerShell 2.0 SDK installed, navigate to the GetProcessSample02 folder. The default location is C:\Program Files (x86)\Microsoft SDKs\Windows\v7.0\Samples\sysmgmt\WindowsPowerShell\csharp\GetProcessSample02.

2. Double-click the icon for the solution (.sln) file. This opens the sample project in Visual Studio.

3. In the **Build** menu, select **Build Solution**.

   The library for the sample will be built in the default \bin or \bin\debug folders.

How to run the sample

1. Create the following module folder:

   `[user]/documents/windowspowershell/modules/GetProcessSample02`

2. Copy the sample assembly to the module folder.

3. Start Windows PowerShell.

4. Run the following command to load the assembly into Windows PowerShell:

   `import-module getprossessample02`

5. Run the following command to run the cmdlet:

   `get-proc`

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

This sample demonstrates the following.

- Declaring a cmdlet class using the Cmdlet attribute.
- Declaring a cmdlet parameter using the Parameter attribute.
- Specifying the position of the parameter.
- Declaring a validation attribute for the parameter input.

Example

This sample shows an implementation of the Get-Proc cmdlet that includes a `Name` parameter.

C#

```
namespace Microsoft.Samples.PowerShell.Commands
{
  using System;
  using System.Diagnostics;
  using System.Management.Automation;     // Windows PowerShell namespace

  #region GetProcCommand

  /// <summary>
  /// This class implements the get-proc cmdlet.
  /// </summary>
  [Cmdlet(VerbsCommon.Get, "Proc")]
  public class GetProcCommand : Cmdlet
  {
    #region Parameters

    /// <summary>
    /// The names of the processes retrieved by the cmdlet.
    /// </summary>
    private string[] processNames;

    /// <summary>
    /// Gets or sets the list of process names on which
    /// the Get-Proc cmdlet will work.
    /// </summary>
    [Parameter(Position = 0)]
    [ValidateNotNullOrEmpty]
    public string[] Name
```

```
    {
      get { return this.processNames; }
      set { this.processNames = value; }
    }

    #endregion Parameters

    #region Cmdlet Overrides

    /// <summary>
    /// The ProcessRecord method calls the Process.GetProcesses
    /// method to retrieve the processes specified by the Name
    /// parameter. Then, the WriteObject method writes the
    /// associated process objects to the pipeline.
    /// </summary>
    protected override void ProcessRecord()
    {
      // If no process names are passed to the cmdlet, get all
      // processes.
      if (this.processNames == null)
      {
        WriteObject(Process.GetProcesses(), true);
      }
      else
      {
        // If process names are passed to cmdlet, get and write
        // the associated processes.
        foreach (string name in this.processNames)
        {
          WriteObject(Process.GetProcessesByName(name), true);
        }
      } // End if (processNames...).
    } // End ProcessRecord.
    #endregion Cmdlet Overrides
  } // End GetProcCommand class.
  #endregion GetProcCommand
}
```

See Also

Writing a Windows PowerShell Cmdlet

GetProcessSample03 Sample

Article • 09/17/2021

This sample shows how to implement a cmdlet that retrieves the processes on the local computer. It provides a `Name` parameter that can accept an object from the pipeline or a value from a property of an object whose property name is the same as the parameter name. This cmdlet is a simplified version of the `Get-Process` cmdlet provided by Windows PowerShell 2.0.

How to build the sample using Visual Studio.

1. With the Windows PowerShell 2.0 SDK installed, navigate to the GetProcessSample03 folder. The default location is C:\Program Files (x86)\Microsoft SDKs\Windows\v7.0\Samples\sysmgmt\WindowsPowerShell\csharp\GetProcessSample03.
2. Double-click the icon for the solution (.sln) file. This opens the sample project in Visual Studio.
3. In the **Build** menu, select **Build Solution**.

   The library for the sample will be built in the default \bin or \bin\debug folders.

How to run the sample

1. Create the following module folder:

   `[user]/documents/windowspowershell/modules/GetProcessSample03`

2. Copy the sample assembly to the module folder.
3. Start Windows PowerShell.
4. Run the following command to load the assembly into Windows PowerShell:

   `Import-module getprossessample03`

5. Run the following command to run the cmdlet:

   `get-proc`

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

This sample demonstrates the following.

- Declaring a cmdlet class using the Cmdlet attribute.
- Declaring a cmdlet parameter using the Parameter attribute.
- Specifying the position of the parameter.
- Specifying that the parameter takes input from the pipeline. The input can be taken from an object or a value from a property of an object whose property name is the same as the parameter name.
- Declaring a validation attribute for the parameter input.

Example

This sample shows an implementation of the Get-Proc cmdlet that includes a `Name` parameter that accepts input from the pipeline.

C#

```
namespace Microsoft.Samples.PowerShell.Commands
{
  using System;
  using System.Diagnostics;
  using System.Management.Automation;           // Windows PowerShell
namespace
  #region GetProcCommand

  /// <summary>
  /// This class implements the get-proc cmdlet.
  /// </summary>
  [Cmdlet(VerbsCommon.Get, "Proc")]
  public class GetProcCommand : Cmdlet
  {
    #region Parameters

    /// <summary>
    /// The names of the processes retrieved by the cmdlet.
    /// </summary>
    private string[] processNames;
```

```
    /// <summary>
    /// Gets or sets the names of the
    /// process that the cmdlet will retrieve.
    /// </summary>
    [Parameter(
               Position = 0,
               ValueFromPipeline = true,
               ValueFromPipelineByPropertyName = true)]
    [ValidateNotNullOrEmpty]
    public string[] Name
    {
      get { return this.processNames; }
      set { this.processNames = value; }
    }

    #endregion Parameters

    #region Cmdlet Overrides

    /// <summary>
    /// The ProcessRecord method calls the Process.GetProcesses
    /// method to retrieve the processes specified by the Name
    /// parameter. Then, the WriteObject method writes the
    /// associated processes to the pipeline.
    /// </summary>
    protected override void ProcessRecord()
    {
      // If no process names are passed to the cmdlet, get all
      // processes.
      if (this.processNames == null)
      {
        WriteObject(Process.GetProcesses(), true);
      }
      else
      {
        // If process names are passed to the cmdlet, get and write
        // the associated processes.
        foreach (string name in this.processNames)
        {
          WriteObject(Process.GetProcessesByName(name), true);
        }
      } // End if (processNames ...)
    } // End ProcessRecord.

    #endregion Overrides
  } // End GetProcCommand.
  #endregion GetProcCommand
}
```

See Also

GetProcessSample04 Sample

Article • 09/17/2021

This sample shows how to implement a cmdlet that retrieves the processes on the local computer. It generates a nonterminating error if an error occurs while retrieving a process. This cmdlet is a simplified version of the `Get-Process` cmdlet provided by Windows PowerShell 2.0.

How to build the sample using Visual Studio.

1. With the Windows PowerShell 2.0 SDK installed, navigate to the GetProcessSample04 folder. The default location is C:\Program Files (x86)\Microsoft SDKs\Windows\v7.0\Samples\sysmgmt\WindowsPowerShell\csharp\GetProcessSample04.

2. Double-click the icon for the solution (.sln) file. This opens the sample project in Visual Studio.

3. In the **Build** menu, select **Build Solution**.

   The library for the sample will be built in the default \bin or \bin\debug folders.

How to run the sample

1. Create the following module folder:

   `[user]/documents/windowspowershell/modules/GetProcessSample04`

2. Copy the sample assembly to the module folder.

3. Start Windows PowerShell.

4. Run the following command to load the assembly into Windows PowerShell:

   `Import-module getprossessample04`

5. Run the following command to run the cmdlet:

   `get-proc`

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

This sample demonstrates the following.

- Declaring a cmdlet class using the Cmdlet attribute.
- Declaring a cmdlet parameter using the Parameter attribute.
- Specifying the position of the parameter.
- Specifying that the parameter takes input from the pipeline. The input can be taken from an object or a value from a property of an object whose property name is the same as the parameter name.
- Declaring a validation attribute for the parameter input.
- Trapping a nonterminating error and writing an error message to the error stream.

Example

This sample shows how to create a cmdlet that handles nonterminating errors and writes error messages to the error stream.

C#

```
namespace Microsoft.Samples.PowerShell.Commands
{
    using System;
    using System.Diagnostics;
    using System.Management.Automation;      // Windows PowerShell
namespace.
   #region GetProcCommand

   /// <summary>
   /// This class implements the get-proc cmdlet.
   /// </summary>
   [Cmdlet(VerbsCommon.Get, "Proc")]
   public class GetProcCommand : Cmdlet
   {
      #region Parameters

       /// <summary>
       /// The names of the processes to act on.
       /// </summary>
       private string[] processNames;
```

```
        /// <summary>
        /// Gets or sets the list of process names on
        /// which the Get-Proc cmdlet will work.
        /// </summary>
        [Parameter(
           Position = 0,
           ValueFromPipeline = true,
           ValueFromPipelineByPropertyName = true)]
        [ValidateNotNullOrEmpty]
        public string[] Name
        {
           get { return this.processNames; }
           set { this.processNames = value; }
        }

        #endregion Parameters

        #region Cmdlet Overrides

        /// <summary>
        /// The ProcessRecord method calls the Process.GetProcesses
        /// method to retrieve the processes specified by the Name
        /// parameter. Then, the WriteObject method writes the
        /// associated processes to the pipeline.
        /// </summary>
        protected override void ProcessRecord()
        {
            // If no process names are passed to cmdlet, get all
            // processes.
            if (this.processNames == null)
            {
                WriteObject(Process.GetProcesses(), true);
            }
            else
            {
                // If process names are passed to the cmdlet, get and write
                // the associated processes.
                // If a nonterminating error occurs while retrieving
processes,
                // call the WriteError method to send an error record to the
                // error stream.
                foreach (string name in this.processNames)
                {
                    Process[] processes;

                    try
                    {
                        processes = Process.GetProcessesByName(name);
                    }
                    catch (InvalidOperationException ex)
                    {
                        WriteError(new ErrorRecord(
                           ex,
                           "UnableToAccessProcessByName",
                           ErrorCategory.InvalidOperation,
```

```
                        name));
                    continue;
                }

                WriteObject(processes, true);
            } // foreach (string name...
        } // else
    } // ProcessRecord

    #endregion Overrides
} // End GetProcCommand class.

#endregion GetProcCommand
}
```

See Also

Writing a Windows PowerShell Cmdlet

GetProcessSample05 Sample

Article • 09/17/2021

This sample shows a complete version of the Get-Proc cmdlet.

How to build the sample using Visual Studio.

1. Open Windows Explorer and navigate to the GetProcessSample05 directory under the Samples directory.

   With the Windows PowerShell 2.0 SDK installed, navigate to the GetProcessSample05 folder. The default location is C:\Program Files (x86)\Microsoft SDKs\Windows\v7.0\Samples\sysmgmt\WindowsPowerShell\csharp\GetProcessSample05.

2. Double-click the icon for the solution (.sln) file. This opens the sample project in Visual Studio.

3. In the **Build** menu, select **Build Solution**.

   The library for the sample will be built in the default \bin or \bin\debug directories.

How to run the sample

1. Create the following module folder:

   ```
   [user]/documents/windowspowershell/modules/GetProcessSample05
   ```

2. Copy the sample assembly to the module folder.

3. Start Windows PowerShell.

4. Run the following command to load the assembly into Windows PowerShell:

   ```
   Import-module getprossessample05
   ```

5. Run the following command to run the cmdlet:

   ```
   get-proc
   ```

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

This sample demonstrates the following.

- Declaring a cmdlet class using the Cmdlet attribute.
- Declaring a cmdlet parameter using the Parameter attribute.
- Specifying positions for parameters.
- Specifying that parameters can take input from the pipeline. The input can be taken from an object or a value from a property of an object whose property name is the same as the parameter name.
- Declaring a validation attribute for the parameter input.
- Handling errors and exceptions.
- Writing debug messages.

Example

This sample shows how to create a cmdlet that displays a list of specified processes.

C#

```
namespace Microsoft.Samples.PowerShell.Commands
{
    using System;
    using System.Collections.Generic;
    using System.Diagnostics;
    using System.Management.Automation;    // Windows PowerShell namespace.
    using System.Security.Permissions;
    using Win32Exception = System.ComponentModel.Win32Exception;
    #region GetProcCommand

    /// <summary>
   /// This class implements the get-proc cmdlet.
   /// </summary>
   [Cmdlet(VerbsCommon.Get, "Proc",
      DefaultParameterSetName = "ProcessName")]
   public class GetProcCommand : PSCmdlet
   {
       #region Fields
       /// <summary>
       /// The names of the processes to act on.
```

```
        /// </summary>
        private string[] processNames;

        /// <summary>
        /// The identifiers of the processes to act on.
        /// </summary>
        private int[] processIds;

        /// <summary>
        /// The process objects to act on.
        /// </summary>
        private Process[] inputObjects;

        #endregion Fields

        #region Parameters

       /// <summary>
       /// Gets or sets the list of process names on
       /// which the Get-Proc cmdlet will work.
       /// </summary>
       [Parameter(
          Position = 0,
          ParameterSetName = "ProcessName",
          ValueFromPipeline = true,
          ValueFromPipelineByPropertyName = true)]
       [ValidateNotNullOrEmpty]
       public string[] Name
       {
          get { return this.processNames; }
          set { this.processNames = value; }
       }

       /// <summary>
       /// Gets or sets the list of process identifiers on
       /// which the Get-Proc cmdlet will work.
       /// </summary>
       [Parameter(
          ParameterSetName = "Id",
          Mandatory = true,
          ValueFromPipeline = true,
          ValueFromPipelineByPropertyName = true,
          HelpMessage = "The unique id of the process to get.")]
       public int[] Id
       {
          get { return this.processIds; }
          set { this.processIds = value; }
       }

       /// <summary>
       /// Gets or sets Process objects directly. If the input is a
       /// stream of [collection of] Process objects, the cmdlet bypasses the
       /// ProcessName and Id parameters and reads the Process objects
       /// directly.  This allows the cmdlet to deal with processes that have
       /// wildcard characters in their name.
```

```
        /// <value>Process objects</value>
        /// </summary>
        [Parameter(
           ParameterSetName = "InputObject",
           Mandatory = true,
           ValueFromPipeline = true)]
        public Process[] Input
        {
           get { return this.inputObjects; }
           set { this.inputObjects = value; }
        }

        #endregion Parameters

        #region Cmdlet Overrides

        /// <summary>
        /// The ProcessRecord method calls the Process.GetProcesses
        /// method to retrieve the processes. Then, the WriteObject
        /// method writes the associated processes to the pipeline.
        /// </summary>
        protected override void ProcessRecord()
        {
           List<Process> matchingProcesses;

           WriteDebug("Obtaining the list of matching process objects.");

           switch (ParameterSetName)
           {
              case "Id":
                 matchingProcesses = this.GetMatchingProcessesById();
                 break;
              case "ProcessName":
                 matchingProcesses = this.GetMatchingProcessesByName();
                 break;
              case "InputObject":
                 matchingProcesses = this.GetProcessesByInput();
                 break;
              default:
                 ThrowTerminatingError(
                     new ErrorRecord(
                         new ArgumentException("Bad ParameterSetName"),
                         "UnableToAccessProcessList",
                         ErrorCategory.InvalidOperation,
                         null));
                 return;
           } // switch (ParameterSetName)

           WriteDebug("Outputting the matching process objects.");

           matchingProcesses.Sort(ProcessComparison);

           foreach (Process process in matchingProcesses)
           {
              WriteObject(process);
```

```
        }
    } // ProcessRecord

    #endregion Overrides

    #region protected Methods and Data

    /// <summary>
    /// Retrieves the list of all processes matching the ProcessName
    /// parameter and generates a nonterminating error for each
    /// specified process name which is not found even though the name
    /// contains no wildcards.
    /// </summary>
    /// <returns>The matching processes.</returns>
    [EnvironmentPermissionAttribute(
        SecurityAction.LinkDemand,
        Unrestricted = true)]
    private List<Process> GetMatchingProcessesByName()
    {
        new EnvironmentPermission(
            PermissionState.Unrestricted).Assert();

        List<Process> allProcesses =
            new List<Process>(Process.GetProcesses());

        // The keys dictionary is used for rapid lookup of
        // processes that are already in the matchingProcesses list.
        Dictionary<int, byte> keys = new Dictionary<int, byte>();

        List<Process> matchingProcesses = new List<Process>();

        if (null == this.processNames)
        {
            matchingProcesses.AddRange(allProcesses);
        }
        else
        {
            foreach (string pattern in this.processNames)
            {
                WriteVerbose("Finding matches for process name \""
                    + pattern + "\".");

                // WildCard search on the available processes
                WildcardPattern wildcard =
                    new WildcardPattern(
                        pattern,
                        WildcardOptions.IgnoreCase);

                bool found = false;

                foreach (Process process in allProcesses)
                {
                    if (!keys.ContainsKey(process.Id))
                    {
                        string processName = SafeGetProcessName(process);
```

```
                        // Remove the process from the allProcesses list
                        // so that it is not tested again.
                        if (processName.Length == 0)
                        {
                            allProcesses.Remove(process);
                        }

                        // Perform a wildcard search on this particular
                        // process name and check whether it matches the
                        // pattern specified.
                        if (!wildcard.IsMatch(processName))
                        {
                            continue;
                        }

                        WriteDebug("Found matching process id "
                           + process.Id + ".");

                        // A match is found.
                        found = true;

                        // Store the process identifier so that the same
process
                        // is not added twice.
                        keys.Add(process.Id, 0);

                        // Add the process to the processes list.
                        matchingProcesses.Add(process);
                    }
                } // foreach (Process...

                if (!found &&
                  !WildcardPattern.ContainsWildcardCharacters(pattern))
                {
                    WriteError(new ErrorRecord(
                       new ArgumentException("Cannot find process name "
                          + "\"" + pattern + "\"."),
                       "ProcessNameNotFound",
                       ErrorCategory.ObjectNotFound,
                       pattern));
                }
            } // foreach (string...
        } // if (null...

        return matchingProcesses;
    } // GetMatchingProcessesByName

    /// <summary>
    /// Returns the name of a process.  If an error occurs, a blank
    /// string is returned.
    /// </summary>
    /// <param name="process">The process whose name is
    /// returned.</param>
    /// <returns>The name of the process.</returns>
```

```
        [EnvironmentPermissionAttribute(
           SecurityAction.LinkDemand, Unrestricted = true)]
        protected static string SafeGetProcessName(Process process)
        {
           new EnvironmentPermission(PermissionState.Unrestricted).Assert();
           string name = String.Empty;

           if (process != null)
           {
              try
              {
                  return process.ProcessName;
              }
              catch (Win32Exception)
              {
              }
              catch (InvalidOperationException)
              {
              }
           }

           return name;
        } // SafeGetProcessName

        #endregion Cmdlet Overrides

        #region Private Methods

        /// <summary>
        /// Function to sort by process name first, and then by
        /// the process identifier.
        /// </summary>
        /// <param name="x">First process object.</param>
        /// <param name="y">Second process object.</param>
        /// <returns>
        /// Returns less than zero if x is less than y,
        /// greater than 0 if x is greater than y, and 0 if x == y.
        /// </returns>
        private static int ProcessComparison(Process x, Process y)
        {
           int diff = String.Compare(
              SafeGetProcessName(x),
              SafeGetProcessName(y),
              StringComparison.CurrentCultureIgnoreCase);

           if (0 != diff)
           {
               return diff;
           }
           else
           {
               return x.Id.CompareTo(y.Id);
           }
        }
```

```
        /// <summary>
        /// Retrieves the list of all processes matching the Id
        /// parameter and generates a nonterminating error for
        /// each specified process identifier which is not found.
        /// </summary>
        /// <returns>
        /// An array of processes that match the given identifier.
        /// </returns>
        [EnvironmentPermissionAttribute(
           SecurityAction.LinkDemand,
           Unrestricted = true)]
        private List<Process> GetMatchingProcessesById()
        {
           new EnvironmentPermission(
              PermissionState.Unrestricted).Assert();

           List<Process> matchingProcesses = new List<Process>();

           if (null != this.processIds)
           {
              // The keys dictionary is used for rapid lookup of the
              // processes already in the matchingProcesses list.
              Dictionary<int, byte> keys = new Dictionary<int, byte>();

              foreach (int processId in this.processIds)
              {
                 WriteVerbose("Finding match for process id "
                    + processId + ".");

                 if (!keys.ContainsKey(processId))
                 {
                    Process process;
                    try
                    {
                        process = Process.GetProcessById(processId);
                    }
                    catch (ArgumentException ex)
                    {
                       WriteError(new ErrorRecord(
                          ex,
                          "ProcessIdNotFound",
                          ErrorCategory.ObjectNotFound,
                          processId));
                       continue;
                    }

                    WriteDebug("Found matching process.");

                    matchingProcesses.Add(process);
                    keys.Add(processId, 0);
                 }
              }
           }

           return matchingProcesses;
```

```
        } // GetMatchingProcessesById

        /// <summary>
        /// Retrieves the list of all processes matching the InputObject
        /// parameter.
        /// </summary>
        /// <returns>The matching processes.</returns>
        [EnvironmentPermissionAttribute(
           SecurityAction.LinkDemand,
           Unrestricted = true)]
        private List<Process> GetProcessesByInput()
        {
           new EnvironmentPermission(
              PermissionState.Unrestricted).Assert();

           List<Process> matchingProcesses = new List<Process>();

           if (null != this.Input)
           {
              // The keys dictionary is used for rapid lookup of the
              // processes already in the matchingProcesses list.
              Dictionary<int, byte> keys = new Dictionary<int, byte>();

              foreach (Process process in this.Input)
              {
                 WriteVerbose("Refreshing process object.");

                 if (!keys.ContainsKey(process.Id))
                 {
                    try
                    {
                        process.Refresh();
                    }
                    catch (Win32Exception)
                    {
                    }
                    catch (InvalidOperationException)
                    {
                    }

                    matchingProcesses.Add(process);
                 }
              }
           }

           return matchingProcesses;
        } // GetProcessesByInput
        #endregion Private Methods
     } // End GetProcCommand class.

     #endregion GetProcCommand
}
```

See Also

Writing a Windows PowerShell Cmdlet

StopProcessSample01 Sample

Article • 09/17/2021

This sample shows how to write a cmdlet that requests feedback from the user before it attempts to stop a process, and how to implement a `PassThru` parameter indicating that the user wants the cmdlet to return an object. This cmdlet is similar to the `Stop-Process` cmdlet provided by Windows PowerShell 2.0.

How to build the sample by using Visual Studio.

1. With the Windows PowerShell 2.0 SDK installed, navigate to the StopProcessSample01 folder. The default location is C:\Program Files (x86)\Microsoft SDKs\Windows\v7.0\Samples\sysmgmt\WindowsPowerShell\csharp\StopProcessSample01.

2. Double-click the icon for the solution (.sln) file. This opens the sample project in Microsoft Visual Studio.

3. In the **Build** menu, select **Build Solution**.

   The library for the sample will be built in the default \bin or \bin\debug folders.

How to run the sample

1. Create the following module folder:

   `[user]/documents/windowspowershell/modules/StopProcessSample01`

2. Copy the sample assembly to the module folder.

3. Start Windows PowerShell.

4. Run the following command to load the assembly into Windows PowerShell:

   `import-module stopprossessample01`

5. Run the following command to run the cmdlet:

   `stop-proc`

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

This sample demonstrates the following.

- Declaring a cmdlet class by using the Cmdlet attribute.
- Declaring a cmdlet parameters by using the Parameter attribute.
- Calling the ShouldProcess method to request confirmation.
- Implementing a `PassThru` parameter that indicates if the user wants the cmdlet to return an object. By default, this cmdlet does not return an object to the pipeline.

Example

This sample shows how to implement a `PassThru` parameter that indicates that the user wants the cmdlet to return an object, and how to request user feedback by calls to the `ShouldProcess` and `ShouldContinue` methods.

C#

```
using System;
using System.Diagnostics;
using System.Collections;
using Win32Exception = System.ComponentModel.Win32Exception;
using System.Management.Automation;    // Windows PowerShell namespace
using System.Globalization;

namespace Microsoft.Samples.PowerShell.Commands
{
   #region StopProcCommand

    /// <summary>
   /// This class implements the stop-proc cmdlet.
   /// </summary>
   [Cmdlet(VerbsLifecycle.Stop, "Proc",
       SupportsShouldProcess = true)]
   public class StopProcCommand : Cmdlet
   {
       #region Parameters

      /// <summary>
      /// This parameter provides the list of process names on
      /// which the Stop-Proc cmdlet will work.
      /// </summary>
       [Parameter(
```

```
            Position = 0,
            Mandatory = true,
            ValueFromPipeline = true,
            ValueFromPipelineByPropertyName = true
        )]
        public string[] Name
        {
            get { return processNames; }
            set { processNames = value; }
        }
        private string[] processNames;

        /// <summary>
        /// This parameter overrides the ShouldContinue call to force
        /// the cmdlet to stop its operation. This parameter should always
        /// be used with caution.
        /// </summary>
        [Parameter]
        public SwitchParameter Force
        {
            get { return force; }
            set { force = value; }
        }
        private bool force;

        /// <summary>
        /// This parameter indicates that the cmdlet should return
        /// an object to the pipeline after the processing has been
        /// completed.
        /// </summary>
        [Parameter]
        public SwitchParameter PassThru
        {
            get { return passThru; }
            set { passThru = value; }
        }
        private bool passThru;

        #endregion Parameters

        #region Cmdlet Overrides

        /// <summary>
        /// The ProcessRecord method does the following for each of the
        /// requested process names:
        /// 1) Check that the process is not a critical process.
        /// 2) Attempt to stop that process.
        /// If no process is requested then nothing occurs.
        /// </summary>
        protected override void ProcessRecord()
        {
            foreach (string name in processNames)
            {
                // For every process name passed to the cmdlet, get the
associated
```

```
                // processes.
                // Write a nonterminating error for failure to retrieve
                // a process.
                Process[] processes;

                try
                {
                    processes = Process.GetProcessesByName(name);
                }
                catch (InvalidOperationException ioe)
                {
                    WriteError(new
ErrorRecord(ioe,"UnableToAccessProcessByName",
                        ErrorCategory.InvalidOperation, name));

                    continue;
                }

                // Try to stop the processes that have been retrieved.
                foreach (Process process in processes)
                {
                    string processName;

                    try
                    {
                        processName = process.ProcessName;
                    }
                    catch (Win32Exception e)
                    {
                       WriteError(new ErrorRecord(e, "ProcessNameNotFound",
                                        ErrorCategory.ReadError,
process));
                       continue;
                    }

                    // Confirm the operation with the user first.
                    // This is always false if the WhatIf parameter is set.
                    if
(!ShouldProcess(string.Format(CultureInfo.CurrentCulture,"{0} ({1})",
processName,
                                process.Id)))
                    {
                        continue;
                    }

                    // Make sure that the user really wants to stop a
critical
                    // process that could possibly stop the computer.
                    bool criticalProcess =

criticalProcessNames.Contains(processName.ToLower(CultureInfo.CurrentCulture
));

                    if (criticalProcess &&!force)
                    {
```

```
                        string message = String.Format
                            (CultureInfo.CurrentCulture,
                                 "The process \"{0}\" is a critical process
and should not be stopped. Are you sure you wish to stop the process?",
                                      processName);

                        // It is possible that the ProcessRecord method is
called
                        // multiple times when objects are received as inputs
from
                        // the pipeline. So to retain YesToAll and NoToAll
input that
                        // the user may enter across multiple calls to this
function,
                        // they are stored as private members of the cmdlet.
                        if (!ShouldContinue(message, "Warning!",
                                            ref yesToAll, ref noToAll))
                        {
                            continue;
                        }
                    } // if (criticalProcess...

                    // Stop the named process.
                    try
                    {
                        process.Kill();
                    }
                    catch (Exception e)
                    {
                        if ((e is Win32Exception) || (e is SystemException)
||
                           (e is InvalidOperationException))
                        {
                            // This process could not be stopped so write
                            // a nonterminating error.
                            WriteError(new ErrorRecord(e,
"CouldNotStopProcess",
                                                       ErrorCategory.CloseError,
process));
                            continue;
                        } // if ((e is...
                        else throw;
                    } // catch

                    // If the PassThru parameter is
                    // specified, return the terminated process.
                    if (passThru)
                    {
                        WriteObject(process);
                    }
                } // foreach (Process...
            } // foreach (string...
        } // ProcessRecord

        #endregion Cmdlet Overrides
```

```
        #region Private Data

        private bool yesToAll, noToAll;

        /// <summary>
        /// Partial list of critical processes that should not be
        /// stopped.  Lower case is used for case insensitive matching.
        /// </summary>
        private ArrayList criticalProcessNames = new ArrayList(
           new string[] { "system", "winlogon", "spoolsv" }
        );

        #endregion Private Data

    } // StopProcCommand

    #endregion StopProcCommand
}
```

See Also

Writing a Windows PowerShell Cmdlet

StopProcessSample02 Sample

Article • 09/17/2021

This sample shows how to write a cmdlet that writes debug (WriteDebug), verbose (WriteVerbose), and warning (WriteWarning) messages while stopping processes on the local computer. This cmdlet is similar to the `Stop-Process` cmdlet provided by Windows PowerShell 2.0.

How to build the sample by using Visual Studio.

1. Open Windows Internet Explorer and navigate to the StopProcessSample02 directory under the Samples directory.

   With the Windows PowerShell 2.0 SDK installed, navigate to the StopProcessSample02 folder. The default location is C:\Program Files (x86)\Microsoft SDKs\Windows\v7.0\Samples\sysmgmt\WindowsPowerShell\csharp\StopProcessSample02.

2. Double-click the icon for the solution (.sln) file. This opens the sample project in Microsoft Visual Studio.

3. In the **Build** menu, select **Build Solution**.

   The library for the sample will be built in the default \bin or \bin\debug folders.

How to run the sample

1. Create the following module folder:

   `[user]/documents/windowspowershell/modules/StopProcessSample02`

2. Copy the sample assembly to the module folder.

3. Start Windows PowerShell.

4. Run the following command to load the assembly into Windows PowerShell:

   `import-module stopprossessample02`

5. Run the following command to run the cmdlet:

   `stop-proc`

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

This sample demonstrates the following.

- Declaring a cmdlet class by using the Cmdlet attribute.
- Declaring a cmdlet parameters by using the Parameter attribute.
- Writing verbose messages. For more information about the method used to write verbose messages, see System.Management.Automation.Cmdlet.WriteVerbose.
- Writing error messages. For more information about the method used to write error messages, see System.Management.Automation.Cmdlet.WriteError.
- Writing warning messages. For more information about the method used to write warning messages, see System.Management.Automation.Cmdlet.WriteWarning.

Example

This sample shows how to write debug, verbose, and warning messages by using the `WriteDebug`, `WriteVerbose`, and `WriteWarning` methods.

C#

```
using System;
using System.Diagnostics;
using System.Collections;
using Win32Exception = System.ComponentModel.Win32Exception;
using System.Management.Automation;             //Windows PowerShell
namespace
using System.Globalization;

namespace Microsoft.Samples.PowerShell.Commands
{
   #region StopProcCommand

    /// <summary>
   /// This class implements the stop-proc cmdlet.
   /// </summary>
   [Cmdlet(VerbsLifecycle.Stop, "Proc",
       SupportsShouldProcess = true)]
   public class StopProcCommand : Cmdlet
   {
```

```
        #region Parameters

        /// <summary>
        /// This parameter provides the list of process names on
        /// which the Stop-Proc cmdlet will work.
        /// </summary>
        [Parameter(
           Position = 0,
           Mandatory = true,
           ValueFromPipeline = true,
           ValueFromPipelineByPropertyName = true
        )]
        public string[] Name
        {
           get { return processNames; }
           set { processNames = value; }
        }
        private string[] processNames;

        /// <summary>
        /// This parameter overrides the ShouldContinue call to force
        /// the cmdlet to stop its operation. This parameter should always
        /// be used with caution.
        /// </summary>
        [Parameter]
        public SwitchParameter Force
        {
            get { return force; }
            set { force = value; }
        }
        private bool force;

        /// <summary>
        /// This parameter indicates that the cmdlet should return
        /// an object to the pipeline after the processing has been
        /// completed.
        /// </summary>
        [Parameter]
        public SwitchParameter PassThru
        {
            get { return passThru; }
            set { passThru = value; }
        }
        private bool passThru;

        #endregion Parameters

        #region Cmdlet Overrides

        /// <summary>
        /// The ProcessRecord method does the following for each of the
        /// requested process names:
        /// 1) Check that the process is not a critical process.
        /// 2) Attempt to stop that process.
        /// If no process is requested then nothing occurs.
```

```
        /// </summary>
        protected override void ProcessRecord()
        {
            foreach (string name in processNames)
            {
                string message = null;

                // For every process name passed to the cmdlet, get the
associated
                // processes.
                // Write a nonterminating error for failure to retrieve
                // a process.

                // Write a user-friendly verbose message to the pipeline.
These
                // messages are intended to give the user detailed
information
                // on the operations performed by the cmdlet. These messages
will
                // appear with the -Verbose option.
                message = String.Format(CultureInfo.CurrentCulture,
                            "Attempting to stop process \"{0}\".", name);
                WriteVerbose(message);

                Process[] processes;

                try
                {
                    processes = Process.GetProcessesByName(name);
                }
                catch (InvalidOperationException ioe)
                {
                    WriteError(new ErrorRecord(ioe,
                                    "UnableToAccessProcessByName",
                                        ErrorCategory.InvalidOperation,
                                            name));
                    continue;
                }

                // Try to stop the processes that have been retrieved.
                foreach (Process process in processes)
                {
                    string processName;

                    try
                    {
                        processName = process.ProcessName;
                    }
                    catch (Win32Exception e)
                    {
                        WriteError(new ErrorRecord(e, "ProcessNameNotFound",
                                        ErrorCategory.ObjectNotFound,
process));
                        continue;
                    }
```

```
                    // Write a debug message to the host that can be used
when
                    // troubleshooting a problem. All debug messages will
appear
                    // with the -Debug option.
                    message = String.Format(CultureInfo.CurrentCulture,
                                "Acquired name for pid {0} : \"{1}\"",
                                      process.Id, processName);
                    WriteDebug(message);

                    // Confirm the operation first.
                    // This is always false if the WhatIf parameter is
specified.
                    if
(!ShouldProcess(string.Format(CultureInfo.CurrentCulture,
                                      "{0} ({1})",
                                          processName, process.Id)))
                    {
                        continue;
                    }

                    // Make sure that the user really wants to stop a
critical
                    // process that can possibly stop the computer.
                    bool criticalProcess =
criticalProcessNames.Contains(processName.ToLower(CultureInfo.CurrentCulture
));

                    if (criticalProcess && !force)
                    {
                        message = String.Format(CultureInfo.CurrentCulture,
                                    "The process \"{0}\" is a critical
process and should not be stopped. Are you sure you wish to stop the
process?",
                                      processName);

                        // It is possible that the ProcessRecord method is
called
                        // multiple times when objects are received as inputs
from
                        // the pipeline. So to retain YesToAll and NoToAll
input that
                        // the user may enter across multiple calls to this
function,
                        // they are stored as private members of the cmdlet.
                        if (!ShouldContinue(message, "Warning!",
                                    ref yesToAll, ref noToAll))
                        {
                            continue;
                        }
                    } // if (criticalProcess...

                    // Display a warning message if the cmdlet is stopping a
                    // critical process.
```

```
                    if (criticalProcess)
                    {
                        message = String.Format(CultureInfo.CurrentCulture,
                                    "Stopping the critical process \"
{0}\".",
                                        processName);
                        WriteWarning(message);
                    } // if (criticalProcess...

                    // Stop the named process.
                    try
                    {
                        process.Kill();
                    }
                    catch (Exception e)
                    {
                        if ((e is Win32Exception) || (e is SystemException)
||
                            (e is InvalidOperationException))
                        {
                            // This process could not be stopped so write
                            // a nonterminating error.
                            WriteError(new ErrorRecord(
                                            e,
                                            "CouldNotStopProcess",
                                            ErrorCategory.CloseError,
                                            process)
                                        );
                            continue;
                        } // if ((e is...
                            else throw;
                    } // catch

                    message = String.Format(CultureInfo.CurrentCulture,
                                   "Stopped process \"{0}\", pid {1}.",
                                        processName, process.Id);

                    WriteVerbose(message);

                    // If the PassThru parameter is specified,
                    // return the terminated process object to the pipeline.
                    if (passThru)
                    {
                        message = String.Format(CultureInfo.CurrentCulture,
                                    "Writing process \"{0}\" to pipeline",
                                        processName);
                        WriteDebug(message);
                        WriteObject(process);
                    } // if (passThru...
                } // foreach (Process...
            } // foreach (string...
        } // ProcessRecord

        #endregion Cmdlet Overrides
```

```
        #region Private Data

        private bool yesToAll, noToAll;

        /// <summary>
        /// Partial list of critical processes that should not be
        /// stopped.  Lower case is used for case insensitive matching.
        /// </summary>
        private ArrayList criticalProcessNames = new ArrayList(
           new string[] { "system", "winlogon", "spoolsv" }
        );

        #endregion Private Data

    } // StopProcCommand

    #endregion StopProcCommand
}
```

See Also

Writing a Windows PowerShell Cmdlet

StopProcessSample03 Sample

Article • 09/17/2021

This sample shows how to write a cmdlet whose parameters have aliases and whose parameters support wildcard characters. This cmdlet is similar to the `Stop-Process` cmdlet provided by Windows PowerShell 2.0.

How to build the sample by using Visual Studio.

1. With the Windows PowerShell 2.0 SDK installed, navigate to the StopProcessSample03 folder. The default location is C:\Program Files (x86)\Microsoft SDKs\Windows\v7.0\Samples\sysmgmt\WindowsPowerShell\csharp\StopProcessSample03.
2. Double-click the icon for the solution (.sln) file. This opens the sample project in Microsoft Visual Studio.
3. In the **Build** menu, select **Build Solution**.

   The library for the sample will be built in the default \bin or \bin\debug folders.

How to run the sample

1. Create the following module folder:

   `[user]/documents/windowspowershell/modules/StopProcessSample03`

2. Copy the sample assembly to the module folder.
3. Start Windows PowerShell.
4. Run the following command to load the assembly into Windows PowerShell:

   `import-module stopprossessample03`

5. Run the following command to run the cmdlet:

   `stop-proc`

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

This sample demonstrates the following.

- Declaring a cmdlet class by using the Cmdlet attribute.
- Declaring a cmdlet parameters by using the Parameter attribute.
- Adding aliases to parameter declarations..
- Adding wildcard support to parameters.

Example

This sample shows how to declare parameter aliases and support wildcards.

C#

```
using System;
using System.Diagnostics;
using System.Collections;
using Win32Exception = System.ComponentModel.Win32Exception;
using System.Management.Automation;             //Windows PowerShell
namespace
using System.Globalization;

namespace Microsoft.Samples.PowerShell.Commands
{

   #region StopProcCommand

    /// <summary>
   /// This class implements the stop-proc cmdlet.
   /// </summary>
   [Cmdlet(VerbsLifecycle.Stop, "Proc",
       SupportsShouldProcess = true)]
   public class StopProcCommand : Cmdlet
   {
       #region Parameters

      /// <summary>
      /// This parameter provides the list of process names on
      /// which the Stop-Proc cmdlet will work.
      /// </summary>
       [Parameter(
          Position = 0,
          Mandatory = true,
          ValueFromPipeline = true,
```

```
            ValueFromPipelineByPropertyName = true,
            HelpMessage = "The name of one or more processes to stop.
Wildcards are permitted."
        )]
        [Alias("ProcessName")]
        public string[] Name
        {
            get { return processNames; }
            set { processNames = value; }
        }
        private string[] processNames;

        /// <summary>
        /// This parameter overrides the ShouldContinue call to force
        /// the cmdlet to stop its operation. This parameter should always
        /// be used with caution.
        /// </summary>
        [Parameter]
        public SwitchParameter Force
        {
            get { return force; }
            set { force = value; }
        }
        private bool force;

        /// <summary>
        /// This parameter indicates that the cmdlet should return
        /// an object to the pipeline after the processing has been
        /// completed.
        /// </summary>
        [Parameter(
            ValueFromPipelineByPropertyName = true,
            HelpMessage = "If set, the process(es) will be passed to the
pipeline after stopped."
        )]
        public SwitchParameter PassThru
        {
            get { return passThru; }
            set { passThru = value; }
        }
        private bool passThru;

        #endregion Parameters

        #region Cmdlet Overrides
        /// <summary>
        /// The ProcessRecord method does the following for each of the
        /// requested process names:
        /// 1) Check that the process is not a critical process.
        /// 2) Attempt to stop that process.
        /// If no process is requested then nothing occurs.
        /// </summary>
        protected override void ProcessRecord()
        {
            Process[] processes = null;
```

```
            try
            {
                processes = Process.GetProcesses();
            }
            catch (InvalidOperationException ioe)
            {
                base.ThrowTerminatingError(new ErrorRecord(ioe,
                          "UnableToAccessProcessList",
                              ErrorCategory.InvalidOperation,
                                  null));
            }

            // For every process name passed to the cmdlet, get the
associated
            // processes.
            // Write a nonterminating error for failure to retrieve
            // a process.
            foreach (string name in processNames)
            {
                // Write a user-friendly verbose message to the pipeline.
These
                // messages are intended to give the user detailed
information
                // on the operations performed by the cmdlet. These messages
will
                // appear with the -Verbose option.
                string message = String.Format(CultureInfo.CurrentCulture,
                                       "Attempting to stop process \"{0}\".",
name);
                WriteVerbose(message);

                // Validate the process name against a wildcard pattern.
                // If the name does not contain any wildcard patterns, it
                // will be treated as an exact match.
                WildcardOptions options = WildcardOptions.IgnoreCase |
                                          WildcardOptions.Compiled;
                WildcardPattern wildcard = new WildcardPattern(name,options);

                foreach (Process process in processes)
                {
                    string processName;

                    try
                    {
                        processName = process.ProcessName;
                    }
                    catch (Win32Exception e)
                    {
                        WriteError(new ErrorRecord(
                                                  e, "ProcessNameNotFound",

ErrorCategory.ObjectNotFound,
                                                      process)
                                   );
```

```
                    continue;
                }

                // Write a debug message to the host that can be used
when
                // troubleshooting a problem. All debug messages will
appear
                // with the -Debug option.
                message = String.Format(CultureInfo.CurrentCulture,
                            "Acquired name for pid {0} : \"{1}\"",
                                  process.Id, processName);
                WriteDebug(message);

                // Check to see if this process matches the current
process
                // name pattern. Skip this process if it does not.
                if (!wildcard.IsMatch(processName))
                {
                    continue;
                }

                // Stop the process.
                SafeStopProcess(process);
            } // foreach (Process...
        } // foreach (string...
    } // ProcessRecord

    #endregion Cmdlet Overrides

    #region Helper Methods

    /// <summary>
    /// Safely stops a named process.  Used as standalone function
    /// to declutter the ProcessRecord method.
    /// </summary>
    /// <param name="process">The process to stop.</param>
    private void SafeStopProcess(Process process)
    {
        string processName = null;
        try
        {
            processName = process.ProcessName;
        }
        catch (Win32Exception e)
        {
            WriteError(new ErrorRecord(e, "ProcessNameNotFound",
                                ErrorCategory.ObjectNotFound, process));
            return;
        }

        string message = null;

        // Confirm the operation first.
        // This is always false if the WhatIf parameter is specified.
        if (!ShouldProcess(string.Format(CultureInfo.CurrentCulture,
```

```
                    "{0} ({1})", processName, process.Id)))
            {
                return;
            }

            // Make sure that the user really wants to stop a critical
            // process that could possibly stop the computer.
            bool criticalProcess =
criticalProcessNames.Contains(processName.ToLower(CultureInfo.CurrentCulture
));

            if (criticalProcess && !force)
            {
                message = String.Format(CultureInfo.CurrentCulture,
                            "The process \"{0}\" is a critical process and
should not be stopped. Are you sure you wish to stop the process?",
                                processName);

                // It is possible that ProcessRecord is called multiple
                // when objects are received as inputs from a pipeline.
                // So, to retain YesToAll and NoToAll input that the
                // user may enter across multiple calls to this
                // function, they are stored as private members of the
                // Cmdlet.
                if (!ShouldContinue(message, "Warning!",
                            ref yesToAll, ref noToAll))
                {
                    return;
                }
            } // if (criticalProcess...

            // Display a warning message if stopping a critical
            // process.
            if (criticalProcess)
            {
                message = String.Format(CultureInfo.CurrentCulture,
                            "Stopping the critical process \"{0}\".",
                                processName);
                WriteWarning(message);
            } // if (criticalProcess...

            try
            {
                // Stop the process.
                process.Kill();
            }
            catch (Exception e)
            {
                if ((e is Win32Exception) || (e is SystemException) ||
                    (e is InvalidOperationException))
                {
                    // This process could not be stopped so write
                    // a non-terminating error.
                    WriteError(new ErrorRecord(e, "CouldNotStopProcess",
                                    ErrorCategory.CloseError,
```

```
                                    process)
                                );
                    return;
                } // if ((e is...
                else throw;
            } // catch

            message = String.Format(CultureInfo.CurrentCulture,
                        "Stopped process \"{0}\", pid {1}.",
                              processName, process.Id);

            WriteVerbose(message);

            // If the PassThru parameter is specified,
            // return the terminated process to the pipeline.
            if (passThru)
            {
                message = String.Format(CultureInfo.CurrentCulture,
                            "Writing process \"{0}\" to pipeline",
                                processName);
                WriteDebug(message);
                WriteObject(process);
            } // if (passThru...
        } // SafeStopProcess

        #endregion Helper Methods

        #region Private Data

        private bool yesToAll, noToAll;

        /// <summary>
        /// Partial list of the critical processes that should not be
        /// stopped.  Lower case is used for case insensitive matching.
        /// </summary>
        private ArrayList criticalProcessNames = new ArrayList(
           new string[] { "system", "winlogon", "spoolsv" }
        );

        #endregion Private Data

    } // StopProcCommand

    #endregion StopProcCommand
} // namespace Microsoft.Samples.PowerShell.Commands
```

See Also

Writing a Windows PowerShell Cmdlet

StopProcessSample04 Sample

Article • 09/17/2021

This sample shows how to write a cmdlet that declares parameter sets, specifies the default parameter set, and can accept an input object. This cmdlet is similar to the `Stop-Process` cmdlet provided by Windows PowerShell 2.0.

How to build the sample by using Visual Studio.

1. With the Windows PowerShell 2.0 SDK installed, navigate to the StopProcessSample04 folder. The default location is C:\Program Files (x86)\Microsoft SDKs\Windows\v7.0\Samples\sysmgmt\WindowsPowerShell\csharp\StopProcessSample04.
2. Double-click the icon for the solution (.sln) file. This opens the sample project in Microsoft Visual Studio.
3. In the **Build** menu, select **Build Solution**.

   The library for the sample will be built in the default \bin or \bin\debug folders.

How to run the sample

1. Create the following module folder:

   `[user]/documents/windowspowershell/modules/StopProcessSample04`

2. Copy the sample assembly to the module folder.
3. Start Windows PowerShell.
4. Run the following command to load the assembly into Windows PowerShell:

   `import-module stopprossessample04`

5. Run the following command to run the cmdlet:

   `stop-proc`

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

This sample demonstrates the following.

- Declaring a cmdlet class by using the Cmdlet attribute.
- Declaring a cmdlet parameters by using the Parameter attribute.
- Adding a parameter that accepts input object.
- Adding parameters to parameter sets
- Specifying the default parameter set.

Example

The following code shows an implementation of the Stop-Proc cmdlet that declare parameter sets, specifies the default parameter set, and can accept an input object.

This sample shows the input object, how to declare parameter sets, and how to specify the default parameter set to use.

C#

```
using System;
using System.Diagnostics;
using System.Collections;
using Win32Exception = System.ComponentModel.Win32Exception;
using System.Management.Automation;             //Windows PowerShell
namespace
using System.Globalization;

namespace Microsoft.Samples.PowerShell.Commands
{
   #region StopProcCommand

   /// <summary>
   /// This class implements the stop-proc cmdlet.
   /// </summary>
   [Cmdlet(VerbsLifecycle.Stop, "Proc",
       DefaultParameterSetName = "ProcessId",
       SupportsShouldProcess = true)]
   public class StopProcCommand : PSCmdlet
   {
       #region Parameters
```

```
      /// <summary>
      /// This parameter provides the list of process names on
      /// which the Stop-Proc cmdlet will work.
      /// </summary>
       [Parameter(
          Position = 0,
          ParameterSetName = "ProcessName",
          Mandatory = true,
          ValueFromPipeline = true,
          ValueFromPipelineByPropertyName = true,
          HelpMessage = "The name of one or more processes to stop.
Wildcards are permitted."
       )]
       [Alias("ProcessName")]
       public string[] Name
       {
           get { return processNames; }
           set { processNames = value; }
       }
       private string[] processNames;

       /// <summary>
       /// This parameter overrides the ShouldContinue call to force
       /// the cmdlet to stop its operation. This parameter should always
       /// be used with caution.
       /// </summary>
       [Parameter]
       public SwitchParameter Force
       {
           get { return force; }
           set { force = value; }
       }
       private bool force;

       /// <summary>
       /// This parameter indicates that the cmdlet should return
       /// an object to the pipeline after the processing has been
       /// completed.
       /// </summary>
       [Parameter(
          HelpMessage = "If set the process(es) will be passed to the
pipeline after stopped."
       )]
       public SwitchParameter PassThru
       {
           get { return passThru; }
           set { passThru = value; }
       }
       private bool passThru;

      /// This parameter provides the list of process identifiers on
      /// which the Stop-Proc cmdlet will work.
       [Parameter(
          ParameterSetName = "ProcessId",
          Mandatory = true,
```

```
            ValueFromPipelineByPropertyName = true,
            ValueFromPipeline = true
        )]
        [Alias("ProcessId")]
        public int[] Id
        {
            get { return processIds; }
            set { processIds = value; }
        }
        private int[] processIds;

        /// <summary>
        /// This parameter accepts an array of Process objects from the
        /// the pipeline. This object contains the processes to stop.
        /// </summary>
        /// <value>Process objects</value>
        [Parameter(
            ParameterSetName = "InputObject",
            Mandatory = true,
            ValueFromPipeline = true)]
        public Process[] InputObject
        {
            get { return inputObject; }
            set { inputObject = value; }
        }
        private Process[] inputObject;

        #endregion Parameters

        #region CmdletOverrides

        /// <summary>
        /// The ProcessRecord method does the following for each of the
        /// requested process names:
        /// 1) Check that the process is not a critical process.
        /// 2) Attempt to stop that process.
        /// If no process is requested then nothing occurs.
        /// </summary>
        protected override void ProcessRecord()
        {
            switch (ParameterSetName)
            {
                case "ProcessName":
                    ProcessByName();
                break;

                case "ProcessId":
                    ProcessById();
                    break;

                case "InputObject":
                    foreach (Process process in inputObject)
                    {
                        SafeStopProcess(process);
                    }
```

```
                    break;

                default:
                    throw new ArgumentException("Bad ParameterSet Name");
            } // switch (ParameterSetName...
        } // ProcessRecord

        #endregion Cmdlet Overrides

        #region Helper Methods

        /// <summary>
        /// Returns all processes with matching names.
        /// </summary>
        /// <param name="processName">
        /// The name of the processes to return.
        /// </param>
        /// <param name="allProcesses">An array of all
        /// computer processes.</param>
        /// <returns>An array of matching processes.</returns>
        internal ArrayList SafeGetProcessesByName(string processName,
                                  ref ArrayList allProcesses)
        {
            // Create and array to store the matching processes.
            ArrayList matchingProcesses = new ArrayList();

            // Create the wildcard for pattern matching.
            WildcardOptions options = WildcardOptions.IgnoreCase |
                                      WildcardOptions.Compiled;
            WildcardPattern wildcard = new WildcardPattern(processName,
options);

            // Walk all of the machine processes.
            foreach(Process process in allProcesses)
            {
                string processNameToMatch = null;
                try
                {
                    processNameToMatch = process.ProcessName;
                }
                catch (Win32Exception e)
                {
                    // Remove the process from the list so that it is not
                    // checked again.
                    allProcesses.Remove(process);

                    string message =
                          String.Format(CultureInfo.CurrentCulture, "The
process \"{0}\" could not be found",
                                                processName);
                    WriteVerbose(message);
                    WriteError(new ErrorRecord(e, "ProcessNotFound",
                                    ErrorCategory.ObjectNotFound,
processName));
```

```
                    continue;
                }

                if (!wildcard.IsMatch(processNameToMatch))
                {
                    continue;
                }

                matchingProcesses.Add(process);
            } // foreach(Process...

            return matchingProcesses;
        } // SafeGetProcessesByName

        /// <summary>
        /// Safely stops a named process.  Used as standalone function
        /// to declutter the ProcessRecord method.
        /// </summary>
        /// <param name="process">The process to stop.</param>
        private void SafeStopProcess(Process process)
        {
            string processName = null;

            try
            {
                processName = process.ProcessName;
            }
            catch (Win32Exception e)
            {
                WriteError(new ErrorRecord(e, "ProcessNotFound",
                                ErrorCategory.OpenError, processName));

                return;
            }

            // Confirm the operation first.
            // This is always false if the WhatIf parameter is specified.
            if (!ShouldProcess(string.Format(CultureInfo.CurrentCulture,
                     "{0} ({1})", processName, process.Id)))
            {
                return;
            }

            // Make sure that the user really wants to stop a critical
            // process that can possibly stop the computer.
            bool criticalProcess =
criticalProcessNames.Contains(processName.ToLower(CultureInfo.CurrentCulture
));

            string message = null;
            if (criticalProcess && !force)
            {
                message = String.Format(CultureInfo.CurrentCulture,
                                        "The process \"{0}\" is a
critical process and should not be stopped. Are you sure you wish to stop
```

```
the process?",
                                                processName);
                // It is possible that the ProcessRecord method is called
                // multiple times when objects are received as inputs from
                // the pipeline. So to retain YesToAll and NoToAll input that
                // the user may enter across multiple calls to this function,
                // they are stored as private members of the cmdlet.
                if (!ShouldContinue(message, "Warning!",
                            ref yesToAll, ref noToAll))
                {
                    return;
                }
            } // if (criticalProcess...

            // Display a warning message if stopping a critical
            // process.
            if (criticalProcess)
            {
                message =
                  String.Format(CultureInfo.CurrentCulture,
                                "Stopping the critical process \"{0}\".",
                                    processName);
                WriteWarning(message);
            } // if (criticalProcess...

            try
            {
                // Stop the process.
                process.Kill();
            }
            catch (Exception e)
            {
                if ((e is Win32Exception) || (e is SystemException) ||
                    (e is InvalidOperationException))
                {
                    // This process could not be stopped so write
                    // a non-terminating error.
                    WriteError(new ErrorRecord(e, "CouldNotStopProcess",
                                    ErrorCategory.CloseError,
                                    process)
                                );

                    return;
                } // if ((e is...
                else throw;
            } // catch

            // Write a user-level verbose message to the pipeline. These are
            // intended to give the user detailed information on the
            // operations performed by the cmdlet. These messages will
            // appear with the -Verbose option.
            message = String.Format(CultureInfo.CurrentCulture,
                                    "Stopped process \"{0}\", pid {1}.",
                                        processName, process.Id);
```

```
            WriteVerbose(message);

            // If the PassThru parameter is specified, return the terminated
            // process to the pipeline.
            if (passThru)
            {
                // Write a debug message to the host that can be used
                // when troubleshooting a problem. All debug messages
                // will appear with the -Debug option
                message =
                    String.Format(CultureInfo.CurrentCulture,
                                  "Writing process \"{0}\" to pipeline",
                                      processName);
                WriteDebug(message);
                WriteObject(process);
            } // if (passThru..
        } // SafeStopProcess

        /// <summary>
        /// Stop processes based on their names (using the
        /// ParameterSetName as ProcessName)
        /// </summary>
        private void ProcessByName()
        {
            ArrayList allProcesses = null;

            // Get a list of all processes.
            try
            {
                allProcesses = new ArrayList(Process.GetProcesses());
            }
            catch (InvalidOperationException ioe)
            {
                base.ThrowTerminatingError(new ErrorRecord(
                     ioe, "UnableToAccessProcessList",
                     ErrorCategory.InvalidOperation, null));
            }

            // If a process name is passed to the cmdlet, get
            // the associated processes.
            // Write a nonterminating error for failure to
            // retrieve a process.
            foreach (string name in processNames)
            {
                // The allProcesses array list is passed as a reference
because
                // any process whose name cannot be obtained will be removed
                // from the list so that its not compared the next time.
                ArrayList processes =
                    SafeGetProcessesByName(name, ref allProcesses);

                // If no processes were found write a non-
                // terminating error.
                if (processes.Count == 0)
                {
```

```
                    WriteError(new ErrorRecord(
                        new Exception("Process not found."),
                        "ProcessNotFound",
                        ErrorCategory.ObjectNotFound,
                        name));
                } // if (processes...
                // Otherwise terminate all processes in the list.
                else
                {
                    foreach (Process process in processes)
                    {
                        SafeStopProcess(process);
                    } // foreach (Process...
                } // else
            } // foreach (string...
        } // ProcessByName

        /// <summary>
        /// Stop processes based on their identifiers (using the
        /// ParameterSetName as ProcessIds)
        /// </summary>
        internal void ProcessById()
        {
            foreach (int processId in processIds)
            {
                Process process = null;
                try
                {
                    process = Process.GetProcessById(processId);

                    // Write a debug message to the host that can be used
                    // when troubleshooting a problem. All debug messages
                    // will appear with the -Debug option
                    string message =
                        String.Format(CultureInfo.CurrentCulture,
                                      "Acquired process for pid : {0}",
                                          process.Id);
                    WriteDebug(message);
                }
                catch (ArgumentException ae)
                {
                    string
                        message = String.Format(CultureInfo.CurrentCulture,
                                                "The process id {0} could not be
found",
                                                    processId);
                    WriteVerbose(message);
                    WriteError(new ErrorRecord(ae, "ProcessIdNotFound",
                                    ErrorCategory.ObjectNotFound,
processId));
                    continue;
                }

                SafeStopProcess(process);
            } // foreach (int...
```

```
        } // ProcessById

        #endregion Helper Methods

        #region Private Data

        private bool yesToAll, noToAll;

        /// <summary>
        /// Partial list of critical processes that should not be
        /// stopped.  Lower case is used for case insensitive matching.
        /// </summary>
        private ArrayList criticalProcessNames = new ArrayList(
           new string[] { "system", "winlogon", "spoolsv", "calc" }
        );

        #endregion Private Data

    } // StopProcCommand

    #endregion StopProcCommand
}
```

See Also

Writing a Windows PowerShell Cmdlet

Events01 Sample

Article • 09/17/2021

This sample shows how to create a cmdlet that allows the user to register for events that are raised by System.IO.FileSystemWatcher. With this cmdlet, users can register an action to execute when a file is created under a specific directory. This sample derives from the Microsoft.PowerShell.Commands.ObjectEventRegistrationBase base class.

How to build the sample by using Visual Studio.

1. With the Windows PowerShell 2.0 SDK installed, navigate to the Events01 folder. The default location is `C:\Program Files (x86)\Microsoft SDKs\Windows\v7.0\Samples\sysmgmt\WindowsPowerShell\csharp\Events01`.

2. Double-click the icon for the solution (.sln) file. This opens the sample project in Microsoft Visual Studio.

3. In the **Build** menu, select **Build Solution**. The library for the sample will be built in the default `\bin` or `\bin\debug` folders.

How to run the sample

1. Create the following module folder:

   `[user]/documents/windowspowershell/modules/events01`

2. Copy the library file for the sample to the module folder.

3. Start Windows PowerShell.

4. Run the following command to load the cmdlet into Windows PowerShell:

   PowerShell

   ```
   import-module events01
   ```

5. Use the Register-FileSystemEvent cmdlet to register an action that will write a message when a file is created under the TEMP directory.

   PowerShell

```
Register-FileSystemEvent $env:temp Created -filter "*.txt" -action {
Write-Host "A file was created in the TEMP directory" }
```

6. Create a file under the TEMP directory and note that the action is executed (the message is displayed).

This is a sample output that results by following these steps.

Output

```
Id              Name            State      HasMoreData     Location
Command
--              ----            -----      -----------     --------
-------
1               26932870-d3b... NotStarted False
Write-Host "A f...
```

PowerShell

```
Set-Content $env:temp\test.txt "This is a test file"
```

Output

```
A file was created in the TEMP directory
```

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

This sample demonstrates the following.

How to write a cmdlet for event registration

The cmdlet derives from the Microsoft.PowerShell.Commands.ObjectEventRegistrationBase class, which provides support for parameters common to the `Register-*Event` cmdlets. Cmdlets that are derived from Microsoft.PowerShell.Commands.ObjectEventRegistrationBase need only to define their particular parameters and override the `GetSourceObject` and `GetSourceObjectEventName` abstract methods.

Example

This sample shows how to register for events raised by System.IO.FileSystemWatcher.

C#

```
namespace Sample
{
    using System;
    using System.IO;
    using System.Management.Automation;
    using System.Management.Automation.Runspaces;
    using Microsoft.PowerShell.Commands;

    [Cmdlet(VerbsLifecycle.Register, "FileSystemEvent")]
    public class RegisterObjectEventCommand : ObjectEventRegistrationBase
    {
        /// <summary>The FileSystemWatcher that exposes the events.
</summary>
        private FileSystemWatcher fileSystemWatcher = new
FileSystemWatcher();

        /// <summary>Name of the event to which the cmdlet registers.
</summary>
        private string eventName = null;

        /// <summary>
        /// Gets or sets the path that will be monitored by the
FileSystemWatcher.
        /// </summary>
        [Parameter(Mandatory = true, Position = 0)]
        public string Path
        {
            get
            {
                return this.fileSystemWatcher.Path;
            }

            set
            {
                this.fileSystemWatcher.Path = value;
            }
        }

        /// <summary>
        /// Gets or sets the name of the event to which the cmdlet
registers.
        /// <para>
        /// Currently System.IO.FileSystemWatcher exposes 6 events: Changed,
Created,
        /// Deleted, Disposed, Error, and Renamed. Check the documentation
of
        /// FileSystemWatcher for details on each event.
```

```
        /// </para>
        /// </summary>
        [Parameter(Mandatory = true, Position = 1)]
        public string EventName
        {
            get
            {
                return this.eventName;
            }

            set
            {
                this.eventName = value;
            }
        }

        /// <summary>
        /// Gets or sets the filter that will be user by the
FileSystemWatcher.
        /// </summary>
        [Parameter(Mandatory = false)]
        public string Filter
        {
            get
            {
                return this.fileSystemWatcher.Filter;
            }

            set
            {
                this.fileSystemWatcher.Filter = value;
            }
        }

        /// <summary>
        /// Derived classes must implement this method to return the object
that generates
        /// the events to be monitored.
        /// </summary>
        /// <returns> This sample returns an instance of
System.IO.FileSystemWatcher</returns>
        protected override object GetSourceObject()
        {
            return this.fileSystemWatcher;
        }

        /// <summary>
        /// Derived classes must implement this method to return the name of
the event to
        /// be monitored. This event must be exposed by the input object.
        /// </summary>
        /// <returns> This sample returns the event specified by the user
with the -EventName parameter.</returns>
        protected override string GetSourceObjectEventName()
        {
```

```
            return this.eventName;
        }
    }
}
```

See Also

Writing a Windows PowerShell Cmdlet

Writing a Windows PowerShell Module

Article • 09/17/2021

This document is written for administrators, script developers, and cmdlet developers who need to package and distribute their Windows PowerShell cmdlets. By using Windows PowerShell modules, you can package and distribute your Windows PowerShell solutions without using a compiled language.

Windows PowerShell modules enable you to partition, organize, and abstract your Windows PowerShell code into self-contained, reusable units. With these reusable units, you can easily share your modules directly with others. If you are a script developer, you can also repackage third-party modules to create custom script-based applications. Modules, similar to modules in other scripting languages such as Perl and Python, enable production-ready scripting solutions that use reusable, redistributable components, with the added benefit of enabling you to repackage and abstract multiple components to create custom solutions.

At their most basic, Windows PowerShell will treat any valid Windows PowerShell script code saved in a `.psm1` file as a module. PowerShell will also automatically treat any binary cmdlet assembly as a module. However, you can also use a module (or more specifically, a module manifest) to bundle an entire solution together. The following scenarios describe typical uses for Windows PowerShell modules.

Libraries

Modules can be used to package and distribute cohesive libraries of functions that perform common tasks. Typically, the names of these functions share one or more nouns that reflect the common task that they are used for. These functions can also be similar to .NET Framework classes in that they can have public and private members. For example, a library can contain a set of functions for file transfers. In this case, the noun reflecting the common task might be "file."

Configuration

Modules can be used to customize your environment by adding specific cmdlets, providers, functions, and variables.

Compiled Code Development and Distribution

Cmdlet and provider developers can use modules to test and distribute their compiled code without needing to create snap-ins. They can import the assembly that contains the compiled code as a module (a binary module) without needing to create and register snap-ins.

See Also

Understanding a Windows PowerShell Module

How to Write a PowerShell Script Module

How to Write a PowerShell Binary Module

How to Write a PowerShell Module Manifest

about_PSModulePath

Importing a PowerShell Module

Installing a PowerShell Module

Understanding a Windows PowerShell Module

Article • 09/17/2021

A *module* is a set of related Windows PowerShell functionalities, grouped together as a convenient unit (usually saved in a single directory). By defining a set of related script files, assemblies, and related resources as a module, you can reference, load, persist, and share your code much easier than you would otherwise.

The main purpose of a module is to allow the modularization (ie, reuse and abstraction) of Windows PowerShell code. For example, the most basic way of creating a module is to simply save a Windows PowerShell script as a .psm1 file. Doing so allows you to control (ie, make public or private) the functions and variables contained in the script. Saving the script as a .psm1 file also allows you to control the scope of certain variables. Finally, you can also use cmdlets such as Install-Module to organize, install, and use your script as building blocks for larger solutions.

Module Components and Types

A module is made up of four basic components:

1. Some sort of code file - usually either a PowerShell script or a managed cmdlet assembly.
2. Anything else that the above code file may need, such as additional assemblies, help files, or scripts.
3. A manifest file that describes the above files, as well as stores metadata such as author and versioning information.
4. A directory that contains all of the above content, and is located where PowerShell can reasonably find it.

> **Note**
>
> none of these components, by themselves, are actually necessary. For example, a module can technically be only a script stored in a .psm1 file. You can also have a module that is nothing but a manifest file, which is used mainly for organizational purposes. You can also write a script that dynamically creates a module, and as such doesn't actually need a directory to

store anything in. The following sections describe the types of modules you can get by mixing and matching the different possible parts of a module together.

Script Modules

As the name implies, a *script module* is a file (`.psm1`) that contains any valid Windows PowerShell code. Script developers and administrators can use this type of module to create modules whose members include functions, variables, and more. At heart, a script module is simply a Windows PowerShell script with a different extension, which allows administrators to use import, export, and management functions on it.

In addition, you can use a manifest file to include other resources in your module, such as data files, other dependent modules, or runtime scripts. Manifest files are also useful for tracking metadata such as authoring and versioning information.

Finally, a script module, like any other module that isn't dynamically created, needs to be saved in a folder that PowerShell can reasonably discover. Usually, this is on the PowerShell module path; but if necessary you can explicitly describe where your module is installed. For more information, see How to Write a PowerShell Script Module.

Binary Modules

A **binary module** is a .NET Framework assembly (`.dll`) that contains compiled code, such as C#. Cmdlet developers can use this type of module to share cmdlets, providers, and more. (Existing snap-ins can also be used as binary modules.) Compared to a script module, a binary module allows you to create cmdlets that are faster or use features (such as multithreading) that are not as easy to code in Windows PowerShell scripts.

As with script modules, you can include a manifest file to describe additional resources that your module uses, and to track metadata about your module. Similarly, you probably should install your binary module in a folder somewhere along the PowerShell module path. For more information, see How to How to Write a PowerShell Binary Module.

Manifest Modules

A **manifest module** is a module that uses a manifest file to describe all of its components, but doesn't have any sort of core assembly or script. (Formally, a manifest module leaves the `ModuleToProcess` or `RootModule` element of the manifest empty.)

However, you can still use the other features of a module, such as the ability to load up dependent assemblies or automatically run certain pre-processing scripts. You can also use a manifest module as a convenient way to package up resources that other modules will use, such as nested modules, assemblies, types, or formats. For more information, see How to Write a PowerShell Module Manifest.

Dynamic Modules

A **dynamic module** is a module that is not loaded from, or saved to, a file. Instead, they are created dynamically by a script, using the New-Module cmdlet. This type of module enables a script to create a module on demand that does not need to be loaded or saved to persistent storage. By its nature, a dynamic module is intended to be short-lived, and therefore cannot be accessed by the `Get-Module` cmdlet. Similarly, they usually do not need module manifests, nor do they likely need permanent folders to store their related assemblies.

Module Manifests

A **module manifest** is a `.psd1` file that contains a hash table. The keys and values in the hash table do the following things:

- Describe the contents and attributes of the module.
- Define the prerequisites.
- Determine how the components are processed.

  Manifests are not required for a module. Modules can reference script files (`.ps1`), script module files (`.psm1`), manifest files (`.psd1`), formatting and type files (`.ps1xml`), cmdlet and provider assemblies (`.dll`), resource files, Help files, localization files, or any other type of file or resource that is bundled as part of the module. For an internationalized script, the module folder also contains a set of message catalog files. If you add a manifest file to the module folder, you can reference the multiple files as a single unit by referencing the manifest.

  The manifest itself describes the following categories of information:

- Metadata about the module, such as the module version number, the author, and the description.
- Prerequisites needed to import the module, such as the Windows PowerShell version, the common language runtime (CLR) version, and the required modules.

- Processing directives, such as the scripts, formats, and types to process.
- Restrictions on the members of the module to export, such as the aliases, functions, variables, and cmdlets to export.

  For more information, see How to Write a PowerShell Module Manifest.

Storing and Installing a Module

Once you have created a script, binary, or manifest module, you can save your work in a location that others may access it. For example, your module can be stored in the system folder where Windows PowerShell is installed, or it can be stored in a user folder.

Generally speaking, you can determine where you should install your module by using one of the paths stored in the `$ENV:PSModulePath` variable. Using one of these paths means that PowerShell can automatically find and load your module when a user makes a call to it in their code. If you store your module somewhere else, you can explicitly let PowerShell know by passing in the location of your module as a parameter when you call `Install-Module`.

Regardless, the path of the folder is referred to as the **base** of the module (ModuleBase), and the name of the script, binary, or manifest module file should be the same as the module folder name, with the following exceptions:

- Dynamic modules that are created by the `New-Module` cmdlet can be named using the `Name` parameter of the cmdlet.
- Modules imported from assembly objects by the `Import-Module -Assembly` command are named according to the following syntax: `"dynamic_code_module_" + assembly.GetName()`.

  For more information, see Installing a PowerShell Module and about_PSModulePath.

Module Cmdlets and Variables

The following cmdlets and variables are provided by Windows PowerShell for the creation and management of modules.

New-Module cmdlet This cmdlet creates a new dynamic module that exists only in memory. The module is created from a script block, and its exported members, such as

its functions and variables, are immediately available in the session and remain available until the session is closed.

New-ModuleManifest cmdlet This cmdlet creates a new module manifest (.psd1) file, populates its values, and saves the manifest file to the specified path. This cmdlet can also be used to create a module manifest template that can be filled in manually.

Import-Module cmdlet This cmdlet adds one or more modules to the current session.

Get-Module cmdlet This cmdlet retrieves information about the modules that have been or that can be imported into the current session.

Export-ModuleMember cmdlet This cmdlet specifies the module members (such as cmdlets, functions, variables, and aliases) that are exported from a script module (.psm1) file or from a dynamic module created by using the `New-Module` cmdlet.

Remove-Module cmdlet This cmdlet removes modules from the current session.

Test-ModuleManifest cmdlet This cmdlet verifies that a module manifest accurately describes the components of a module by verifying that the files that are listed in the module manifest file (.psd1) actually exist in the specified paths.

$PSScriptRoot This variable contains the directory from which the script module is being executed. It enables scripts to use the module path to access other resources.

$env:PSModulePath This environment variable contains a list of the directories in which Windows PowerShell modules are stored. Windows PowerShell uses the value of this variable when importing modules automatically and updating Help topics for modules.

See Also

Writing a Windows PowerShell Module

How to Write a PowerShell Script Module

Article • 06/09/2022

A script module is any valid PowerShell script saved in a `.psm1` extension. This extension allows the PowerShell engine to use rules and module cmdlets on your file. Most of these capabilities are there to help you install your code on other systems, as well as manage scoping. You can also use a module manifest file, which describes more complex installations and solutions.

Writing a PowerShell script module

To create a script module, save a valid PowerShell script to a `.psm1` file. The script and the directory where it's stored must use the same name. For example, a script named `MyPsScript.psm1` is stored in a directory named `MyPsScript`.

The module's directory needs to be in a path specified in `$env:PSModulePath`. The module's directory can contain any resources that are needed to run the script, and a module manifest file that describes to PowerShell how your module works.

Create a basic PowerShell module

The following steps describe how to create a PowerShell module.

1. Save a PowerShell script with a `.psm1` extension. Use the same name for the script and the directory where the script is saved.

   Saving a script with the `.psm1` extension means that you can use the module cmdlets, such as Import-Module. The module cmdlets exist primarily so that you can import and export your code onto other user's systems. The alternate solution would be to load your code on other systems and then dot-source it into active memory, which isn't a scalable solution. For more information, see Understanding a Windows PowerShell Module. By default, when users import your `.psm1` file, all functions in your script are accessible, but variables aren't.

   An example PowerShell script, entitled `Show-Calendar`, is available at the end of this article.

   ```
   PowerShell
   ```

```
function Show-Calendar {
param(
    [DateTime] $start = [DateTime]::Today,
    [DateTime] $end = $start,
    $firstDayOfWeek,
    [int[]] $highlightDay,
    [string[]] $highlightDate = [DateTime]::Today.ToString('yyyy-MM-
dd')
    )

    #actual code for the function goes here see the end of the topic
for the complete code sample
}
```

2. To control user access to certain functions or variables, call Export-ModuleMember at the end of your script.

   The example code at the bottom of the article has only one function, which by default would be exposed. However, it's recommended you explicitly call out which functions you wish to expose, as described in the following code:

   PowerShell

   ```
   function Show-Calendar {
         }
   Export-ModuleMember -Function Show-Calendar
   ```

   You can restrict what's imported using a module manifest. For more information, see Importing a PowerShell Module and How to Write a PowerShell Module Manifest.

3. If you have modules that your own module needs to load, you can use `Import-Module`, at the top of your module.

   The `Import-Module` cmdlet imports a targeted module onto a system, and can be used at a later point in the procedure to install your own module. The sample code at the bottom of this article doesn't use any import modules. But if it did, they would be listed at the top of the file, as shown in the following code:

   PowerShell

   ```
   Import-Module GenericModule
   ```

4. To describe your module to the PowerShell Help system, you can either use standard help comments inside the file, or create an additional Help file.

The code sample at the bottom of this article includes the help information in the comments. You could also write expanded XML files that contain additional help content. For more information, see Writing Help for Windows PowerShell Modules.

5. If you have additional modules, XML files, or other content you want to package with your module, you can use a module manifest.

   A module manifest is a file that contains the names of other modules, directory layouts, versioning numbers, author data, and other pieces of information. PowerShell uses the module manifest file to organize and deploy your solution. For more information, see How to write a PowerShell module manifest.

6. To install and run your module, save the module to one of the appropriate PowerShell paths, and use `Import-Module`.

   The paths where you can install your module are located in the `$env:PSModulePath` global variable. For example, a common path to save a module on a system would be `%SystemRoot%/users/<user>/Documents/PowerShell/Modules/<moduleName>`. Be sure to create a directory for your module that uses the same name as the script module, even if it's only a single `.psm1` file. If you didn't save your module to one of these paths, you would have to specify the module's location in the `Import-Module` command. Otherwise, PowerShell wouldn't be able to find the module.

   > ⓘ **Note**
   >
   > Starting with PowerShell 3.0, if you've placed your module in one of the PowerShell module paths, you don't need to explicitly import it. Your module is automatically loaded when a user calls your function. For more information about the module path, see **Importing a PowerShell Module** and **about_PSModulePath**.

7. To remove a module from active service in the current PowerShell session, use Remove-Module.

   > ⓘ **Note**
   >
   > `Remove-Module` removes a module from the current PowerShell session, but doesn't uninstall the module or delete the module's files.

Show-Calendar code example

The following example is a script module that contains a single function named `Show-Calendar`. This function displays a visual representation of a calendar. The sample contains the PowerShell Help strings for the synopsis, description, parameter values, and code. When the module is imported, the `Export-ModuleMember` command ensures that the `Show-Calendar` function is exported as a module member.

PowerShell

```
<#
 .Synopsis
  Displays a visual representation of a calendar.

 .Description
  Displays a visual representation of a calendar. This function supports
multiple months
  and lets you highlight specific date ranges or days.

 .Parameter Start
  The first month to display.

 .Parameter End
  The last month to display.

 .Parameter FirstDayOfWeek
  The day of the month on which the week begins.

 .Parameter HighlightDay
  Specific days (numbered) to highlight. Used for date ranges like (25..31).
  Date ranges are specified by the Windows PowerShell range syntax. These
dates are
  enclosed in square brackets.

 .Parameter HighlightDate
  Specific days (named) to highlight. These dates are surrounded by
asterisks.

 .Example
   # Show a default display of this month.
   Show-Calendar

 .Example
   # Display a date range.
   Show-Calendar -Start "March, 2010" -End "May, 2010"

 .Example
   # Highlight a range of days.
   Show-Calendar -HighlightDay (1..10 + 22) -HighlightDate "2008-12-25"
#>
function Show-Calendar {
param(
    [DateTime] $start = [DateTime]::Today,
    [DateTime] $end = $start,
```

```
    $firstDayOfWeek,
    [int[]] $highlightDay,
    [string[]] $highlightDate = [DateTime]::Today.ToString('yyyy-MM-dd')
    )

## Determine the first day of the start and end months.
$start = New-Object DateTime $start.Year,$start.Month,1
$end = New-Object DateTime $end.Year,$end.Month,1

## Convert the highlighted dates into real dates.
[DateTime[]] $highlightDate = [DateTime[]] $highlightDate

## Retrieve the DateTimeFormat information so that the
## calendar can be manipulated.
$dateTimeFormat  = (Get-Culture).DateTimeFormat
if($firstDayOfWeek)
{
    $dateTimeFormat.FirstDayOfWeek = $firstDayOfWeek
}

$currentDay = $start

## Process the requested months.
while($start -le $end)
{
    ## Return to an earlier point in the function if the first day of the
month
    ## is in the middle of the week.
    while($currentDay.DayOfWeek -ne $dateTimeFormat.FirstDayOfWeek)
    {
        $currentDay = $currentDay.AddDays(-1)
    }

    ## Prepare to store information about this date range.
    $currentWeek = New-Object PsObject
    $dayNames = @()
    $weeks = @()

    ## Continue processing dates until the function reaches the end of the
month.
    ## The function continues until the week is completed with
    ## days from the next month.
    while(($currentDay -lt $start.AddMonths(1)) -or
        ($currentDay.DayOfWeek -ne $dateTimeFormat.FirstDayOfWeek))
    {
        ## Determine the day names to use to label the columns.
        $dayName = "{0:ddd}" -f $currentDay
        if($dayNames -notcontains $dayName)
        {
            $dayNames += $dayName
        }

        ## Pad the day number for display, highlighting if necessary.
        $displayDay = " {0,2} " -f $currentDay.Day
```

```
        ## Determine whether to highlight a specific date.
        if($highlightDate)
        {
            $compareDate = New-Object DateTime $currentDay.Year,
                $currentDay.Month,$currentDay.Day
            if($highlightDate -contains $compareDate)
            {
                $displayDay = "*" + ("{0,2}" -f $currentDay.Day) + "*"
            }
        }

        ## Otherwise, highlight as part of a date range.
        if($highlightDay -and ($highlightDay[0] -eq $currentDay.Day))
        {
            $displayDay = "[" + ("{0,2}" -f $currentDay.Day) + "]"
            $null,$highlightDay = $highlightDay
        }

        ## Add the day of the week and the day of the month as note
properties.
        $currentWeek | Add-Member NoteProperty $dayName $displayDay

        ## Move to the next day of the month.
        $currentDay = $currentDay.AddDays(1)

        ## If the function reaches the next week, store the current week
        ## in the week list and continue.
        if($currentDay.DayOfWeek -eq $dateTimeFormat.FirstDayOfWeek)
        {
            $weeks += $currentWeek
            $currentWeek = New-Object PsObject
        }
    }

    ## Format the weeks as a table.
    $calendar = $weeks | Format-Table $dayNames -AutoSize | Out-String

    ## Add a centered header.
    $width = ($calendar.Split("`n") | Measure-Object -Maximum
Length).Maximum
    $header = "{0:MMMM yyyy}" -f $start
    $padding = " " * (($width - $header.Length) / 2)
    $displayCalendar = " `n" + $padding + $header + "`n " + $calendar
    $displayCalendar.TrimEnd()

    ## Move to the next month.
    $start = $start.AddMonths(1)

}
}
Export-ModuleMember -Function Show-Calendar
```

How to Write a PowerShell Binary Module

Article • 09/17/2021

A binary module can be any assembly (.dll) that contains cmdlet classes. By default, all the cmdlets in the assembly are imported when the binary module is imported. However, you can restrict the cmdlets that are imported by creating a module manifest whose root module is the assembly. (For example, the CmdletsToExport key of the manifest can be used to export only those cmdlets that are needed.) In addition, a binary module can contain additional files, a directory structure, and other pieces of useful management information that a single cmdlet cannot.

The following procedure describes how to create and install a PowerShell binary module.

How to create and install a PowerShell binary module

1. Create a binary PowerShell solution (such as a cmdlet written in C#), with the capabilities you need, and ensure that it runs properly.

   From a code perspective, the core of a binary module is simply a cmdlet assembly. In fact, PowerShell will treat a single cmdlet assembly as a module, in terms of loading and unloading, with no additional effort on the part of the developer. For more information about writing a cmdlet, see Writing a Windows PowerShell Cmdlet.

2. If necessary, create the rest of your solution: (additional cmdlets, XML files, and so on) and describe them with a module manifest.

   In addition to describing the cmdlet assemblies in your solution, a module manifest can describe how you want your module exported and imported, what cmdlets will be exposed, and what additional files will go into the module. As stated previously however, PowerShell can treat a binary cmdlet like a module with no additional effort. As such, a module manifest is useful mainly for combining multiple files into a single package, or for explicitly controlling publication for a given assembly. For more information, see How to Write a PowerShell Module Manifest.

The following code is an extremely simple C# code block that contains three cmdlets in the same file that can be used as a module.

C#

```
using System.Management.Automation;           // Windows PowerShell
namespace.

namespace ModuleCmdlets
{
  [Cmdlet(VerbsDiagnostic.Test,"BinaryModuleCmdlet1")]
  public class TestBinaryModuleCmdlet1Command : Cmdlet
  {
    protected override void BeginProcessing()
    {
      WriteObject("BinaryModuleCmdlet1 exported by the ModuleCmdlets
module.");
    }
  }

  [Cmdlet(VerbsDiagnostic.Test, "BinaryModuleCmdlet2")]
  public class TestBinaryModuleCmdlet2Command : Cmdlet
  {
      protected override void BeginProcessing()
      {
          WriteObject("BinaryModuleCmdlet2 exported by the
ModuleCmdlets module.");
      }
  }

  [Cmdlet(VerbsDiagnostic.Test, "BinaryModuleCmdlet3")]
  public class TestBinaryModuleCmdlet3Command : Cmdlet
  {
      protected override void BeginProcessing()
      {
          WriteObject("BinaryModuleCmdlet3 exported by the
ModuleCmdlets module.");
      }
  }

}
```

3. Package your solution, and save the package to somewhere in the PowerShell module path.

   The `PSModulePath` global environment variable describes the default paths that PowerShell will use to locate your module. For example, a common path to save a module on a system would be `%SystemRoot%\users\<user>\Documents\WindowsPowerShell\Modules\<moduleName>`. If you do not use the default paths, you will need to explicitly state the location of your module during

installation. Be sure to create a folder to save your module in, as you may need the folder to store multiple assemblies and files for your solution.

Note that technically you do not need to install your module anywhere on the `PSModulePath` - those are simply the default locations that PowerShell will look for your module. However, it is considered best practice to do so, unless you have a good reason for storing your module somewhere else. For more information, see Installing a PowerShell Module and about_PSModulePath.

4. Import your module into PowerShell with a call to Import-Module.

   Calling to Import-Module will load your module into active memory. If you are using PowerShell 3.0 and later, simply calling the name of your module in code will also import it; for more information, see Importing a PowerShell Module.

Importing Snap-in Assemblies as Modules

Cmdlets and providers that exist in snap-in assemblies can be loaded as binary modules. When the snap-in assemblies are loaded as binary modules, the cmdlets and providers in the snap-in are available to the user, but the snap-in class in the assembly is ignored, and the snap-in is not registered. As a result, the snap-in cmdlets provided by Windows PowerShell cannot detect the snap-in even though the cmdlets and providers are available to the session.

In addition, any formatting or types files that are referenced by the snap-in cannot be imported as part of a binary module. To import the formatting and types files you must create a module manifest. See, How to Write a PowerShell Module Manifest.

See Also

Writing a Windows PowerShell Module

How to write a PowerShell module manifest

Article • 03/06/2023

After you've written your PowerShell module, you can add an optional module manifest that includes information about the module. For example, you can describe the author, specify files in the module (such as nested modules), run scripts to customize the user's environment, load type and formatting files, define system requirements, and limit the members that the module exports.

Creating a module manifest

A **module manifest** is a PowerShell data file (`.psd1`) that describes the contents of a module and determines how a module is processed. The manifest file is a text file that contains a hash table of keys and values. You link a manifest file to a module by naming the manifest the same as the module, and storing the manifest in the module's root directory.

For simple modules that contain only a single `.psm1` or binary assembly, a module manifest is optional. But, the recommendation is to use a module manifest whenever possible, as they're useful to help you organize your code and maintain versioning information. And, a module manifest is required to export an assembly that is installed in the Global Assembly Cache. A module manifest is also required for modules that support the Updatable Help feature. Updatable Help uses the **HelpInfoUri** key in the module manifest to find the Help information (HelpInfo XML) file that contains the location of the updated help files for the module. For more information about Updatable Help, see Supporting Updatable Help.

To create and use a module manifest

1. The best practice to create a module manifest is to use the New-ModuleManifest cmdlet. You can use parameters to specify one or more of the manifest's default keys and values. The only requirement is to name the file. `New-ModuleManifest` creates a module manifest with your specified values, and includes the remaining keys and their default values. If you need to create multiple modules, use `New-ModuleManifest` to create a module manifest template that can be modified for your different modules. For an example of a default module manifest, see the Sample module manifest.

```
New-ModuleManifest -Path C:\myModuleName.psd1 -ModuleVersion "2.0" -Author
"YourNameHere"
```

An alternative is to manually create the module manifest's hash table using the minimal information required, the **ModuleVersion**. You save the file with the same name as your module and use the `.psd1` file extension. You can then edit the file and add the appropriate keys and values.

2. Add any additional elements that you want in the manifest file.

   To edit the manifest file, use any text editor you prefer. But, the manifest file is a script file that contains code, so you may wish to edit it in a scripting or development environment, such as Visual Studio Code. All elements of a manifest file are optional, except for the **ModuleVersion** number.

   For descriptions of the keys and values you can include in a module manifest, see the Module manifest elements table. For more information, see the parameter descriptions in the New-ModuleManifest cmdlet.

3. To address any scenarios that might not be covered by the base module manifest elements, you have the option to add additional code to your module manifest.

   For security concerns, PowerShell only runs a small subset of the available operations in a module manifest file. Generally, you can use the `if` statement, arithmetic and comparison operators, and the basic PowerShell data types.

4. After you've created your module manifest, you can test it to confirm that any paths described in the manifest are correct. To test your module manifest, use Test-ModuleManifest.

   ```
   Test-ModuleManifest myModuleName.psd1
   ```

5. Be sure that your module manifest is located in the top level of the directory that contains your module.

   When you copy your module onto a system and import it, PowerShell uses the module manifest to import your module.

6. Optionally, you can directly test your module manifest with a call to Import-Module by dot-sourcing the manifest itself.

   ```
   Import-Module .\myModuleName.psd1
   ```

Module manifest elements

The following table describes the elements you can include in a module manifest.

Element	Default	Description
RootModule Type: `String`	`<empty string>`	Script module or binary module file associated with this manifest. Previous versions of PowerShell called this element the **ModuleToProcess**. Possible types for the root module can be empty, which creates a **Manifest** module, the name of a script module (`.psm1`), or the name of a binary module (`.exe` or `.dll`). Placing the name of a module manifest (`.psd1`) or a script file (`.ps1`) in this element causes an error. Example: `RootModule = 'ScriptModule.psm1'`
ModuleVersion Type: `Version`	`'0.0.1'`	Version number of this module. If a value isn't specified, `New-ModuleManifest` uses the default. The string must be able to convert to the type `Version` for example `#.#.#.#`. `Import-Module` loads the first module it finds on the **$PSModulePath** that matches the name, and has at least as high a **ModuleVersion**, as the **MinimumVersion** parameter. To import a specific version, use the `Import-Module` cmdlet's **RequiredVersion** parameter. Example: `ModuleVersion = '1.0'`
GUID Type: `GUID`	`'<GUID>'`	ID used to uniquely identify this module. If a value isn't specified, `New-ModuleManifest` autogenerates the value. You can't currently import a module by **GUID**. Example: `GUID = 'cfc45206-1e49-459d-a8ad-5b571ef94857'`
Author Type: `String`	`'<Current user>'`	Author of this module. If a value isn't specified, `New-ModuleManifest` uses the current user. Example: `Author = 'AuthorNameHere'`
CompanyName Type: `String`	`'Unknown'`	Company or vendor of this module. If a value isn't specified, `New-ModuleManifest` uses the default. Example: `CompanyName = 'Fabrikam'`
Copyright Type: `String`	`'(c) <Author>. All rights reserved.'`	Copyright statement for this module. If a value isn't specified, `New-ModuleManifest` uses the default with the current user as the `<Author>`. To specify an author, use the **Author** parameter. Example: `Copyright = '2019 AuthorName. All rights reserved.'`

Element	Default	Description
Description Type: `String`	`<empty string>`	Description of the functionality provided by this module. Example: `Description = 'This is the module's description.'`
PowerShellVersion Type: `Version`	`<empty string>`	Minimum version of the PowerShell engine required by this module. Valid values are 1.0, 2.0, 3.0, 4.0, 5.0, 5.1, 6.0, 6.1, 6.2, 7.0 and 7.1. Example: `PowerShellVersion = '5.0'`
PowerShellHostName Type: `String`	`<empty string>`	Name of the PowerShell host required by this module. This name is provided by PowerShell. To find the name of a host program, in the program, type: `$host.name`. Example: `PowerShellHostName = 'ConsoleHost'`
PowerShellHostVersion Type: `Version`	`<empty string>`	Minimum version of the PowerShell host required by this module. Example: `PowerShellHostVersion = '2.0'`
DotNetFrameworkVersion Type: `Version`	`<empty string>`	Minimum version of Microsoft .NET Framework required by this module. This prerequisite is valid for the PowerShell Desktop edition only, such as Windows PowerShell 5.1, and only applies to .NET Framework versions lower than 4.5. Example: `DotNetFrameworkVersion = '3.5'`
CLRVersion Type: `Version`	`<empty string>`	Minimum version of the common language runtime (CLR) required by this module. This prerequisite is valid for the PowerShell Desktop edition only, such as Windows PowerShell 5.1, and only applies to .NET Framework versions lower than 4.5. Example: `CLRVersion = '3.5'`
ProcessorArchitecture Type: `ProcessorArchitecture`	`<empty string>`	Processor architecture (None, X86, Amd64) required by this module. Valid values are x86, AMD64, Arm, IA64, MSIL, and None (unknown or unspecified). Example: `ProcessorArchitecture = 'x86'`

Element	Default	Description
RequiredModules Type: `Object[]`	`@()`	Modules that must be imported into the global environment prior to importing this module. This loads any modules listed unless they've already been loaded. For example, some modules may already be loaded by a different module. It's possible to specify a specific version to load using `RequiredVersion` rather than `ModuleVersion`. When `ModuleVersion` is used it will load the newest version available with a minimum of the version specified. You can combine strings and hash tables in the parameter value. Example: `RequiredModules = @("MyModule", @{ModuleName="MyDependentModule"; ModuleVersion="2.0"; GUID="cfc45206-1e49-459d-a8ad-5b571ef94857"})` Example: `RequiredModules = @("MyModule", @{ModuleName="MyDependentModule"; RequiredVersion="1.5"; GUID="cfc45206-1e49-459d-a8ad-5b571ef94857"})`
RequiredAssemblies Type: `String[]`	`@()`	Assemblies that must be loaded prior to importing this module. Specifies the assembly (`.dll`) file names that the module requires. PowerShell loads the specified assemblies before updating types or formats, importing nested modules, or importing the module file that is specified in the value of the RootModule key. Use this parameter to list all the assemblies that the module requires. Example: `RequiredAssemblies = @("assembly1.dll", "assembly2.dll", "assembly3.dll")`
ScriptsToProcess Type: `String[]`	`@()`	Script (`.ps1`) files that are run in the caller's session state when the module is imported. This could be the global session state or, for nested modules, the session state of another module. You can use these scripts to prepare an environment just as you might use a log in script. These scripts are run before any of the modules listed in the manifest are loaded. Example: `ScriptsToProcess = @("script1.ps1", "script2.ps1", "script3.ps1")`

Element	Default	Description
TypesToProcess Type: `String[]`	`@()`	Type files (`.ps1xml`) to be loaded when importing this module. Example: `TypesToProcess = @("type1.ps1xml", "type2.ps1xml", "type3.ps1xml")`
FormatsToProcess Type: `String[]`	`@()`	Format files (`.ps1xml`) to be loaded when importing this module. Example: `FormatsToProcess = @("format1.ps1xml", "format2.ps1xml", "format3.ps1xml")`
NestedModules Type: `Object[]`	`@()`	Modules to import as nested modules of the module specified in **RootModule** (alias:**ModuleToProcess**). Adding a module name to this element is similar to calling `Import-Module` from within your script or assembly code. The main difference by using a manifest file is that it's easier to see what you're loading. And, if a module fails to load, you will not yet have loaded your actual module. In addition to other modules, you may also load script (`.ps1`) files here. These files will execute in the context of the root module. This is equivalent to dot sourcing the script in your root module. Example: `NestedModules = @("script.ps1", @{ModuleName="MyModule"; ModuleVersion="1.0.0.0"; GUID="50cdb55f-5ab7-489f-9e94-4ec21ff51e59"})`

Element	Default	Description
FunctionsToExport Type: `String[]`	`@()`	Specifies the functions to export from this module, for best performance, do not use wildcards and do not delete the entry, use an empty array if there are no functions to export. By default, no functions are exported. You can use this key to list the functions that are exported by the module. The module exports the functions to the caller's session state. The caller's session state can be the global session state or, for nested modules, the session state of another module. When chaining nested modules, all functions that are exported by a nested module will be exported to the global session state unless a module in the chain restricts the function by using the **FunctionsToExport** key. If the manifest exports aliases for the functions, this key can remove functions whose aliases are listed in the **AliasesToExport** key, but this key cannot add function aliases to the list. Example: `FunctionsToExport = @("function1", "function2", "function3")`
CmdletsToExport Type: `String[]`	`@()`	Specifies the cmdlets to export from this module, for best performance, do not use wildcards and do not delete the entry, use an empty array if there are no cmdlets to export. By default, no cmdlets are exported. You can use this key to list the cmdlets that are exported by the module. The caller's session state can be the global session state or, for nested modules, the session state of another module. When you're chaining nested modules, all cmdlets that are exported by a nested module will be exported to the global session state unless a module in the chain restricts the cmdlet by using the **CmdletsToExport** key. If the manifest exports aliases for the cmdlets, this key can remove cmdlets whose aliases are listed in the **AliasesToExport** key, but this key cannot add cmdlet aliases to the list. Example: `CmdletsToExport = @("Get-MyCmdlet", "Set-MyCmdlet", "Test-MyCmdlet")`

Element	Default	Description
VariablesToExport Type: `String[]`	`'*'`	Specifies the variables that the module exports to the caller's session state. Wildcard characters are permitted. By default, all variables (`'*'`) are exported. You can use this key to restrict the variables that are exported by the module. The caller's session state can be the global session state or, for nested modules, the session state of another module. When you are chaining nested modules, all variables that are exported by a nested module will be exported to the global session state unless a module in the chain restricts the variable by using the **VariablesToExport** key. If the manifest also exports aliases for the variables, this key can remove variables whose aliases are listed in the **AliasesToExport** key, but this key cannot add variable aliases to the list. Example: `VariablesToExport = @('$MyVariable1', '$MyVariable2', '$MyVariable3')`
AliasesToExport Type: `String[]`	`@()`	Specifies the aliases to export from this module, for best performance, do not use wildcards and do not delete the entry, use an empty array if there are no aliases to export. By default, no aliases are exported. You can use this key to list the aliases that are exported by the module. The module exports the aliases to caller's session state. The caller's session state can be the global session state or, for nested modules, the session state of another module. When you are chaining nested modules, all aliases that are exported by a nested module will be ultimately exported to the global session state unless a module in the chain restricts the alias by using the **AliasesToExport** key. Example: `AliasesToExport = @("MyAlias1", "MyAlias2", "MyAlias3")`
DscResourcesToExport Type: `String[]`	`@()`	Specifies DSC resources to export from this module. Wildcards are permitted. Example: `DscResourcesToExport = @("DscResource1", "DscResource2", "DscResource3")`

Element	Default	Description
ModuleList Type: `Object[]`	`@()`	Specifies all the modules that are packaged with this module. These modules can be entered by name, using a comma-separated string, or as a hash table with **ModuleName** and **GUID** keys. The hash table can also have an optional **ModuleVersion** key. The **ModuleList** key is designed to act as a module inventory. These modules are not automatically processed. Example: `ModuleList = @("SampleModule", "MyModule", @{ModuleName="MyModule"; ModuleVersion="1.0.0.0"; GUID="50cdb55f-5ab7-489f-9e94-4ec21ff51e59"})`
FileList Type: `String[]`	`@()`	List of all files packaged with this module. As with **ModuleList**, **FileList** is an inventory list, and isn't otherwise processed. Example: `FileList = @("File1", "File2", "File3")`
PrivateData Type: `Object`	`@{...}`	Specifies any private data that needs to be passed to the root module specified by the **RootModule** (alias: **ModuleToProcess**) key. **PrivateData** is a hash table that comprises several elements: **Tags**, **LicenseUri**, **ProjectURI**, **IconUri**, **ReleaseNotes**, **Prerelease**, **RequireLicenseAcceptance**, and **ExternalModuleDependencies**.
Tags Type: `String[]`	`@()`	Tags help with module discovery in online galleries. Example: `Tags = "PackageManagement", "PowerShell", "Manifest"`
LicenseUri Type: `Uri`	`<empty string>`	A URL to the license for this module. Example: `LicenseUri = 'https://www.contoso.com/license'`
ProjectUri Type: `Uri`	`<empty string>`	A URL to the main website for this project. Example: `ProjectUri = 'https://www.contoso.com/project'`
IconUri Type: `Uri`	`<empty string>`	A URL to an icon representing this module. Example: `IconUri = 'https://www.contoso.com/icons/icon.png'`
ReleaseNotes Type: `String`	`<empty string>`	Specifies the module's release notes. Example: `ReleaseNotes = 'The release notes provide information about the module.`

Element	Default	Description
PreRelease Type: `String`	`<empty string>`	This parameter was added in PowerShellGet 1.6.6. A **PreRelease** string that identifies the module as a prerelease version in online galleries. Example: `PreRelease = 'alpha'`
RequireLicenseAcceptance Type: `Boolean`	`$true`	This parameter was added in PowerShellGet 1.5. Flag to indicate whether the module requires explicit user acceptance for install, update, or save. Example: `RequireLicenseAcceptance = $false`
ExternalModuleDependencies Type: `String[]`	`@()`	This parameter was added in PowerShellGet v2. A list of external modules that this module is dependent upon. Example: `ExternalModuleDependencies = @("ExtModule1", "ExtModule2", "ExtModule3")`
HelpInfoURI Type: `String`	`<empty string>`	HelpInfo URI of this module. Example: `HelpInfoURI = 'https://www.contoso.com/help'`
DefaultCommandPrefix Type: `String`	`<empty string>`	Default prefix for commands exported from this module. Override the default prefix using `Import-Module -Prefix`. Example: `DefaultCommandPrefix = 'My'`

Sample module manifest

The following sample module manifest was created with `New-ModuleManifest` in PowerShell 7 and contains the default keys and values.

PowerShell

```
#
# Module manifest for module 'SampleModuleManifest'
#
# Generated by: User01
#
# Generated on: 10/15/2019
#

@{

# Script module or binary module file associated with this manifest.
# RootModule = ''

# Version number of this module.
ModuleVersion = '0.0.1'
```

```
# Supported PSEditions
# CompatiblePSEditions = @()

# ID used to uniquely identify this module
GUID = 'b632e90c-df3d-4340-9f6c-3b832646bf87'

# Author of this module
Author = 'User01'

# Company or vendor of this module
CompanyName = 'Unknown'

# Copyright statement for this module
Copyright = '(c) User01. All rights reserved.'

# Description of the functionality provided by this module
# Description = ''

# Minimum version of the PowerShell engine required by this module
# PowerShellVersion = ''

# Name of the PowerShell host required by this module
# PowerShellHostName = ''

# Minimum version of the PowerShell host required by this module
# PowerShellHostVersion = ''

# Minimum version of Microsoft .NET Framework required by this module. This
prerequisite is valid for the PowerShell Desktop edition only.
# DotNetFrameworkVersion = ''

# Minimum version of the common language runtime (CLR) required by this
module. This prerequisite is valid for the PowerShell Desktop edition only.
# CLRVersion = ''

# Processor architecture (None, X86, Amd64) required by this module
# ProcessorArchitecture = ''

# Modules that must be imported into the global environment prior to
importing this module
# RequiredModules = @()

# Assemblies that must be loaded prior to importing this module
# RequiredAssemblies = @()

# Script files (.ps1) that are run in the caller's environment prior to
importing this module.
# ScriptsToProcess = @()

# Type files (.ps1xml) to be loaded when importing this module
# TypesToProcess = @()

# Format files (.ps1xml) to be loaded when importing this module
# FormatsToProcess = @()
```

```
# Modules to import as nested modules of the module specified in
RootModule/ModuleToProcess
# NestedModules = @()

# Functions to export from this module, for best performance, do not use
wildcards and do not delete the entry, use an empty array if there are no
functions to export.
FunctionsToExport = @()

# Cmdlets to export from this module, for best performance, do not use
wildcards and do not delete the entry, use an empty array if there are no
cmdlets to export.
CmdletsToExport = @()

# Variables to export from this module
VariablesToExport = '*'

# Aliases to export from this module, for best performance, do not use
wildcards and do not delete the entry, use an empty array if there are no
aliases to export.
AliasesToExport = @()

# DSC resources to export from this module
# DscResourcesToExport = @()

# List of all modules packaged with this module
# ModuleList = @()

# List of all files packaged with this module
# FileList = @()

# Private data to pass to the module specified in
RootModule/ModuleToProcess. This may also contain a PSData hashtable with
additional module metadata used by PowerShell.
PrivateData = @{

    PSData = @{

        # Tags applied to this module. These help with module discovery in
online galleries.
        # Tags = @()

        # A URL to the license for this module.
        # LicenseUri = ''

        # A URL to the main website for this project.
        # ProjectUri = ''

        # A URL to an icon representing this module.
        # IconUri = ''

        # ReleaseNotes of this module
        # ReleaseNotes = ''
```

```
        # Prerelease string of this module
        # Prerelease = ''

        # Flag to indicate whether the module requires explicit user
acceptance for install/update/save
        RequireLicenseAcceptance = $true

        # External dependent modules of this module
        # ExternalModuleDependencies = @()

    } # End of PSData hashtable

} # End of PrivateData hashtable

# HelpInfo URI of this module
# HelpInfoURI = ''

# Default prefix for commands exported from this module. Override the
default prefix using Import-Module -Prefix.
# DefaultCommandPrefix = ''

}
```

See also

about_Comparison_Operators

about_If

Global Assembly Cache

Import-Module

New-ModuleManifest

Test-ModuleManifest

Update-ModuleManifest

Writing a Windows PowerShell Module

Installing a PowerShell Module

Article • 11/15/2022

After you have created your PowerShell module, you will likely want to install the module on a system, so that you or others may use it. Generally speaking, this consists of copying the module files (ie, the .psm1, or the binary assembly, the module manifest, and any other associated files) onto a directory on that computer. For a very small project, this may be as simple as copying and pasting the files with Windows Explorer onto a single remote computer; however, for larger solutions you may wish to use a more sophisticated installation process. Regardless of how you get your module onto the system, PowerShell can use a number of techniques that will let users find and use your modules. Therefore, the main issue for installation is ensuring that PowerShell will be able to find your module. For more information, see Importing a PowerShell Module.

Rules for Installing Modules

The following information pertains to all modules, including modules that you create for your own use, modules that you get from other parties, and modules that you distribute to others.

Install Modules in PSModulePath

Whenever possible, install all modules in a path that is listed in the **PSModulePath** environment variable or add the module path to the **PSModulePath** environment variable value.

The **PSModulePath** environment variable (`$Env:PSModulePath`) contains the locations of Windows PowerShell modules. Cmdlets rely on the value of this environment variable to find modules.

By default, the **PSModulePath** environment variable value contains the following system and user module directories, but you can add to and edit the value.

- `$PSHome\Modules` (`%Windir%\System32\WindowsPowerShell\v1.0\Modules`)

  > ⚠ **Warning**
  >
  > This location is reserved for modules that ship with Windows. Do not install modules to this location.

- `$HOME\Documents\WindowsPowerShell\Modules` (`%HOMEDRIVE%%HOMEPATH%\Documents\WindowsPowerShell\Modules`)
- `$Env:ProgramFiles\WindowsPowerShell\Modules` (`%ProgramFiles%\WindowsPowerShell\Modules`)

  To get the value of the **PSModulePath** environment variable, use either of the following commands.

  ```PowerShell
  $Env:PSModulePath
  [Environment]::GetEnvironmentVariable("PSModulePath")
  ```

  To add a module path to value of the **PSModulePath** environment variable value, use the following command format. This format uses the **SetEnvironmentVariable** method of the **System.Environment** class to make a session-independent change to the **PSModulePath** environment variable.

  ```PowerShell
  #Save the current value in the $p variable.
  $p = [Environment]::GetEnvironmentVariable("PSModulePath")

  #Add the new path to the $p variable. Begin with a semi-colon
  separator.
  $p += ";C:\Program Files (x86)\MyCompany\Modules\"

  #Add the paths in $p to the PSModulePath value.
  [Environment]::SetEnvironmentVariable("PSModulePath",$p)
  ```

  > **Important**
  >
  > Once you have added the path to **PSModulePath**, you should broadcast an environment message about the change. Broadcasting the change allows other applications, such as the shell, to pick up the change. To broadcast the change, have your product installation code send a **WM_SETTINGCHANGE** message with `lParam` set to the string "Environment". Be sure to send the message after your module installation code has updated **PSModulePath**.

Use the Correct Module Directory Name

A well-formed module is a module that is stored in a directory that has the same name as the base name of at least one file in the module directory. If a module is not well-formed, Windows PowerShell does not recognize it as a module.

The "base name" of a file is the name without the file name extension. In a well-formed module, the name of the directory that contains the module files must match the base name of at least one file in the module.

For example, in the sample Fabrikam module, the directory that contains the module files is named "Fabrikam" and at least one file has the "Fabrikam" base name. In this case, both Fabrikam.psd1 and Fabrikam.dll have the "Fabrikam" base name.

```
C:\Program Files
  Fabrikam Technologies
    Fabrikam Manager
      Modules
        Fabrikam
          Fabrikam.psd1 (module manifest)
          Fabrikam.dll (module assembly)
```

Effect of Incorrect Installation

If the module is not well-formed and its location is not included in the value of the **PSModulePath** environment variable, basic discovery features of Windows PowerShell, such as the following, do not work.

- The Module Auto-Loading feature cannot import the module automatically.
- The `ListAvailable` parameter of the Get-Module cmdlet cannot find the module.
- The Import-Module cmdlet cannot find the module. To import the module, you must provide the full path to the root module file or module manifest file.

  Additional features, such as the following, do not work unless the module is imported into the session. In well-formed modules in the **PSModulePath** environment variable, these features work even when the module is not imported into the session.
- The Get-Command cmdlet cannot find commands in the module.
- The Update-Help and Save-Help cmdlets cannot update or save help for the module.

- The Show-Command cmdlet cannot find and display the commands in the module.

  The commands in the module are missing from the `Show-Command` window in Windows PowerShell Integrated Scripting Environment (ISE).

Where to Install Modules

This section explains where in the file system to install Windows PowerShell modules. The location depends on how the module is used.

Installing Modules for a Specific User

If you create your own module or get a module from another party, such as a Windows PowerShell community website, and you want the module to be available for your user account only, install the module in your user-specific Modules directory.

```
$HOME\Documents\WindowsPowerShell\Modules\<Module Folder>\<Module Files>
```

The user-specific Modules directory is added to the value of the **PSModulePath** environment variable by default.

Installing Modules for all Users in Program Files

If you want a module to be available to all user accounts on the computer, install the module in the Program Files location.

```
$Env:ProgramFiles\WindowsPowerShell\Modules\<Module Folder>\<Module Files>
```

> ⓘ **Note**
>
> The Program Files location is added to the value of the PSModulePath environment variable by default in Windows PowerShell 4.0 and later. For earlier versions of Windows PowerShell, you can manually create the Program Files location (%ProgramFiles%\WindowsPowerShell\Modules) and add this path to your PSModulePath environment variable as described above.

Installing Modules in a Product Directory

If you are distributing the module to other parties, use the default Program Files location described above, or create your own company-specific or product-specific subdirectory of the %ProgramFiles% directory.

For example, Fabrikam Technologies, a fictitious company, is shipping a Windows PowerShell module for their Fabrikam Manager product. Their module installer creates a Modules subdirectory in the Fabrikam Manager product subdirectory.

```
C:\Program Files
  Fabrikam Technologies
    Fabrikam Manager
      Modules
        Fabrikam
          Fabrikam.psd1 (module manifest)
          Fabrikam.dll (module assembly)
```

To enable the Windows PowerShell module discovery features to find the Fabrikam module, the Fabrikam module installer adds the module location to the value of the **PSModulePath** environment variable.

PowerShell

```
$p = [Environment]::GetEnvironmentVariable("PSModulePath")
$p += ";C:\Program Files\Fabrikam Technologies\Fabrikam Manager\Modules\"
[Environment]::SetEnvironmentVariable("PSModulePath",$p)
```

Installing Modules in the Common Files Directory

If a module is used by multiple components of a product or by multiple versions of a product, install the module in a module-specific subdirectory of the %ProgramFiles%\Common Files\Modules subdirectory.

In the following example, the Fabrikam module is installed in a Fabrikam subdirectory of the `%ProgramFiles%\Common Files\Modules` subdirectory. Note that each module resides in its own subdirectory in the Modules subdirectory.

```
C:\Program Files
  Common Files
    Modules
      Fabrikam
        Fabrikam.psd1 (module manifest)
        Fabrikam.dll (module assembly)
```

Then, the installer assures the value of the **PSModulePath** environment variable includes the path of the common files modules subdirectory.

PowerShell

```
$m = $env:ProgramFiles + '\Common Files\Modules'
$p = [Environment]::GetEnvironmentVariable("PSModulePath")
$q = $p -split ';'
if ($q -notContains $m) {
    $q += ";$m"
}
$p = $q -join ';'
[Environment]::SetEnvironmentVariable("PSModulePath", $p)
```

Installing Multiple Versions of a Module

To install multiple versions of the same module, use the following procedure.

1. Create a directory for each version of the module. Include the version number in the directory name.
2. Create a module manifest for each version of the module. In the value of the **ModuleVersion** key in the manifest, enter the module version number. Save the manifest file (.psd1) in the version-specific directory for the module.
3. Add the module root folder path to the value of the **PSModulePath** environment variable, as shown in the following examples.

To import a particular version of the module, the end-user can use the `MinimumVersion` or `RequiredVersion` parameters of the Import-Module cmdlet.

For example, if the Fabrikam module is available in versions 8.0 and 9.0, the Fabrikam module directory structure might resemble the following.

```
C:\Program Files
Fabrikam Manager
 Fabrikam8
   Fabrikam
     Fabrikam.psd1 (module manifest: ModuleVersion = "8.0")
     Fabrikam.dll (module assembly)
 Fabrikam9
   Fabrikam
     Fabrikam.psd1 (module manifest: ModuleVersion = "9.0")
     Fabrikam.dll (module assembly)
```

The installer adds both of the module paths to the **PSModulePath** environment variable value.

PowerShell

```
$p = [Environment]::GetEnvironmentVariable("PSModulePath")
$p += ";C:\Program Files\Fabrikam\Fabrikam8;C:\Program
Files\Fabrikam\Fabrikam9"
[Environment]::SetEnvironmentVariable("PSModulePath",$p)
```

When these steps are complete, the **ListAvailable** parameter of the Get-Module cmdlet gets both of the Fabrikam modules. To import a particular module, use the `MinimumVersion` or `RequiredVersion` parameters of the Import-Module cmdlet.

If both modules are imported into the same session, and the modules contain cmdlets with the same names, the cmdlets that are imported last are effective in the session.

Handling Command Name Conflicts

Command name conflicts can occur when the commands that a module exports have the same name as commands in the user's session.

When a session contains two commands that have the same name, Windows PowerShell runs the command type that takes precedence. When a session contains two commands that have the same name and the same type, Windows PowerShell runs the command that was added to the session most recently. To run a command that is not run by default, users can qualify the command name with the module name.

For example, if the session contains a `Get-Date` function and the `Get-Date` cmdlet, Windows PowerShell runs the function by default. To run the cmdlet, preface the command with the module name, such as:

PowerShell

```
Microsoft.PowerShell.Utility\Get-Date
```

To prevent name conflicts, module authors can use the **DefaultCommandPrefix** key in the module manifest to specify a noun prefix for all commands exported from the module.

Users can use the **Prefix** parameter of the `Import-Module` cmdlet to use an alternate prefix. The value of the **Prefix** parameter takes precedence over the value of the **DefaultCommandPrefix** key.

Supporting paths on non-Windows systems

Non-Windows platforms use the colon (`:`) character as a path separator and a forward-slash (`/`) character as a directory separator. The `[System.IO.Path]` class has static members that can be used to make your code work on any platform:

- `[System.IO.Path]::PathSeparator` - returns the character used to separate paths in a PATH environment variable for the host platform
- `[System.IO.Path]::DirectorySeparatorChar` - returns the character used to separate directory names with a path for the host platform

Use these static properties to in place of the `;` and `\` characters when you are constructing path strings.

See Also

about_Command_Precedence

Writing a Windows PowerShell Module

Registering Cmdlets

Article • 09/17/2021

The topics in this section describe modules and snap-ins and how to use modules and snap-ins to make cmdlets available in a Windows PowerShell session.

In This Section

Modules and Snap-ins Describes the differences between registering cmdlets through modules and through snap-ins.

How to Register Cmdlets using Modules Describes how to register cmdlets using modules.

How to Create a Windows PowerShell Snap-in Describes how to register cmdlets using snap-ins.

See Also

Writing a Windows PowerShell Cmdlet

Modules and Snap-ins

Article • 09/17/2021

Cmdlets can be added to a session using modules (introduced by Windows PowerShell 2.0) or snap-ins. Once the cmdlet is added to the session it can be run programmatically by a host application or interactively at the command line.

We recommend that you use modules as the delivery method for adding cmdlets to a session for the following reasons:

- Modules allow you to add cmdlets by loading the assembly where the cmdlet is defined. There is no need to implement a snap-in class.
- Modules allow you to add other resources, such as variables, functions, scripts, types and formatting files, and more.
- Snap-ins can be used only to add cmdlets and providers to the session.

See Also

Writing a Windows PowerShell Module

Writing a Windows PowerShell Cmdlet

How to Import Cmdlets Using Modules

Article • 09/17/2021

This article describes how to import cmdlets to a PowerShell session by using a binary module.

> **Note**
>
> The members of modules can include cmdlets, providers, functions, variables, aliases, and much more. Snap-ins can contain only cmdlets and providers.

How to load cmdlets using a module

1. Create a module folder that has the same name as the assembly file in which the cmdlets are implemented. In this procedure, the module folder is created in the Windows `system32` folder.

   ```
   %SystemRoot%\system32\WindowsPowerShell\v1.0\Modules\mymodule
   ```

2. Make sure that the `PSModulePath` environment variable includes the path to your new module folder. By default, the system folder is already added to the `PSModulePath` environment variable. To view the `PSModulePath`, type: `$env:PSModulePath`.

3. Copy the cmdlet assembly into the module folder.

4. Add a module manifest file (`.psd1`) in the module's root folder. PowerShell uses the module manifest to import your module. For more information, see How to Write a PowerShell Module Manifest.

5. Run the following command to add the cmdlets to the session:

   ```
   Import-Module [Module_Name]
   ```

   This procedure can be used to test your cmdlets. It adds all the cmdlets in the assembly to the session. For more information about modules, see Writing a Windows PowerShell Module.

See also

How to Write a PowerShell Module Manifest

Importing a PowerShell Module

Import-Module

Installing Modules

about_PSModulePath

Writing a Windows PowerShell Cmdlet

How to Create a Windows PowerShell Snap-in

Article • 09/17/2021

A Windows PowerShell snap-in provides a mechanism for registering sets of cmdlets and another Windows PowerShell provider with the shell, thus extending the functionality of the shell. A Windows PowerShell snap-in can register all the cmdlets and providers in a single assembly, or it can register a specific list of cmdlets and providers.

Snap-in assemblies should be installed in a protected directory, just as they would be with other operating systems. Otherwise, malicious users can replace an assembly with unsafe code.

Windows PowerShell Snap-in Classes

All Windows PowerShell snap-in classes derive from the System.Management.Automation.PSSnapIn or System.Management.Automation.Custompssnapin classes.

Examples

Writing a Windows PowerShell Snap-in: This example shows how to create a snap-in that is used to register all the cmdlets and providers in an assembly.

Writing a Custom Windows PowerShell Snap-in: This example shows how to create a custom snap-in that is used to register a specific set of cmdlets and providers that might or might not exist in a single assembly.

See Also

System.Management.Automation.PSSnapIn

System.Management.Automation.Custompssnapin

Registering Cmdlets

Windows PowerShell Shell SDK

Writing a Windows PowerShell Snap-in

Article • 09/17/2021

This example shows how to write a Windows PowerShell snap-in that can be used to register all the cmdlets and Windows PowerShell providers in an assembly.

With this type of snap-in, you do not select which cmdlets and providers you want to register. To write a snap-in that allows you to select what is registered, see Writing a Custom Windows PowerShell Snap-in.

Writing a Windows PowerShell Snap-in

1. Add the RunInstallerAttribute attribute.
2. Create a public class that derives from the System.Management.Automation.PSSnapIn class.

   In this example, the class name is "GetProcPSSnapIn01".
3. Add a public property for the name of the snap-in (required). When naming snap-ins, do not use any of the following characters: `#`, `.`, `,`, `(`, `)`, `{`, `}`, `[`, `]`, `&`, `-`, `/`, `\`, `$`, `;`, `:`, `"`, `'`, `<`, `>`, `|`, `?`, `@`, `` ` ``, `*`

   In this example, the name of the snap-in is "GetProcPSSnapIn01".
4. Add a public property for the vendor of the snap-in (required).

   In this example, the vendor is "Microsoft".
5. Add a public property for the vendor resource of the snap-in (optional).

   In this example, the vendor resource is "GetProcPSSnapIn01,Microsoft".
6. Add a public property for the description of the snap-in (required).

   In this example, the description is "This is a Windows PowerShell snap-in that registers the get-proc cmdlet".
7. Add a public property for the description resource of the snap-in (optional).

   In this example, the vendor resource is "GetProcPSSnapIn01,This is a Windows PowerShell snap-in that registers the get-proc cmdlet".

Example

This example shows how to write a Windows PowerShell snap-in that can be used to register the Get-Proc cmdlet in the Windows PowerShell shell. Be aware that in this example, the complete assembly would contain only the GetProcPSSnapIn01 snap-in class and the `Get-Proc` cmdlet class.

C#

```
[RunInstaller(true)]
public class GetProcPSSnapIn01 : PSSnapIn
{
  /// <summary>
  /// Create an instance of the GetProcPSSnapIn01 class.
  /// </summary>
  public GetProcPSSnapIn01()
         : base()
  {
  }

  /// <summary>
  /// Specify the name of the PowerShell snap-in.
  /// </summary>
  public override string Name
  {
    get
    {
      return "GetProcPSSnapIn01";
    }
  }

  /// <summary>
  /// Specify the vendor for the PowerShell snap-in.
  /// </summary>
  public override string Vendor
  {
    get
    {
      return "Microsoft";
    }
  }

  /// <summary>
  /// Specify the localization resource information for the vendor.
  /// Use the format: resourceBaseName,VendorName.
  /// </summary>
  public override string VendorResource
  {
    get
    {
      return "GetProcPSSnapIn01,Microsoft";
    }
```

```
  }

  /// <summary>
  /// Specify a description of the PowerShell snap-in.
  /// </summary>
  public override string Description
  {
    get
    {
      return "This is a PowerShell snap-in that includes the get-proc
cmdlet.";
    }
  }

  /// <summary>
  /// Specify the localization resource information for the description.
  /// Use the format: resourceBaseName,Description.
  /// </summary>
  public override string DescriptionResource
  {
    get
    {
      return "GetProcPSSnapIn01,This is a PowerShell snap-in that includes
the get-proc cmdlet.";
    }
  }
}
```

See Also

How to Register Cmdlets, Providers, and Host Applications

Windows PowerShell Shell SDK

Writing a Custom Windows PowerShell Snap-in

Article • 09/17/2021

This example shows how to write a Windows PowerShell snap-in that registers specific cmdlets.

With this type of snap-in, you specify which cmdlets, providers, types, or formats to register. For more information about how to write a snap-in that registers all the cmdlets and providers in an assembly, see Writing a Windows PowerShell Snap-in.

To write a Windows PowerShell Snap-in that registers specific cmdlets.

1. Add the RunInstallerAttribute attribute.
2. Create a public class that derives from the System.Management.Automation.Custompssnapin class.

   In this example, the class name is "CustomPSSnapinTest".
3. Add a public property for the name of the snap-in (required). When naming snap-ins, do not use any of the following characters: `#`, `.`, `,`, `(`, `)`, `{`, `}`, `[`, `]`, `&`, `-`, `/`, `\`, `$`, `;`, `:`, `"`, `'`, `<`, `>`, `|`, `?`, `@`, `` ` ``, `*`

   In this example, the name of the snap-in is "CustomPSSnapInTest".
4. Add a public property for the vendor of the snap-in (required).

   In this example, the vendor is "Microsoft".
5. Add a public property for the vendor resource of the snap-in (optional).

   In this example, the vendor resource is "CustomPSSnapInTest,Microsoft".
6. Add a public property for the description of the snap-in (required).

   In this example, the description is: "This is a custom Windows PowerShell snap-in that includes the `Test-HelloWorld` and `Test-CustomSnapinTest` cmdlets".
7. Add a public property for the description resource of the snap-in (optional).

   In this example, the vendor resource is:

> CustomPSSnapInTest, This is a custom Windows PowerShell snap-in that includes the Test-HelloWorld and Test-CustomSnapinTest cmdlets".

8. Specify the cmdlets that belong to the custom snap-in (optional) using the System.Management.Automation.Runspaces.Cmdletconfigurationentry class. The information added here includes the name of the cmdlet, its .NET type, and the cmdlet Help file name (the format of the cmdlet Help file name should be `name.dll-help.xml`).

   This example adds the Test-HelloWorld and TestCustomSnapinTest cmdlets.

9. Specify the providers that belong to the custom snap-in (optional).

   This example does not specify any providers.

10. Specify the types that belong to the custom snap-in (optional).

    This example does not specify any types.

11. Specify the formats that belong to the custom snap-in (optional).

    This example does not specify any formats.

Example

This example shows how to write a Custom Windows PowerShell snap-in that can be used to register the `Test-HelloWorld` and `Test-CustomSnapinTest` cmdlets. Be aware that in this example, the complete assembly could contain other cmdlets and providers that would not be registered by this snap-in.

C#

```
[RunInstaller(true)]
public class CustomPSSnapinTest : CustomPSSnapIn
{
  /// <summary>
  /// Creates an instance of CustomPSSnapInTest class.
  /// </summary>
  public CustomPSSnapinTest()
          : base()
  {
  }

  /// <summary>
  /// Specify the name of the custom PowerShell snap-in.
  /// </summary>
  public override string Name
```

```
  {
    get
    {
      return "CustomPSSnapInTest";
    }
  }

  /// <summary>
  /// Specify the vendor for the custom PowerShell snap-in.
  /// </summary>
  public override string Vendor
  {
    get
    {
      return "Microsoft";
    }
  }

  /// <summary>
  /// Specify the localization resource information for the vendor.
  /// Use the format: resourceBaseName,resourceName.
  /// </summary>
  public override string VendorResource
  {
    get
    {
        return "CustomPSSnapInTest,Microsoft";
    }
  }

  /// <summary>
  /// Specify a description of the custom PowerShell snap-in.
  /// </summary>
  public override string Description
  {
    get
    {
      return "This is a custom PowerShell snap-in that includes the Test-
HelloWorld and Test-CustomSnapinTest cmdlets.";
    }
  }

  /// <summary>
  /// Specify the localization resource information for the description.
  /// Use the format: resourceBaseName,Description.
  /// </summary>
  public override string DescriptionResource
  {
    get
    {
        return "CustomPSSnapInTest,This is a custom PowerShell snap-in that
includes the Test-HelloWorld and Test-CustomSnapinTest cmdlets.";
    }
  }
```

```
  /// <summary>
  /// Specify the cmdlets that belong to this custom PowerShell snap-in.
  /// </summary>
  private Collection<CmdletConfigurationEntry> _cmdlets;
  public override Collection<CmdletConfigurationEntry> Cmdlets
  {
    get
    {
      if (_cmdlets == null)
      {
        _cmdlets = new Collection<CmdletConfigurationEntry>();
        _cmdlets.Add(new CmdletConfigurationEntry("test-customsnapintest",
typeof(TestCustomSnapinTest), "TestCmdletHelp.dll-help.xml"));
        _cmdlets.Add(new CmdletConfigurationEntry("test-helloworld",
typeof(TestHelloWorld), "HelloWorldHelp.dll-help.xml"));
      }

      return _cmdlets;
    }
  }

  /// <summary>
  /// Specify the providers that belong to this custom PowerShell snap-in.
  /// </summary>
  private Collection<ProviderConfigurationEntry> _providers;
  public override Collection<ProviderConfigurationEntry> Providers
  {
    get
    {
      if (_providers == null)
      {
        _providers = new Collection<ProviderConfigurationEntry>();
      }

      return _providers;
    }
  }

  /// <summary>
  /// Specify the types that belong to this custom PowerShell snap-in.
  /// </summary>
  private Collection<TypeConfigurationEntry> _types;
  public override Collection<TypeConfigurationEntry> Types
  {
    get
    {
      if (_types == null)
      {
        _types = new Collection<TypeConfigurationEntry>();
      }

      return _types;
    }
  }
```

```
    /// <summary>
    /// Specify the formats that belong to this custom PowerShell snap-in.
    /// </summary>
    private Collection<FormatConfigurationEntry> _formats;
    public override Collection<FormatConfigurationEntry> Formats
    {
      get
      {
        if (_formats == null)
        {
          _formats = new Collection<FormatConfigurationEntry>();
        }

        return _formats;
      }
    }
}
```

For more information about registering snap-ins, see How to Register Cmdlets, Providers, and Host Applications in the Windows PowerShell Programmer's Guide.

See Also

How to Register Cmdlets, Providers, and Host Applications

Windows PowerShell Shell SDK

Importing a PowerShell Module

Article • 09/17/2021

Once you have installed a module on a system, you will likely want to import the module. Importing is the process that loads the module into active memory, so that a user can access that module in their PowerShell session. In PowerShell 2.0, you can import a newly-installed PowerShell module with a call to Import-Module cmdlet. In PowerShell 3.0, PowerShell is able to implicitly import a module when one of the functions or cmdlets in the module is called by a user. Note that both versions assume that you install your module in a location where PowerShell is able to find it; for more information, see Installing a PowerShell Module. You can use a module manifest to restrict what parts of your module are exported, and you can use parameters of the `Import-Module` call to restrict what parts are imported.

Importing a Snap-In (PowerShell 1.0)

Modules did not exist in PowerShell 1.0: instead, you had to register and use snap-ins. However, it is not recommended that you use this technology at this point, as modules are generally easier to install and import. For more information, see How to Create a Windows PowerShell Snap-in.

Importing a Module with Import-Module (PowerShell 2.0)

PowerShell 2.0 uses the appropriately-named Import-Module cmdlet to import modules. When this cmdlet is run, Windows PowerShell searches for the specified module within the directories specified in the `PSModulePath` variable. When the specified directory is found, Windows PowerShell searches for files in the following order: module manifest files (.psd1), script module files (.psm1), binary module files (.dll). For more information about adding directories to the search, see about_PSModulePath. The following code describes how to import a module:

```
PowerShell

Import-Module myModule
```

Assuming that myModule was located in the `PSModulePath`, PowerShell would load myModule into active memory. If myModule was not located on a `PSModulePath` path,

you could still explicitly tell PowerShell where to find it:

```PowerShell
Import-Module -Name C:\myRandomDirectory\myModule -Verbose
```

You can also use the `-Verbose` parameter to identify what is being exported out of the module, and what is being imported into active memory. Both exports and imports restrict what is exposed to the user: the difference is who is controlling the visibility. Essentially, exports are controlled by code within the module. In contrast, imports are controlled by the `Import-Module` call. For more information, see **Restricting Members That Are Imported**, below.

Implicitly Importing a Module (PowerShell 3.0)

Beginning in Windows PowerShell 3.0, modules are imported automatically when any cmdlet or function in the module is used in a command. This feature works on any module in a directory that is included in the value of the **PSModulePath** environment variable. If you do not save your module on a valid path however, you can still load them using the explicit Import-Module option, described above.

The following actions trigger automatic importing of a module, also known as "module auto-loading."

- Using a cmdlet in a command. For example, typing `Get-ExecutionPolicy` imports the Microsoft.PowerShell.Security module that contains the `Get-ExecutionPolicy` cmdlet.
- Using the Get-Command cmdlet to get the command. For example, typing `Get-Command Get-JobTrigger` imports the **PSScheduledJob** module that contains the `Get-JobTrigger` cmdlet. A `Get-Command` command that includes wildcard characters is considered to be discovery and does not trigger importing of a module.
- Using the Get-Help cmdlet to get help for a cmdlet. For example, typing `Get-Help Get-WinEvent` imports the Microsoft.PowerShell.Diagnostics module that contains the `Get-WinEvent` cmdlet.

To support automatic importing of modules, the `Get-Command` cmdlet gets all cmdlets and functions in all installed modules, even if the module is not imported into the session. For more information, see the help topic for the Get-Command cmdlet.

The Importing Process

When a module is imported, a new session state is created for the module, and a System.Management.Automation.PSModuleInfo object is created in memory. A session-state is created for each module that is imported (this includes the root module and any nested modules). The members that are exported from the root module, including any members that were exported to the root module by any nested modules, are then imported into the caller's session state.

The metadata of members that are exported from a module have a ModuleName property. This property is populated with the name of the module that exported them.

> ⚠ **Warning**
>
> If the name of an exported member uses an unapproved verb or if the name of the member uses restricted characters, a warning is displayed when the **Import-Module** cmdlet is run.

By default, the Import-Module cmdlet does not return any objects to the pipeline. However, the cmdlet supports a **PassThru** parameter that can be used to return a System.Management.Automation.PSModuleInfo object for each module that is imported. To send output to the host, users should run the Write-Host cmdlet.

Restricting the Members That Are Imported

When a module is imported by using the Import-Module cmdlet, by default, all exported module members are imported into the session, including any commands exported to the module by a nested module. By default, variables and aliases are not exported. To restrict the members that are exported, use a module manifest. To restrict the members that are imported, use the following parameters of the `Import-Module` cmdlet.

- **Function**: This parameter restricts the functions that are exported. (If you are using a module manifest, see the FunctionsToExport key.)
- **`Cmdlet**: This parameter restricts the cmdlets that are exported (If you are using a module manifest, see the CmdletsToExport key.)
- **Variable**: This parameter restricts the variables that are exported (If you are using a module manifest, see the VariablesToExport key.)
- **Alias**: This parameter restricts the aliases that are exported (If you are using a module manifest, see the AliasesToExport key.)

See Also

Writing a Windows PowerShell Module

Windows PowerShell Provider Quickstart

Article • 09/17/2021

This topic explains how to create a Windows PowerShell provider that has basic functionality of creating a new drive. For general information about providers, see Windows PowerShell Provider Overview. For examples of providers with more complete functionality, see Provider Samples.

Writing a basic provider

The most basic functionality of a Windows PowerShell provider is to create and remove drives. In this example, we implement the System.Management.Automation.Provider.Drivecmdletprovider.Newdrive* and System.Management.Automation.Provider.Drivecmdletprovider.Removedrive* methods of the System.Management.Automation.Provider.Drivecmdletprovider class. You will also see how to declare a provider class.

When you write a provider, you can specify default drives-drives that are created automatically when the provider is available. You also define a method to create new drives that use that provider.

The examples provided in this topic are based on the AccessDBProviderSample02 sample, which is part of a larger sample that represents an Access database as a Windows PowerShell drive.

Setting up the project

In Visual Studio, create a Class Library project named AccessDBProviderSample. Complete the following steps to configure your project so that Windows PowerShell will start, and the provider will be loaded into the session, when you build and start your project.

Configure the provider project

1. Add the System.Management.Automation assembly as a reference to your project.
2. Click **Project** > **AccessDBProviderSample Properties** > **Debug**. In **Start project**, click **Start external program**, and navigate to the Windows PowerShell executable (typically c:\Windows\System32\WindowsPowerShell\v1.0\.powershell.exe).

3. Under **Start Options**, enter the following into the **Command line arguments** box:
   `-noexit -command "[reflection.assembly]::loadFrom(AccessDBProviderSample.dll') | import-module"`

Declaring the provider class

Our provider derives from the System.Management.Automation.Provider.Drivecmdletprovider class. Most providers that provide real functionality (accessing and manipulating items, navigating the data store, and getting and setting content of items) derive from the System.Management.Automation.Provider.Navigationcmdletprovider class.

In addition to specifying that the class derives from System.Management.Automation.Provider.Drivecmdletprovider, you must decorate it with the System.Management.Automation.Provider.Cmdletproviderattribute as shown in the example.

C#

```
namespace Microsoft.Samples.PowerShell.Providers
{
  using System;
  using System.Data;
  using System.Data.Odbc;
  using System.IO;
  using System.Management.Automation;
  using System.Management.Automation.Provider;

  #region AccessDBProvider

  [CmdletProvider("AccessDB", ProviderCapabilities.None)]
  public class AccessDBProvider : DriveCmdletProvider
  {

}
}
```

Implementing NewDrive

The System.Management.Automation.Provider.Drivecmdletprovider.Newdrive* method is called by the Windows PowerShell engine when a user calls the Microsoft.PowerShell.Commands.NewPSDriveCommand cmdlet specifying the name of your provider. The PSDriveInfo parameter is passed by the Windows PowerShell engine, and the method returns the new drive to the Windows PowerShell engine. This method must be declared within the class created above.

The method first checks to make sure both the drive object and the drive root that were passed in exist, returning `null` if either of them do not. It then uses a constructor of the internal class AccessDBPSDriveInfo to create a new drive and a connection to the Access database the drive represents.

C#

```
protected override PSDriveInfo NewDrive(PSDriveInfo drive)
    {
      // Check if the drive object is null.
      if (drive == null)
      {
        WriteError(new ErrorRecord(
                   new ArgumentNullException("drive"),
                   "NullDrive",
                   ErrorCategory.InvalidArgument,
                   null));

        return null;
      }

      // Check if the drive root is not null or empty
      // and if it is an existing file.
      if (String.IsNullOrEmpty(drive.Root) || (File.Exists(drive.Root) ==
false))
      {
        WriteError(new ErrorRecord(
                   new ArgumentException("drive.Root"),
                   "NoRoot",
                   ErrorCategory.InvalidArgument,
                   drive));

        return null;
      }

      // Create a new drive and create an ODBC connection to the new drive.
      AccessDBPSDriveInfo accessDBPSDriveInfo = new
AccessDBPSDriveInfo(drive);
      OdbcConnectionStringBuilder builder = new
OdbcConnectionStringBuilder();

      builder.Driver = "Microsoft Access Driver (*.mdb)";
      builder.Add("DBQ", drive.Root);

      OdbcConnection conn = new OdbcConnection(builder.ConnectionString);
      conn.Open();
      accessDBPSDriveInfo.Connection = conn;

      return accessDBPSDriveInfo;
    }
```

The following is the AccessDBPSDriveInfo internal class that includes the constructor used to create a new drive, and contains the state information for the drive.

C#

```
internal class AccessDBPSDriveInfo : PSDriveInfo
  {
    /// <summary>
    /// A reference to the connection to the database.
    /// </summary>
    private OdbcConnection connection;

    /// <summary>
    /// Initializes a new instance of the AccessDBPSDriveInfo class.
    /// The constructor takes a single argument.
    /// </summary>
    /// <param name="driveInfo">Drive defined by this provider</param>
    public AccessDBPSDriveInfo(PSDriveInfo driveInfo)
           : base(driveInfo)
    {
    }

    /// <summary>
    /// Gets or sets the ODBC connection information.
    /// </summary>
    public OdbcConnection Connection
    {
        get { return this.connection; }
        set { this.connection = value; }
    }
  }
```

Implementing RemoveDrive

The System.Management.Automation.Provider.Drivecmdletprovider.Removedrive* method is called by the Windows PowerShell engine when a user calls the Microsoft.PowerShell.Commands.RemovePSDriveCommand cmdlet. The method in this provider closes the connection to the Access database.

C#

```
protected override PSDriveInfo RemoveDrive(PSDriveInfo drive)
    {
      // Check if drive object is null.
      if (drive == null)
      {
        WriteError(new ErrorRecord(
                   new ArgumentNullException("drive"),
                   "NullDrive",
                   ErrorCategory.InvalidArgument,
```

```
                    drive));

          return null;
        }

        // Close the ODBC connection to the drive.
        AccessDBPSDriveInfo accessDBPSDriveInfo = drive as
AccessDBPSDriveInfo;

        if (accessDBPSDriveInfo == null)
        {
           return null;
        }

        accessDBPSDriveInfo.Connection.Close();

        return accessDBPSDriveInfo;
      }
```

Windows PowerShell Provider Overview

Article • 09/17/2021

A Windows PowerShell provider allows any data store to be exposed like a file system as if it were a mounted drive. For example, the built-in Registry provider allows you to navigate the registry like you would navigate the `c` drive of your computer. A provider can also override the `Item` cmdlets (for example, `Get-Item`, `Set-Item`, etc.) such that the data in your data store can be treated like files and directories are treated when navigating a file system. For more information about providers and drives, and the built-in providers in Windows PowerShell, see about_Providers.

Providers and Drives

A Provider defines the logic that is used to access, navigate, and edit a data store, while a drive specifies a specific entry point to a data store (or a portion of a data store) that is of the type defined by the provider. For example, the Registry provider allows you to access hives and keys in a registry, and the HKLM and HKCU drives specify the corresponding hives within the registry. The HKLM and HKCU drives both use the Registry provider.

When you write a provider, you can specify default drives-drives that are created automatically when the provider is available. You also define a method to create new drives that use that provider.

Type of Providers

There are several types of providers, each of which provides a different level of functionality. A provider is implemented as a class that derives from one of the descendants of the System.Management.Automation.SessionStateCategory **CmdletProvider** class. For information about the different types of providers, see Provider types.

Provider cmdlets

Providers can implement methods that correspond to cmdlets, creating custom behaviors for those cmdlets when used in a drive for that provider. Depending on the type of provider, different sets of cmdlets are available. For a complete list of the cmdlets available for customization in providers, see Provider cmdlets.

Provider paths

Users navigate provider drives like file systems. Because of this, they expect the syntax of paths to correspond to the paths used in file system navigation. When a user runs a provider cmdlet, they specify a path to the item to be accessed. The path that is specified can be interpreted in several ways. A provider should support one or more of the following path types.

Drive-qualified paths

A drive-qualified path is a combination of the item name, the container and subcontainers in which the item is located, and the Windows PowerShell drive through which the item is accessed. (Drives are defined by the provider that is used to access the data store. This path starts with the drive name followed by a colon (:). For example: `get-childitem C:`

Provider-qualified paths

To allow the Windows PowerShell engine to initialize and uninitialize your provider, the provider must support a provider-qualified path. For example, the user can initialize and uninitialize the FileSystem provider because it defines the following provider-qualified path: `FileSystem::\\uncshare\abc\bar`.

Provider-direct paths

To allow remote access to your Windows PowerShell provider, it should support a provider-direct path to pass directly to the Windows PowerShell provider for the current location. For example, the registry Windows PowerShell provider can use `\\server\regkeypath` as a provider-direct path.

Provider-internal paths

To allow the provider cmdlet to access data using non-Windows PowerShell application programming interfaces (APIs), your Windows PowerShell provider should support a provider-internal path. This path is indicated after the "::" in the provider-qualified path. For example, the provider-internal path for the filesystem Windows PowerShell provider is `\\uncshare\abc\bar`.

Overriding cmdlet parameters

The behavior of some provider-specific cmdlets can be overridden by a provider. For a list of parameters that can be overridden, and how to override them in your provider class, see Provider cmdlet parameters

Dynamic parameters

Providers can define dynamic parameters that are added to a provider cmdlet when the user specifies a certain value for one of the static parameters of the cmdlet. A provider does this by implementing one or more dynamic parameter methods. For a list of cmdlet parameters that can be used to add dynamic parameter, and the methods used to implement them, see Provider cmdlet dynamic parameters.

Provider capabilities

The System.Management.Automation.Provider.Providercapabilities enumeration defines a number of capabilities that providers can support. These include the ability to use wildcards, filter items, and support transactions. To specify capabilities for a provider, add a list of values of the System.Management.Automation.Provider.Providercapabilities enumeration, combined with a logical `OR` operation, as the System.Management.Automation.Provider.Cmdletproviderattribute.Providercapabilities* property (the second parameter of the attribute) of the System.Management.Automation.Provider.Cmdletproviderattribute attribute for your provider class. For example, the following attribute specifies that the provider supports the System.Management.Automation.Provider.Providercapabilities **ShouldProcess** and System.Management.Automation.Provider.ProviderCapabilities **Transactions** capabilities.

C#

```
[CmdletProvider(RegistryProvider.ProviderName,
ProviderCapabilities.ShouldProcess | ProviderCapabilities.Transactions)]
```

Provider cmdlet help

When writing a provider, you can implement your own Help for the provider cmdlets that you support. This includes a single help topic for each provider cmdlet or multiple versions of a help topic for cases where the provider cmdlet acts differently based on the use of dynamic parameters. To support provider cmdlet-specific help, your provider must implement the System.Management.Automation.Provider.Icmdletprovidersupportshelp interface.

The Windows PowerShell engine calls the System.Management.Automation.Provider.Icmdletprovidersupportshelp.Gethelpmaml* method to display the Help topic for your provider cmdlets. The engine provides the name of the cmdlet that the user specified when running the `Get-Help` cmdlet and the current path of the user. The current path is required if your provider implements different versions of the same provider cmdlet for different drives. The method must return a string that contains the XML for the cmdlet Help.

The content for the Help file is written using PSMAML XML. This is the same XML schema that is used for writing Help content for stand-alone cmdlets. Add the content for your custom cmdlet Help to the Help file for your provider under the `CmdletHelpPaths` element. The following example shows the `command` element for a single provider cmdlet, and it shows how you specify the name of the provider cmdlet that your provider. supports

XML

```
<CmdletHelpPaths>
  <command:command>
    <command:details>
      <command:name>ProviderCmdletName</command:name>
      <command:verb>Verb</command:verb>
      <command:noun>Noun</command:noun>
    <command:details>
  </command:command>
<CmdletHelpPath>
```

See Also

Windows PowerShell Provider Functionality

Provider Cmdlets

Writing a Windows PowerShell Provider

Provider types

Article • 11/03/2021

Providers define their basic functionality by changing how the provider cmdlets, provided by PowerShell, perform their actions. For example, providers can use the default functionality of the `Get-Item` cmdlet, or they can change how that cmdlet operates when retrieving items from the data store. The provider functionality described in this document includes functionality defined by overwriting methods from specific provider base classes and interfaces.

> **Note**
>
> For provider features that are pre-defined by PowerShell, see **Provider capabilities**.

Drive-enabled providers

Drive-enabled providers specify the default drives available to the user and allow the user to add or remove drives. In most cases, providers are drive-enabled providers because they require some default drive to access the data store. However, when writing your own provider you might or might not want to allow the user to create and remove drives.

To create a drive-enabled provider, your provider class must derive from the System.Management.Automation.Provider.DriveCmdletProvider class or another class that derives from that class. The **DriveCmdletProvider** class defines the following methods for implementing the default drives of the provider and supporting the `New-PSDrive` and `Remove-PSDrive` cmdlets. In most cases, to support a provider cmdlet you must overwrite the method that the PowerShell engine calls to invoke the cmdlet, such as the `NewDrive` method for the `New-PSDrive` cmdlet, and optionally you can overwrite a second method, such as `NewDriveDynamicParameters`, for adding dynamic parameters to the cmdlet.

- The InitializeDefaultDrives method defines the default drives that are available to the user whenever the provider is used.
- The NewDrive and NewDriveDynamicParameters methods defines how your provider supports the `New-PSDrive` provider cmdlet. This cmdlet allows the user to create drives to access the data store.

- The RemoveDrive method defines how your provider supports the `Remove-PSDrive` provider cmdlet. This cmdlet allows the user to remove drives from the data store.

Item-enabled providers

Item-enabled providers allow the user to get, set, or clear the items in the data store. An "item" is an element of the data store that the user can access or manage independently. To create an item-enabled provider, your provider class must derive from the System.Management.Automation.Provider.ItemCmdletProvider class or another class that derives from that class.

The **ItemCmdletProvider** class defines the following methods for implementing specific provider cmdlets. In most cases, to support a provider cmdlet you must overwrite the method that the PowerShell engine calls to invoke the cmdlet, such as the `ClearItem` method for the `Clear-Item` cmdlet, and optionally you can overwrite a second method, such as `ClearItemDynamicParameters`, for adding dynamic parameters to the cmdlet.

- The ClearItem and ClearItemDynamicParameters methods define how your provider supports the `Clear-Item` provider cmdlet. This cmdlet allows the user to remove of the value of an item in the data store.
- The GetItem and GetItemDynamicParameters methods define how your provider supports the `Get-Item` provider cmdlet. This cmdlet allows the user to retrieve data from the data store.
- The SetItem and SetItemDynamicParameters methods define how your provider supports the `Set-Item` provider cmdlet. This cmdlet allows the user to update the values of items in the data store.
- The InvokeDefaultAction and InvokeDefaultActionDynamicParameters methods define how your provider supports the `Invoke-Item` provider cmdlet. This cmdlet allows the user to perform the default action specified by the item.
- The ItemExists and ItemExistsDynamicParameters methods define how your provider supports the `Test-Path` provider cmdlet. This cmdlet allows the user to determine if all the elements of a path exist.

In addition to the methods used to implement provider cmdlets, the **ItemCmdletProvider** class also defines the following methods:

- The ExpandPath method allows the user to use wildcards when specifying the provider path.

- The IsValidPath is used to determine if a path is syntactically and semantically valid for the provider.

Container-enabled providers

Container-enabled providers allow the user to manage items that are containers. A container is a group of child items under a common parent item. To create a container-enabled provider, your provider class must derive from the System.Management.Automation.Provider.ContainerCmdletProvider class or another class that derives from that class.

> **Important**
>
> Container-enabled providers can't access data stores that contain nested containers. If a child item of a container is another container, you must implement a navigation-enabled provider.

The **ContainerCmdletProvider** class defines the following methods for implementing specific provider cmdlets. In most cases, to support a provider cmdlet you must overwrite the method that the PowerShell engine calls to invoke the cmdlet, such as the `CopyItem` method for the `Copy-Item` cmdlet, and optionally you can overwrite a second method, such as `CopyItemDynamicParameters`, for adding dynamic parameters to the cmdlet.

- The CopyItem and CopyItemDynamicParameters methods define how your provider supports the `Copy-Item` provider cmdlet. This cmdlet allows the user to copy an item from one location to another.
- The GetChildItems and GetChildItemsDynamicParameters methods define how your provider supports the `Get-ChildItem` provider cmdlet. This cmdlet allows the user to retrieve the child items of the parent item.
- The GetChildNames and GetChildNamesDynamicParameters methods define how your provider supports the `Get-ChildItem` provider cmdlet if its `Name` parameter is specified.
- The NewItem and NewItemDynamicParameters methods define how your provider supports the `New-Item` provider cmdlet. This cmdlet allows the user to create new items in the data store.

- The RemoveItem and RemoveItemDynamicParameters methods define how your provider supports the `Remove-Item` provider cmdlet. This cmdlet allows the user to remove items from the data store.
- The RenameItem and RenameItemDynamicParameters methods define how your provider supports the `Rename-Item` provider cmdlet. This cmdlet allows the user to rename items in the data store.

In addition to the methods used to implement provider cmdlets, the **ContainerCmdletProvider** class also defines the following methods:

- The HasChildItems method can be used by the provider class to determine whether an item has child items.
- The ConvertPath method can be used by the provider class to create a new provider-specific path from a specified path.

Navigation-enabled providers

Navigation-enabled providers allow the user to move items in the data store. To create a navigation-enabled provider, your provider class must derive from the System.Management.Automation.Provider.NavigationCmdletProvider class.

The **NavigationCmdletProvider** class defines the following methods for implementing specific provider cmdlets. In most cases, to support a provider cmdlet you must overwrite the method that the PowerShell engine calls to invoke the cmdlet, such as the `MoveItem` method for the `Move-Item` cmdlet, and optionally you can overwrite a second method, such as `MoveItemDynamicParameters`, for adding dynamic parameters to the cmdlet.

- The MoveItem and MoveItemDynamicParameters methods define how your provider supports the `Move-Item` provider cmdlet. This cmdlet allows the user to move an item from one location in the store to another location.
- The MakePath method defines how your provider supports the `Join-Path` provider cmdlet. This cmdlet allows the user to combine a parent and child path segment to create a provider-internal path.

In addition to the methods used to implement provider cmdlets, the **NavigationCmdletProvider** class also defines the following methods:

- The GetChildName method extracts the name of the child node of a path.

- The GetParentPath method extracts the parent part of a path.
- The IsItemContainer method determines whether the item is a container item. In this context, a container is a group of child items under a common parent item.
- The NormalizeRelativePath method returns a path to an item that's relative to a specified base path.

Content-enabled providers

Content-enabled providers allow the user to clear, get, or set the content of items in a data store. For example, the FileSystem provider allows you to clear, get, and set the content of files in the file system. To create a content enabled provider, your provider class must implement the methods of the System.Management.Automation.Provider.IContentCmdletProvider interface.

The **IContentCmdletProvider** interface defines the following methods for implementing specific provider cmdlets. In most cases, to support a provider cmdlet you must overwrite the method that the PowerShell engine calls to invoke the cmdlet, such as the `ClearContent` method for the `Clear-Content` cmdlet, and optionally you can overwrite a second method, such as `ClearContentDynamicParameters`, for adding dynamic parameters to the cmdlet.

- The ClearContent and ClearContentDynamicParameters methods define how your provider supports the `Clear-Content` provider cmdlet. This cmdlet allows the user to delete the content of an item without deleting the item.
- The GetContentReader and GetContentReaderDynamicParameters methods define how your provider supports the `Get-Content` provider cmdlet. This cmdlet allows the user to retrieve the content of an item. The `GetContentReader` method returns an System.Management.Automation.Provider.IContentReader interface that defines the methods used to read the content.
- The GetContentWriter and GetContentWriterDynamicParameters methods define how your provider supports the `Set-Content` provider cmdlet. This cmdlet allows the user to update the content of an item. The `GetContentWriter` method returns an System.Management.Automation.Provider.IContentWriter interface that defines the methods used to write the content.

Property-enabled providers

Property-enabled providers allow the user to manage the properties of the items in the data store. To create a property-enabled provider, your provider class must implement the methods of the System.Management.Automation.Provider.IPropertyCmdletProvider and System.Management.Automation.Provider.IDynamicPropertyCmdletProvider interfaces. In most cases, to support a provider cmdlet you must overwrite the method that the PowerShell engine calls to invoke the cmdlet, such as the `ClearProperty` method for the Clear-Property cmdlet, and optionally you can overwrite a second method, such as `ClearPropertyDynamicParameters`, for adding dynamic parameters to the cmdlet.

The **IPropertyCmdletProvider** interface defines the following methods for implementing specific provider cmdlets:

- The ClearProperty and ClearPropertyDynamicParameters methods define how your provider supports the `Clear-ItemProperty` provider cmdlet. This cmdlet allows the user to delete the value of a property.
- The GetProperty and GetPropertyDynamicParameters methods define how your provider supports the `Get-ItemProperty` provider cmdlet. This cmdlet allows the user to retrieve the property of an item.
- The SetProperty and SetPropertyDynamicParameters methods define how your provider supports the `Set-ItemProperty` provider cmdlet. This cmdlet allows the user to update the properties of an item.

The **IDynamicPropertyCmdletProvider** interface defines the following methods for implementing specific provider cmdlets:

- The CopyProperty and CopyPropertyDynamicParameters methods define how your provider supports the `Copy-ItemProperty` provider cmdlet. This cmdlet allows the user to copy a property and its value from one location to another.
- The MoveProperty and MovePropertyDynamicParameters methods define how your provider supports the `Move-ItemProperty` provider cmdlet. This cmdlet allows the user to move a property and its value from one location to another.
- The NewProperty and NewPropertyDynamicParameters methods define how your provider supports the `New-ItemProperty` provider cmdlet. This cmdlet allows the user to create a new property and set its value.
- The RemoveProperty and RemovePropertyDynamicParameters methods define how your provider supports the `Remove-ItemProperty` cmdlet. This cmdlet allows the user to delete a property and its value.

- The RenameProperty and RenamePropertyDynamicParameters methods define how your provider supports the `Rename-ItemProperty` cmdlet. This cmdlet allows the user to change the name of a property.

See also

about_Providers

Writing a Windows PowerShell Provider

Provider cmdlets

Article • 11/23/2021

The cmdlets that the user can run to manage a data store are referred to as provider cmdlets. To support these cmdlets, you need to overwrite some of the methods defined by the base provider classes and interfaces.

Here are the provider cmdlets that can be run by the user:

PSDrive cmdlets

`Get-PSDrive`

This cmdlet returns the PowerShell drives in the current session. You do not need to overwrite any methods to support this cmdlet.

`New-PSDrive`

This cmdlet allows the user to create PowerShell drives to access the data store. To support this cmdlet, overwrite the following methods of System.Management.Automation.Provider.DriveCmdletProvider class:

- Newdrive
- NewDriveDynamicParameters

`Remove-PSDrive`

This cmdlet allows the user to remove PowerShell drives that access the data store. To support this cmdlet, overwrite the System.Management.Automation.Provider.DriveCmdletProvider.Removedrive method.

Item cmdlets

`Clear-Item`

This cmdlet allows the user to remove the value of an item in the data store. To support this cmdlet, overwrite the following methods of System.Management.Automation.Provider.ItemCmdletProvider class:

- Clearitem
- ClearItemDynamicParameters

`Copy-Item`

This cmdlet allows the user to copy an item from one location to another. To support this cmdlet, overwrite the following methods of System.Management.Automation.Provider.ContainerCmdletProvider class:

- Copyitem
- CopyItemDynamicParameters

`Get-Item`

This cmdlet allows the user to retrieve data from the data store. To support this cmdlet, overwrite the following methods of System.Management.Automation.Provider.ItemCmdletProvider class:

- Getitem
- GetItemDynamicParameters

`Get-ChildItem`

This cmdlet allows the user to retrieve the child items of the parent item. To support this cmdlet, overwrite the following methods of System.Management.Automation.Provider.ContainerCmdletProvider class:

- GetChildItems
- GetChildItemsDynamicParameters
- GetChildNames
- GetChildNamesDynamicParameters

`Invoke-Item`

This cmdlet allows the user to perform the default action specified by the item. To support this cmdlet, overwrite the System.Management.Automation.Provider.ItemCmdletProvider.InvokeDefaultAction method.

`Move-Item`

This cmdlet allows the user to move an item from one location to another location. To support this cmdlet, overwrite the following methods of System.Management.Automation.Provider.Navigationcmdletprovider class:

- MoveItem
- MoveItemDynamicParameters

`New-ItemProperty`

This cmdlet allows the user to create a new item in the data store.

`Remove-Item`

This cmdlet allows the user to remove items from the data store. To support this cmdlet, overwrite the following methods of System.Management.Automation.Provider.ContainerCmdletProvider class:

- RemoveItem
- RemoveItemDynamicParameters

`Rename-Item`

This cmdlet allows the user to rename items in the data store. To support this cmdlet, overwrite the following methods of System.Management.Automation.Provider.ContainerCmdletProvider class:

- RenameItem
- RenameItemDynamicParameters

`Set-Item`

This cmdlet allows the user to update the values of items in the data store. To support this cmdlet, overwrite the following methods of System.Management.Automation.Provider.ItemCmdletProvider class:

- SetItem
- SetItemDynamicParameters

Item content cmdlets

`Add-Content`

This cmdlet allows the user to add content to an item.

`Clear-Content`

This cmdlet allows the user to delete content from an item without deleting the item. To support this cmdlet, overwrite the following methods of System.Management.Automation.Provider.IContentCmdletProvider interface:

- ClearContent
- ClearContentDynamicParameters

`Get-Content`

This cmdlet allows the user to retrieve the content of an item. To support this cmdlet, overwrite the following methods of System.Management.Automation.Provider.IContentCmdletProvider interface:

- GetContentReader
- GetContentReaderDynamicParameters

The GetContentReader method returns an System.Management.Automation.Provider.IContentReader interface that defines the methods used to read the content.

`Set-Content`

This cmdlet allows the user to update the content of an item. To support this cmdlet, overwrite the following methods of System.Management.Automation.Provider.IContentCmdletProvider interface:

- GetContentWriter
- GetContentWriterDynamicParameters

The GetContentWriter method returns an System.Management.Automation.Provider.IContentWriter interface that defines the methods used to write the content.

Item property cmdlets

`Clear-ItemProperty`

This cmdlet allows the user to delete the value of a property. To support this cmdlet, overwrite the following methods of System.Management.Automation.Provider.IPropertyCmdletProvider interface:

- ClearProperty
- ClearPropertyDynamicParameters

`Copy-ItemProperty`

This cmdlet allows the user to copy a property and its value from one location to another. To support this cmdlet, overwrite the following methods of System.Management.Automation.Provider.IDynamicPropertyCmdletProvider interface:

- CopyProperty
- CopyPropertyDynamicParameters

`Get-ItemProperty`

This cmdlet retrieves the properties of an item. To support this cmdlet, overwrite the following methods of System.Management.Automation.Provider.IPropertyCmdletProvider interface:

- GetProperty
- GetPropertyDynamicParameters

`Move-ItemProperty`

This cmdlet allows the user to move a property and its value from one location to another. To support this cmdlet, overwrite the following methods of System.Management.Automation.Provider.IDynamicPropertyCmdletProvider interface:

- MoveProperty
- MovePropertyDynamicParameters

`New-ItemProperty`

This cmdlet allows the user to create a new property and set its value. To support this cmdlet, overwrite the following methods of System.Management.Automation.Provider.IDynamicPropertyCmdletProvider interface:

- NewProperty
- NewPropertyDynamicParameters

`Remove-ItemProperty`

This cmdlet allows the user to delete a property and its value. To support this cmdlet, overwrite the following methods of System.Management.Automation.Provider.IDynamicPropertyCmdletProvider interface:

- RemoveProperty
- RemovePropertyDynamicParameters

`Rename-ItemProperty`

This cmdlet allows the user to change the name of a property. To support this cmdlet, overwrite the following methods of System.Management.Automation.Provider.IDynamicPropertyCmdletProvider interface:

- RenameProperty
- RenamePropertyDynamicParameters

`Set-ItemProperty`

This cmdlet allows the user to update the properties of an item. To support this cmdlet, overwrite the following methods of System.Management.Automation.Provider.IPropertyCmdletProvider interface:

- SetProperty
- SetPropertyDynamicParameters

Location cmdlets

`Get-Location`

Retrieves information about the current working location. You do not need to overwrite any methods to support this cmdlet.

`Pop-Location`

This cmdlet changes the current location to the location most recently pushed onto the stack. You do not need to overwrite any methods to support this cmdlet.

`Push-Location`

This cmdlet adds the current location to the top of a list of locations (a "stack"). You do not need to overwrite any methods to support this cmdlet.

`Set-Location`

This cmdlet sets the current working location to a specified location. You do not need to overwrite any methods to support this cmdlet.

Path cmdlets

`Join-Path`

This cmdlet allows the user to combine a parent and child path segment to create a provider-internal path. To support this cmdlet, overwrite the System.Management.Automation.Provider.NavigationCmdletProvider.MakePath method.

`Convert-Path`

This cmdlet converts a path from a PowerShell path to a PowerShell provider path.

`Split-Path`

Returns the specified part of a path.

`Resolve-Path`

Resolves the wildcard characters in a path, and displays the path contents.

`Test-Path`

This cmdlet determines whether all elements of a path exist. To support this cmdlet, overwrite the following methods of System.Management.Automation.Provider.ItemCmdletProvider class:

- ItemExists
- ItemExistsDynamicParameters

PSProvider cmdlets

`Get-PSProvider`

This cmdlet returns information about the providers available in the session. You do not need to overwrite any methods to support this cmdlet.

Provider cmdlet parameters

Article • 09/17/2021

Provider cmdlets come with a set of static parameters that are available to all providers that support the cmdlet, as well as dynamic parameters that are added when the user specifies a certain value for certain static parameters of the provider cmdlet.

Provider Cmdlet Static Parameters

Static parameters are defined by Windows PowerShell. A large set of these parameters is implemented by Windows PowerShell to provide consistency across all the providers and to provide a simpler development experience. Examples of these parameters include the `literalPath`, `exclude`, and `include` parameters of the `Get-Item` cmdlet. A smaller set of these parameters can be overwritten to provide actions that are specific to your provider. Examples of these parameters include the `Path` and `Value` parameter of the `Set-Item` cmdlet. Here is a list of the parameters that can be overwritten for the provider cmdlets.

`Clear-Content` cmdlet You can define how your provider will use the values passed to the `Path` parameter of the `Clear-Content` cmdlet by implementing the System.Management.Automation.Provider.Icontentcmdletprovider.Clearcontent* method.

`Clear-Item` cmdlet You can define how your provider will use the values passed to the `Path` parameter of the `Clear-Item` cmdlet by implementing the System.Management.Automation.Provider.Itemcmdletprovider.Clearitem* method.

`Clear-ItemProperty` cmdlet You can define how your provider will use the values passed to the `Path` and `Name` parameters of the `Clear-ItemProperty` cmdlet by implementing the System.Management.Automation.Provider.Ipropertycmdletprovider.Clearproperty* method.

`Copy-Item` cmdlet You can define how your provider will use the values passed to the `Path`, `Destination`, and `Recurse` parameters of the `Copy-Item` cmdlet by implementing the System.Management.Automation.Provider.ContainerCmdletProvider.CopyItem method.

Get-ChildItems cmdlet You can define how your provider will use the values passed to the `Path` and `Recurse` parameters of the `Get-ChildItem` cmdlet by implementing the System.Management.Automation.Provider.Containercmdletprovider.Getchilditems* and

System.Management.Automation.Provider.Containercmdletprovider.Getchildnames* methods.

`Get-Content` cmdlet You can define how your provider will use the values passed to the `Path` parameter of the `Get-Content` cmdlet by implementing the System.Management.Automation.Provider.Icontentcmdletprovider.Getcontentreader* method.

`Get-Item` cmdlet You can define how your provider will use the values passed to the `Path` parameter of the `Get-Item` cmdlet by implementing the System.Management.Automation.Provider.Itemcmdletprovider.Getitem* method.

`Get-ItemProperty` cmdlet You can define how your provider will use the values passed to the `Path` and `Name` parameters of the `Get-ItemProperty` cmdlet by implementing the System.Management.Automation.Provider.Ipropertycmdletprovider.Getproperty* method.

`Invoke-Item` cmdlet You can define how your provider will use the values passed to the `Path` parameter of the `Invoke-Item` cmdlet by implementing the System.Management.Automation.Provider.Itemcmdletprovider.Invokedefaultaction* method.

`Move-Item` cmdlet You can define how your provider will use the values passed to the `Path` and `Destination` parameters of the `Move-Item` cmdlet by implementing the System.Management.Automation.Provider.Navigationcmdletprovider.Moveitem* method.

`New-Item` cmdlet You can define how your provider will use the values passed to the `Path`, `ItemType`, and `Value` parameters of the `New-Item` cmdlet by implementing the System.Management.Automation.Provider.Containercmdletprovider.Newitem* method.

`New-ItemProperty` cmdlet You can define how your provider will use the values passed to the `Path`, `Name`, `PropertyType`, and `Value` parameters of the `New-ItemProperty` cmdlet by implementing the Microsoft.PowerShell.Commands.Registryprovider.Newproperty* method.

`Remove-Item` You can define how your provider will use the values passed to the `Path` and `Recurse` parameters of the `Remove-Item` cmdlet by implementing the System.Management.Automation.Provider.Containercmdletprovider.Removeitem* method.

`Remove-ItemProperty` You can define how your provider will use the values passed to the `Path` and `Name` parameters of the `Remove-ItemProperty` cmdlet by implementing the System.Management.Automation.Provider.Idynamicpropertycmdletprovider.Removeproperty* method.

`Rename-Item` cmdlet You can define how your provider will use the values passed to the `Path` and `NewName` parameters of the `Rename-Item` cmdlet by implementing the System.Management.Automation.Provider.Containercmdletprovider.Renameitem* method.

`Rename-ItemProperty` You can define how your provider will use the values passed to the `Path`, `NewName`, and `Name` parameters of the `Rename-ItemProperty` cmdlet by implementing the System.Management.Automation.Provider.Idynamicpropertycmdletprovider.Renameproperty* method.

`Set-Content` cmdlet You can define how your provider will use the values passed to the `Path` parameter of the `Set-Content` cmdlet by implementing the System.Management.Automation.Provider.Icontentcmdletprovider.Getcontentwriter* method.

`Set-Item` cmdlet You can define how your provider will use the values passed to the `Path` and `Value` parameters of the `Set-Item` cmdlet by implementing the System.Management.Automation.Provider.Itemcmdletprovider.Setitem* method.

`Set-ItemProperty` cmdlet You can define how your provider will use the values passed to the `Path` and `Value` parameters of the `Set-Item` cmdlet by implementing the System.Management.Automation.Provider.Ipropertycmdletprovider.Setproperty* method.

`Test-Path` cmdlet You can define how your provider will use the values passed to the `Path` parameter of the `Test-Path` cmdlet by implementing the System.Management.Automation.Provider.Itemcmdletprovider.Invokedefaultaction* method.

In addition, you cannot specify the characteristics of these parameters, such as whether they are optional or required, nor can you give these parameters an alias or specify any of the validation attributes. In contrast, you can specify parameter characteristics in stand-alone cmdlets by using attributes such as the `Parameters` attribute.

Provider Cmdlet Dynamic Parameters

Dynamic parameters for cmdlet providers are similar to dynamic providers for stand-alone cmdlets. In both cases, the parameters are added to the cmdlet when the user specifies a certain value for one of the default parameters, such as the `path` parameter. However, not all of the static parameters can be used to trigger the addition of dynamic parameters. For more information about dynamic parameters, see Provider Cmdlet Dynamic Parameters.

See Also

Provider Cmdlet Dynamic Parameters

Writing a Windows PowerShell Provider

Provider cmdlet dynamic parameters

Article • 09/17/2021

Providers can define dynamic parameters that are added to a provider cmdlet when the user specifies a certain value for one of the static parameters of the cmdlet. For example, a provider can add different dynamic parameters based on what path the user specifies when they call the `Get-Item` or `Set-Item` provider cmdlets.

Dynamic Parameter Methods

Dynamic parameters are defined by implementing one of the dynamic parameter methods, such as the System.Management.Automation.Provider.Itemcmdletprovider.Getitemdynamicparameters* and System.Management.Automation.Provider.Itemcmdletprovider.Setitemdynamicparameters*s methods. These methods return an object that has public properties that are decorated with attributes similar to those of stand-alone cmdlets. Here is an example of an implementation of the System.Management.Automation.Provider.Itemcmdletprovider.Getitemdynamicparameters* method taken from the Certificate provider:

C#

```
protected override object GetItemDynamicParameters(string path)
{
    return new CertificateProviderDynamicParameters();
}
```

Unlike the static parameters of provider cmdlets, you can specify the characteristics of these parameters in the same way that parameters are defined in stand-alone cmdlets. Here is an example of a dynamic parameter class taken from the Certificate provider:

C#

```
internal sealed class CertificateProviderDynamicParameters
{
  /// <summary>
  /// Dynamic parameter the controls whether we only return
  /// code signing certs.
  /// </summary>
  [Parameter()]
  public SwitchParameter CodeSigningCert
  {
```

```
    get
    {
      {
        return codeSigningCert;
      }
    }

    set
    {
      {
        codeSigningCert = value;
      }
    }
  }

    private SwitchParameter codeSigningCert = new SwitchParameter();
}
```

Dynamic Parameters

Here is a list of the static parameters that can be used to add dynamic parameters.

`Clear-Content` cmdlet You can define dynamic parameters that are triggered by the `Path` parameter of the Clear-Clear cmdlet by implementing the System.Management.Automation.Provider.Icontentcmdletprovider.Clearcontentdynamicparameters* method.

`Clear-Item` cmdlet You can define dynamic parameters that are triggered by the `Path` parameter of the `Clear-Item` cmdlet by implementing the System.Management.Automation.Provider.Itemcmdletprovider.Clearitemdynamicparameters* method.

`Clear-ItemProperty` cmdlet You can define dynamic parameters that are triggered by the `Path` parameter of the `Clear-ItemProperty` cmdlet by implementing the System.Management.Automation.Provider.Ipropertycmdletprovider.Clearpropertydynamicparameters* method.

`Copy-Item` cmdlet You can define dynamic parameters that are triggered by the `Path`, `Destination`, and `Recurse` parameters of the `Copy-Item` cmdlet by implementing the System.Management.Automation.Provider.Containercmdletprovider.Copyitemdynamicparameters* method.

Get-ChildItems cmdlet You can define dynamic parameters that are triggered by the `Path` and `Recurse` parameters of the `Get-ChildItem` cmdlet by implementing the System.Management.Automation.Provider.Containercmdletprovider.Getchilditemsdyna

micparameters* and System.Management.Automation.Provider.Containercmdletprovider.Getchildnamesdynamicparameters* methods.

`Get-Content` cmdlet You can define dynamic parameters that are triggered by the `Path` parameter of the `Get-Content` cmdlet by implementing the System.Management.Automation.Provider.Icontentcmdletprovider.Getcontentreaderdynamicparameters* method.

`Get-Item` cmdlet You can define dynamic parameters that are triggered by the `Path` parameter of the `Get-Item` cmdlet by implementing the System.Management.Automation.Provider.Itemcmdletprovider.Getitemdynamicparameters* method.

`Get-ItemProperty` cmdlet You can define dynamic parameters that are triggered by the `Path` and `Name` parameters of the `Get-ItemProperty` cmdlet by implementing the System.Management.Automation.Provider.Ipropertycmdletprovider.Getpropertydynamicparameters* method.

`Invoke-Item` cmdlet You can define dynamic parameters that are triggered by the `Path` parameter of the `Invoke-Item` cmdlet by implementing the System.Management.Automation.Provider.Itemcmdletprovider.Invokedefaultactiondynamicparameters* method.

`Move-Item` cmdlet You can define dynamic parameters that are triggered by the `Path` and `Destination` parameters of the `Move-Item` cmdlet by implementing the System.Management.Automation.Provider.Navigationcmdletprovider.Moveitemdynamicparameters* method.

`New-Item` cmdlet You can define dynamic parameters that are triggered by the `Path`, `ItemType`, and `Value` parameters of the `New-Item` cmdlet by implementing the System.Management.Automation.Provider.Containercmdletprovider.Newitemdynamicparameters* method.

`New-ItemProperty` cmdlet You can define dynamic parameters that are triggered by the `Path`, `Name`, `PropertyType`, and `Value` parameters of the `New-ItemProperty` cmdlet by implementing the System.Management.Automation.Provider.Idynamicpropertycmdletprovider.Newpropertydynamicparameters* method.

`New-PSDrive` cmdlet You can define dynamic parameters that are triggered by the System.Management.Automation.PSDriveinfo object returned by the `New-PSDrive`

cmdlet by implementing the System.Management.Automation.Provider.Drivecmdletprovider.Newdrivedynamicparameters* method.

`Remove-Item` You can define dynamic parameters that are triggered by the `Path` and `Recurse` parameters of the `Remove-Item` cmdlet by implementing the System.Management.Automation.Provider.Containercmdletprovider.Removeitemdynamicparameters* method.

`Remove-ItemProperty` You can define dynamic parameters that are triggered by the `Path` and `Name` parameters of the `Remove-ItemProperty` cmdlet by implementing the System.Management.Automation.Provider.Idynamicpropertycmdletprovider.Removepropertydynamicparameters* method.

`Rename-Item` cmdlet You can define dynamic parameters that are triggered by the `Path` and `NewName` parameters of the `Rename-Item` cmdlet by implementing the System.Management.Automation.Provider.Containercmdletprovider.Renameitemdynamicparameters* method.

`Rename-ItemProperty` You can define dynamic parameters that are triggered by the `Path`, `Name`, and `NewName` parameters of the `Rename-ItemProperty` cmdlet by implementing the System.Management.Automation.Provider.Idynamicpropertycmdletprovider.Renamepropertydynamicparameters* method.

`Set-Content` cmdlet You can define dynamic parameters that are triggered by the `Path` parameter of the `Set-Content` cmdlet by implementing the System.Management.Automation.Provider.Icontentcmdletprovider.Getcontentwriterdynamicparameters* method.

`Set-Item` cmdlet You can define dynamic parameters that are triggered by the `Path` and `Value` parameters of the `Set-Item` cmdlet by implementing the System.Management.Automation.Provider.Itemcmdletprovider.Setitemdynamicparameters* method.

`Set-ItemProperty` cmdlet You can define dynamic parameters that are triggered by the `Path` and `Value` parameters of the `Set-Item` cmdlet by implementing the System.Management.Automation.Provider.Ipropertycmdletprovider.Setpropertydynamicparameters* method.

`Test-Path` cmdlet You can define dynamic parameters that are triggered by the `Path` parameter of the `Test-Path` cmdlet by implementing the

System.Management.Automation.Provider.Itemcmdletprovider.Invokedefaultactiondynamicparameters* method.

See Also

Writing a Windows PowerShell Provider

Writing an item provider

Article • 09/17/2021

This topic describes how to implement the methods of a Windows PowerShell provider that access and manipulate items in the data store. To be able to access items, a provider must derive from the System.Management.Automation.Provider.Itemcmdletprovider class.

The provider in the examples in this topic uses an Access database as its data store. There are several helper methods and classes that are used to interact with the database. For the complete sample that includes the helper methods, see AccessDBProviderSample03

For more information about Windows PowerShell providers, see Windows PowerShell Provider Overview.

Implementing item methods

The System.Management.Automation.Provider.Itemcmdletprovider class exposes several methods that can be used to access and manipulate the items in a data store. For a complete list of these methods, see ItemCmdletProvider Methods. In this example, we will implement four of these methods. System.Management.Automation.Provider.Itemcmdletprovider.Getitem* gets an item at a specified path. System.Management.Automation.Provider.Itemcmdletprovider.Setitem* sets the value of the specified item. System.Management.Automation.Provider.Itemcmdletprovider.Itemexists* checks whether an item exists at the specified path. System.Management.Automation.Provider.Itemcmdletprovider.Isvalidpath* checks a path to see if it maps to a location in the data store.

> **Note**
>
> This topic builds on the information in **Windows PowerShell Provider QuickStart**. This topic does not cover the basics of how to set up a provider project, or how to implement the methods inherited from the **System.Management.Automation.Provider.Drivecmdletprovider** class that create and remove drives.

Declaring the provider class

Declare the provider to derive from the System.Management.Automation.Provider.Itemcmdletprovider class, and decorate it with the System.Management.Automation.Provider.Cmdletproviderattribute.

C#

```
[CmdletProvider("AccessDB", ProviderCapabilities.None)]

   public class AccessDBProvider : ItemCmdletProvider
   {

  }
```

Implementing GetItem

The System.Management.Automation.Provider.Itemcmdletprovider.Getitem* is called by the PowerShell engine when a user calls the Microsoft.PowerShell.Commands.GetItemCommand cmdlet on your provider. The method returns the item at the specified path. In the Access database example, the method checks whether the item is the drive itself, a table in the database, or a row in the database. The method sends the item to the PowerShell engine by calling the System.Management.Automation.Provider.Cmdletprovider.Writeitemobject* method.

C#

```
protected override void GetItem(string path)
      {
          // check if the path represented is a drive
          if (PathIsDrive(path))
          {
              WriteItemObject(this.PSDriveInfo, path, true);
              return;
          }// if (PathIsDrive...

           // Get table name and row information from the path and do
           // necessary actions
           string tableName;
           int rowNumber;

           PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

           if (type == PathType.Table)
           {
               DatabaseTableInfo table = GetTable(tableName);
               WriteItemObject(table, path, true);
           }
```

```
            else if (type == PathType.Row)
            {
                DatabaseRowInfo row = GetRow(tableName, rowNumber);
                WriteItemObject(row, path, false);
            }
            else
            {
                ThrowTerminatingInvalidPathException(path);
            }

        }
```

Implementing SetItem

The System.Management.Automation.Provider.Itemcmdletprovider.Setitem* method is called by the PowerShell engine calls when a user calls the Microsoft.PowerShell.Commands.SetItemCommand cmdlet. It sets the value of the item at the specified path.

In the Access database example, it makes sense to set the value of an item only if that item is a row, so the method throws NotSupportedException when the item is not a row.

C#

```
protected override void SetItem(string path, object values)
        {
            // Get type, table name and row number from the path specified
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type != PathType.Row)
            {
                WriteError(new ErrorRecord(new NotSupportedException(
                      "SetNotSupported"), "",
                   ErrorCategory.InvalidOperation, path));

                return;
            }

            // Get in-memory representation of table
            OdbcDataAdapter da = GetAdapterForTable(tableName);

            if (da == null)
            {
                return;
            }
            DataSet ds = GetDataSetForTable(da, tableName);
```

```
            DataTable table = GetDataTable(ds, tableName);

            if (rowNumber >= table.Rows.Count)
            {
                // The specified row number has to be available. If not
                // NewItem has to be used to add a new row
                throw new ArgumentException("Row specified is not
available");
            } // if (rowNum...

            string[] colValues = (values as string).Split(',');

            // set the specified row
            DataRow row = table.Rows[rowNumber];

            for (int i = 0; i < colValues.Length; i++)
            {
                row[i] = colValues[i];
            }

            // Update the table
            if (ShouldProcess(path, "SetItem"))
            {
                da.Update(ds, tableName);
            }

        }
```

Implementing ItemExists

The System.Management.Automation.Provider.Itemcmdletprovider.Itemexists* method is called by the PowerShell engine when a user calls the Microsoft.PowerShell.Commands.TestPathCommand cmdlet. The method determines whether there is an item at the specified path. If the item does exist, the method passes it back to the PowerShell engine by calling System.Management.Automation.Provider.Cmdletprovider.Writeitemobject*.

C#

```
protected override bool ItemExists(string path)
        {
            // check if the path represented is a drive
            if (PathIsDrive(path))
            {
                return true;
            }

            // Obtain type, table name and row number from path
            string tableName;
            int rowNumber;
```

```
            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            DatabaseTableInfo table = GetTable(tableName);

            if (type == PathType.Table)
            {
                // if specified path represents a table then
DatabaseTableInfo
                // object for the same should exist
                if (table != null)
                {
                    return true;
                }
            }
            else if (type == PathType.Row)
            {
                // if specified path represents a row then DatabaseTableInfo
should
                // exist for the table and then specified row number must be
within
                // the maximum row count in the table
                if (table != null && rowNumber < table.RowCount)
                {
                    return true;
                }
            }

            return false;

        }
```

Implementing IsValidPath

The System.Management.Automation.Provider.Itemcmdletprovider.Isvalidpath* method checks whether the specified path is syntactically valid for the current provider. It does not check whether an item exists at the path.

C#

```
protected override bool IsValidPath(string path)
        {
            bool result = true;

            // check if the path is null or empty
            if (String.IsNullOrEmpty(path))
            {
                result = false;
            }
```

```
            // convert all separators in the path to a uniform one
            path = NormalizePath(path);

            // split the path into individual chunks
            string[] pathChunks = path.Split(pathSeparator.ToCharArray());

            foreach (string pathChunk in pathChunks)
            {
                if (pathChunk.Length == 0)
                {
                    result = false;
                }
            }
            return result;
        }
```

Next steps

A typical real-world provider is capable of supporting items that contain other items, and of moving items from one path to another within the drive. For an example of a provider that supports containers, see Writing a container provider. For an example of a provider that supports moving items, see Writing a navigation provider.

See Also

Writing a container provider

Writing a navigation provider

Windows PowerShell Provider Overview

Writing a container provider

Article • 09/17/2021

This topic describes how to implement the methods of a Windows PowerShell provider that support items that contain other items, such as folders in the file system provider. To be able to support containers, a provider must derive from the System.Management.Automation.Provider.Containercmdletprovider class.

The provider in the examples in this topic uses an Access database as its data store. There are several helper methods and classes that are used to interact with the database. For the complete sample that includes the helper methods, see AccessDBProviderSample04.

For more information about Windows PowerShell providers, see Windows PowerShell Provider Overview.

Implementing container methods

The System.Management.Automation.Provider.Containercmdletprovider class implements methods that support containers, and create, copy, and remove items. For a complete list of these methods, see System.Management.Automation.Provider.ContainerCmdletProvider.

> **Note**
>
> This topic builds on the information in **Windows PowerShell Provider QuickStart**. This topic does not cover the basics of how to set up a provider project, or how to implement the methods inherited from the **System.Management.Automation.Provider.Drivecmdletprovider** class that create and remove drives. This topic also does not cover how to implement methods exposed by the **System.Management.Automation.Provider.Itemcmdletprovider** class. For an example that shows how to implement item cmdlets, see **Writing an item provider**.

Declaring the provider class

Declare the provider to derive from the System.Management.Automation.Provider.Containercmdletprovider class, and decorate it with the System.Management.Automation.Provider.Cmdletproviderattribute.

C#

```
[CmdletProvider("AccessDB", ProviderCapabilities.None)]
   public class AccessDBProvider : ContainerCmdletProvider
   {

   }
```

Implementing GetChildItems

The PowerShell engine calls the System.Management.Automation.Provider.Containercmdletprovider.Getchilditems* method when a user calls the Microsoft.PowerShell.Commands.GetChildItemCommand cmdlet. This method gets the items that are the children of the item at the specified path.

In the Access database example, the behavior of the System.Management.Automation.Provider.Containercmdletprovider.Getchilditems* method depends on the type of the specified item. If the item is the drive, then the children are tables, and the method returns the set of tables from the database. If the specified item is a table, then the children are the rows of that table. If the item is a row, then it has no children, and the method returns that row only. All child items are sent back to the PowerShell engine by the System.Management.Automation.Provider.Cmdletprovider.Writeitemobject* method.

C#

```
protected override void GetChildItems(string path, bool recurse)
       {
           // If path represented is a drive then the children in the path
are
           // tables. Hence all tables in the drive represented will have to
be
           // returned
           if (PathIsDrive(path))
           {
               foreach (DatabaseTableInfo table in GetTables())
               {
                   WriteItemObject(table, path, true);

                   // if the specified item exists and recurse has been set
then
                   // all child items within it have to be obtained as well
                   if (ItemExists(path) && recurse)
                   {
                       GetChildItems(path + pathSeparator + table.Name,
recurse);
```

```
                    }
                } // foreach (DatabaseTableInfo...
            } // if (PathIsDrive...
            else
            {
                // Get the table name, row number and type of path from the
                // path specified
                string tableName;
                int rowNumber;

                PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

                if (type == PathType.Table)
                {
                    // Obtain all the rows within the table
                    foreach (DatabaseRowInfo row in GetRows(tableName))
                    {
                        WriteItemObject(row, path + pathSeparator +
row.RowNumber,
                                        false);
                    } // foreach (DatabaseRowInfo...
                }
                else if (type == PathType.Row)
                {
                    // In this case the user has directly specified a row,
hence
                    // just give that particular row
                    DatabaseRowInfo row = GetRow(tableName, rowNumber);
                    WriteItemObject(row, path + pathSeparator +
row.RowNumber,
                                    false);
                }
                else
                {
                    // In this case, the path specified is not valid
                    ThrowTerminatingInvalidPathException(path);
                }
            } // else
        }
```

Implementing GetChildNames

The System.Management.Automation.Provider.Containercmdletprovider.Getchildnames* method is similar to the System.Management.Automation.Provider.Containercmdletprovider.Getchilditems* method, except that it returns only the name property of the items, and not the items themselves.

```
C#
```

```
protected override void GetChildNames(string path,
                                      ReturnContainers returnContainers)
       {
           // If the path represented is a drive, then the child items are
           // tables. get the names of all the tables in the drive.
           if (PathIsDrive(path))
           {
               foreach (DatabaseTableInfo table in GetTables())
               {
                   WriteItemObject(table.Name, path, true);
               } // foreach (DatabaseTableInfo...
           } // if (PathIsDrive...
           else
           {
               // Get type, table name and row number from path specified
               string tableName;
               int rowNumber;

               PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

               if (type == PathType.Table)
               {
                   // Get all the rows in the table and then write out the
                   // row numbers.
                   foreach (DatabaseRowInfo row in GetRows(tableName))
                   {
                       WriteItemObject(row.RowNumber, path, false);
                   } // foreach (DatabaseRowInfo...
               }
               else if (type == PathType.Row)
               {
                   // In this case the user has directly specified a row,
hence
                   // just give that particular row
                   DatabaseRowInfo row = GetRow(tableName, rowNumber);

                   WriteItemObject(row.RowNumber, path, false);
               }
               else
               {
                   ThrowTerminatingInvalidPathException(path);
               }
           } // else
       }
```

Implementing NewItem

The System.Management.Automation.Provider.Containercmdletprovider.Newitem* method creates a new item of the specified type at the specified path. The PowerShell

engine calls this method when a user calls the Microsoft.PowerShell.Commands.NewItemCommand cmdlet.

In this example, the method implements logic to determine that the path and type match. That is, only a table can be created directly under the drive (the database), and only a row can be created under a table. If the specified path and item type don't match in this way, the method throws an exception.

C#

```
protected override void NewItem(string path, string type,
                                object newItemValue)
       {
           string tableName;
           int rowNumber;

           PathType pt = GetNamesFromPath(path, out tableName, out
rowNumber);

           if (pt == PathType.Invalid)
           {
               ThrowTerminatingInvalidPathException(path);
           }

           // Check if type is either "table" or "row", if not throw an
           // exception
           if (!String.Equals(type, "table",
StringComparison.OrdinalIgnoreCase)
               && !String.Equals(type, "row",
StringComparison.OrdinalIgnoreCase))
           {
               WriteError(new ErrorRecord
                                (new ArgumentException("Type must be either
a table or row"),
                                    "CannotCreateSpecifiedObject",
                                       ErrorCategory.InvalidArgument,
                                            path
                                 )
                          );

               throw new ArgumentException("This provider can only create
items of type \"table\" or \"row\"");
           }

           // Path type is the type of path of the container. So if a drive
           // is specified, then a table can be created under it and if a
table
           // is specified, then a row can be created under it. For the sake
of
           // completeness, if a row is specified, then if the row specified
by
           // the path does not exist, a new row is created. However, the
```

```
row
            // number may not match as the row numbers only get incremented
based
            // on the number of rows

            if (PathIsDrive(path))
            {
                if (String.Equals(type, "table",
StringComparison.OrdinalIgnoreCase))
                {
                    // Execute command using ODBC connection to create a
table
                    try
                    {
                        // create the table using an sql statement
                        string newTableName = newItemValue.ToString();

                        if (!TableNameIsValid(newTableName))
                        {
                            return;
                        }
                        string sql = "create table " + newTableName
                                              + " (ID INT)";

                        // Create the table using the Odbc connection from
the
                        // drive.
                        AccessDBPSDriveInfo di = this.PSDriveInfo as
AccessDBPSDriveInfo;

                        if (di == null)
                        {
                            return;
                        }
                        OdbcConnection connection = di.Connection;

                        if (ShouldProcess(newTableName, "create"))
                        {
                            OdbcCommand cmd = new OdbcCommand(sql,
connection);

                            cmd.ExecuteScalar();
                        }
                    }
                    catch (Exception ex)
                    {
                        WriteError(new ErrorRecord(ex,
"CannotCreateSpecifiedTable",
                                    ErrorCategory.InvalidOperation, path)
                                    );
                    }
                } // if (String...
                else if (String.Equals(type, "row",
StringComparison.OrdinalIgnoreCase))
                {
                    throw new
```

```
                        ArgumentException("A row cannot be created under a
database, specify a path that represents a Table");
                }
            }// if (PathIsDrive...
            else
            {
                if (String.Equals(type, "table",
StringComparison.OrdinalIgnoreCase))
                {
                    if (rowNumber < 0)
                    {
                        throw new
                            ArgumentException("A table cannot be created
within another table, specify a path that represents a database");
                    }
                    else
                    {
                        throw new
                            ArgumentException("A table cannot be created
inside a row, specify a path that represents a database");
                    }
                } //if (String.Equals....
                // if path specified is a row, create a new row
                else if (String.Equals(type, "row",
StringComparison.OrdinalIgnoreCase))
                {
                    // The user is required to specify the values to be
inserted
                    // into the table in a single string separated by commas
                    string value = newItemValue as string;

                    if (String.IsNullOrEmpty(value))
                    {
                        throw new
                            ArgumentException("Value argument must have comma
separated values of each column in a row");
                    }
                    string[] rowValues = value.Split(',');

                    OdbcDataAdapter da = GetAdapterForTable(tableName);

                    if (da == null)
                    {
                        return;
                    }

                    DataSet ds = GetDataSetForTable(da, tableName);
                    DataTable table = GetDataTable(ds, tableName);

                    if (rowValues.Length != table.Columns.Count)
                    {
                        string message =
                             String.Format(CultureInfo.CurrentCulture,
                                           "The table has {0} columns and
the value specified must have so many comma separated values",
```

```
                                                table.Columns.Count);

                        throw new ArgumentException(message);
                    }

                    if (!Force && (rowNumber >=0 && rowNumber <
table.Rows.Count))
                    {
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                                              "The row {0} already
exists. To create a new row specify row number as {1}, or specify path to a
table, or use the -Force parameter",
                                                                  rowNumber,
table.Rows.Count);

                        throw new ArgumentException(message);
                    }

                    if (rowNumber > table.Rows.Count)
                    {
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                                "To create a new row specify row
number as {0}, or specify path to a table",
                                                    table.Rows.Count);

                        throw new ArgumentException(message);
                    }

                    // Create a new row and update the row with the input
                    // provided by the user
                    DataRow row = table.NewRow();
                    for (int i = 0; i < rowValues.Length; i++)
                    {
                        row[i] = rowValues[i];
                    }
                    table.Rows.Add(row);

                    if (ShouldProcess(tableName, "update rows"))
                    {
                        // Update the table from memory back to the data
source
                        da.Update(ds, tableName);
                    }

                }// else if (String...
            }// else ...

        }
```

Implementing CopyItem

The System.Management.Automation.Provider.ContainerCmdletProvider.CopyItem copies the specified item to the specified path. The PowerShell engine calls this method when a user calls the Microsoft.PowerShell.Commands.CopyItemCommand cmdlet. This method can also be recursive, copying all of the items children in addition to the item itself.

Similarly to the System.Management.Automation.Provider.Containercmdletprovider.Newitem* method, this method performs logic to make sure that the specified item is of the correct type for the path to which it is being copied. For example, if the destination path is a table, the item to be copied must be a row.

C#

```
protected override void CopyItem(string path, string copyPath, bool recurse)
       {
            string tableName, copyTableName;
            int rowNumber, copyRowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);
            PathType copyType = GetNamesFromPath(copyPath, out copyTableName,
out copyRowNumber);

            if (type == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(path);
            }

            if (type == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(copyPath);
            }

            // Get the table and the table to copy to
            OdbcDataAdapter da = GetAdapterForTable(tableName);
            if (da == null)
            {
                return;
            }

            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);

            OdbcDataAdapter cda = GetAdapterForTable(copyTableName);
            if (cda == null)
            {
                return;
            }

            DataSet cds = GetDataSetForTable(cda, copyTableName);
```

```
            DataTable copyTable = GetDataTable(cds, copyTableName);

            // if source represents a table
            if (type == PathType.Table)
            {
                // if copyPath does not represent a table
                if (copyType != PathType.Table)
                {
                    ArgumentException e = new ArgumentException("Table can
only be copied on to another table location");

                    WriteError(new ErrorRecord(e, "PathNotValid",
                        ErrorCategory.InvalidArgument, copyPath));

                    throw e;
                }

                // if table already exists then force parameter should be set
                // to force a copy
                if (!Force && GetTable(copyTableName) != null)
                {
                    throw new ArgumentException("Specified path already
exists");
                }

                for (int i = 0; i < table.Rows.Count; i++)
                {
                    DataRow row = table.Rows[i];
                    DataRow copyRow = copyTable.NewRow();

                    copyRow.ItemArray = row.ItemArray;
                    copyTable.Rows.Add(copyRow);
                }
            } // if (type == ...
            // if source represents a row
            else
            {
                if (copyType == PathType.Row)
                {
                    if (!Force && (copyRowNumber < copyTable.Rows.Count))
                    {
                        throw new ArgumentException("Specified path already
exists.");
                    }

                    DataRow row = table.Rows[rowNumber];
                    DataRow copyRow = null;

                    if (copyRowNumber < copyTable.Rows.Count)
                    {
                        // copy to an existing row
                        copyRow = copyTable.Rows[copyRowNumber];
                        copyRow.ItemArray = row.ItemArray;
                        copyRow[0] = GetNextID(copyTable);
                    }
```

```
                    else if (copyRowNumber == copyTable.Rows.Count)
                    {
                        // copy to the next row in the table that will
                        // be created
                        copyRow = copyTable.NewRow();
                        copyRow.ItemArray = row.ItemArray;
                        copyRow[0] = GetNextID(copyTable);
                        copyTable.Rows.Add(copyRow);
                    }
                    else
                    {
                        // attempting to copy to a nonexistent row or a row
                        // that cannot be created now - throw an exception
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                                "The item cannot be specified
to the copied row. Specify row number as {0}, or specify a path to the
table.",
                                                        table.Rows.Count);

                        throw new ArgumentException(message);
                    }
                }
                else
                {
                    // destination path specified represents a table,
                    // create a new row and copy the item
                    DataRow copyRow = copyTable.NewRow();
                    copyRow.ItemArray = table.Rows[rowNumber].ItemArray;
                    copyRow[0] = GetNextID(copyTable);
                    copyTable.Rows.Add(copyRow);
                }
            }

            if (ShouldProcess(copyTableName, "CopyItems"))
            {
                cda.Update(cds, copyTableName);
            }

        } //CopyItem
```

Implementing RemoveItem

The System.Management.Automation.Provider.Containercmdletprovider.Removeitem* method removes the item at the specified path. The PowerShell engine calls this method when a user calls the Microsoft.PowerShell.Commands.RemoveItemCommand cmdlet.

C#

```
protected override void RemoveItem(string path, bool recurse)
        {
```

```
            string tableName;
            int rowNumber = 0;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type == PathType.Table)
            {
                // if recurse flag has been specified, delete all the rows as
well
                if (recurse)
                {
                    OdbcDataAdapter da = GetAdapterForTable(tableName);
                    if (da == null)
                    {
                        return;
                    }

                    DataSet ds = GetDataSetForTable(da, tableName);
                    DataTable table = GetDataTable(ds, tableName);

                    for (int i = 0; i < table.Rows.Count; i++)
                    {
                        table.Rows[i].Delete();
                    }

                    if (ShouldProcess(path, "RemoveItem"))
                    {
                        da.Update(ds, tableName);
                        RemoveTable(tableName);
                    }
                }//if (recurse...
                else
                {
                    // Remove the table
                    if (ShouldProcess(path, "RemoveItem"))
                    {
                        RemoveTable(tableName);
                    }
                }
            }
            else if (type == PathType.Row)
            {
                OdbcDataAdapter da = GetAdapterForTable(tableName);
                if (da == null)
                {
                    return;
                }

                DataSet ds = GetDataSetForTable(da, tableName);
                DataTable table = GetDataTable(ds, tableName);

                table.Rows[rowNumber].Delete();

                if (ShouldProcess(path, "RemoveItem"))
```

```
                {
                    da.Update(ds, tableName);
                }
            }
            else
            {
                ThrowTerminatingInvalidPathException(path);
            }

        }
```

Next steps

A typical real-world provider is capable of moving items from one path to another within the drive. For an example of a provider that supports moving items, see Writing a navigation provider.

See Also

Writing a navigation provider

Windows PowerShell Provider Overview

Writing a navigation provider

Article • 09/17/2021

This topic describes how to implement the methods of a Windows PowerShell provider that support nested containers (multi-level data stores), moving items, and relative paths. A navigation provider must derive from the System.Management.Automation.Provider.Navigationcmdletprovider class.

The provider in the examples in this topic uses an Access database as its data store. There are several helper methods and classes that are used to interact with the database. For the complete sample that includes the helper methods, see AccessDBProviderSample05.

For more information about Windows PowerShell providers, see Windows PowerShell Provider Overview.

Implementing navigation methods

The System.Management.Automation.Provider.Navigationcmdletprovider class implements methods that support nested containers, relative paths, and moving items. For a complete list of these methods, see NavigationCmdletProvider Methods.

> **Note**
>
> This topic builds on the information in **Windows PowerShell Provider QuickStart**. This topic does not cover the basics of how to set up a provider project, or how to implement the methods inherited from the **System.Management.Automation.Provider.Drivecmdletprovider** class that create and remove drives. This topic also does not cover how to implement methods exposed by the **System.Management.Automation.Provider.Itemcmdletprovider** or **System.Management.Automation.Provider.Containercmdletprovider** classes. For an example that shows how to implement item cmdlets, see **Writing an item provider**. For an example that shows how to implement container cmdlets, see **Writing a container provider**.

Declaring the provider class

Declare the provider to derive from the System.Management.Automation.Provider.Navigationcmdletprovider class, and decorate

it with the System.Management.Automation.Provider.Cmdletproviderattribute.

```
[CmdletProvider("AccessDB", ProviderCapabilities.None)]
   public class AccessDBProvider : NavigationCmdletProvider
   {

   }
```

Implementing IsItemContainer

The System.Management.Automation.Provider.Navigationcmdletprovider.Isitemcontainer* method checks whether the item at the specified path is a container.

C#

```
protected override bool IsItemContainer(string path)
      {
         if (PathIsDrive(path))
         {
             return true;
         }

         string[] pathChunks = ChunkPath(path);
         string tableName;
         int rowNumber;

         PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

         if (type == PathType.Table)
         {
            foreach (DatabaseTableInfo ti in GetTables())
            {
                if (string.Equals(ti.Name, tableName,
StringComparison.OrdinalIgnoreCase))
                {
                    return true;
                }
            } // foreach (DatabaseTableInfo...
         } // if (pathChunks...

         return false;
      }
```

Implementing GetChildName

The System.Management.Automation.Provider.Navigationcmdletprovider.Getchildname* method gets the name property of the child item at the specified path. If the item at the specified path is not a child of a container, then this method should return the path.

C#

```
protected override string GetChildName(string path)
        {
            if (PathIsDrive(path))
            {
                return path;
            }

            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type == PathType.Table)
            {
                return tableName;
            }
            else if (type == PathType.Row)
            {
                return rowNumber.ToString(CultureInfo.CurrentCulture);
            }
            else
            {
                ThrowTerminatingInvalidPathException(path);
            }

            return null;
        }
```

Implementing GetParentPath

The System.Management.Automation.Provider.Navigationcmdletprovider.Getparentpath* method gets the path of the parent of the item at the specified path. If the item at the specified path is the root of the data store (so it has no parent), then this method should return the root path.

C#

```
protected override string GetParentPath(string path, string root)
        {
            // If root is specified then the path has to contain
            // the root. If not nothing should be returned
```

```
            if (!String.IsNullOrEmpty(root))
            {
                if (!path.Contains(root))
                {
                    return null;
                }
            }

            return path.Substring(0, path.LastIndexOf(pathSeparator,
StringComparison.OrdinalIgnoreCase));
        }
```

Implementing MakePath

The System.Management.Automation.Provider.Navigationcmdletprovider.Makepath* method joins a specified parent path and a specified child path to create a provider-internal path (for information about path types that providers can support, see Windows PowerShell Provider Overview. The PowerShell engine calls this method when a user calls the Microsoft.PowerShell.Commands.JoinPathCommand cmdlet.

C#

```
protected override string MakePath(string parent, string child)
        {
            string result;

            string normalParent = NormalizePath(parent);
            normalParent = RemoveDriveFromPath(normalParent);
            string normalChild = NormalizePath(child);
            normalChild = RemoveDriveFromPath(normalChild);

            if (String.IsNullOrEmpty(normalParent) &&
String.IsNullOrEmpty(normalChild))
            {
                result = String.Empty;
            }
            else if (String.IsNullOrEmpty(normalParent) &&
!String.IsNullOrEmpty(normalChild))
            {
                result = normalChild;
            }
            else if (!String.IsNullOrEmpty(normalParent) &&
String.IsNullOrEmpty(normalChild))
            {
                if (normalParent.EndsWith(pathSeparator,
StringComparison.OrdinalIgnoreCase))
                {
                    result = normalParent;
                }
                else
```

```
                {
                    result = normalParent + pathSeparator;
                }
            } // else if (!String...
            else
            {
                if (!normalParent.Equals(String.Empty) &&
                    !normalParent.EndsWith(pathSeparator,
StringComparison.OrdinalIgnoreCase))
                {
                    result = normalParent + pathSeparator;
                }
                else
                {
                    result = normalParent;
                }

                if (normalChild.StartsWith(pathSeparator,
StringComparison.OrdinalIgnoreCase))
                {
                    result += normalChild.Substring(1);
                }
                else
                {
                    result += normalChild;
                }
            } // else

            return result;
        }
```

Implementing NormalizeRelativePath

The System.Management.Automation.Provider.Navigationcmdletprovider.Normalizerelativepath* method takes `path` and `basepath` parameters, and returns a normalized path that is equivalent to the `path` parameter and relative to the `basepath` parameter.

C#

```
protected override string NormalizeRelativePath(string path,
                                                 string basepath)
        {
            // Normalize the paths first
            string normalPath = NormalizePath(path);
            normalPath = RemoveDriveFromPath(normalPath);
            string normalBasePath = NormalizePath(basepath);
            normalBasePath = RemoveDriveFromPath(normalBasePath);

            if (String.IsNullOrEmpty(normalBasePath))
            {
```

```
                return normalPath;
            }
            else
            {
                if (!normalPath.Contains(normalBasePath))
                {
                    return null;
                }

                return normalPath.Substring(normalBasePath.Length +
pathSeparator.Length);
            }
        }
```

Implementing MoveItem

The System.Management.Automation.Provider.Navigationcmdletprovider.Moveitem* method moves an item from the specified path to the specified destination path. The PowerShell engine calls this method when a user calls the Microsoft.PowerShell.Commands.MoveItemCommand cmdlet.

C#

```
protected override void MoveItem(string path, string destination)
        {
            // Get type, table name and rowNumber from the path
            string tableName, destTableName;
            int rowNumber, destRowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            PathType destType = GetNamesFromPath(destination, out
destTableName,
                                        out destRowNumber);

            if (type == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(path);
            }

            if (destType == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(destination);
            }

            if (type == PathType.Table)
            {
                ArgumentException e = new ArgumentException("Move not
supported for tables");
```

```
                WriteError(new ErrorRecord(e, "MoveNotSupported",
                    ErrorCategory.InvalidArgument, path));

                throw e;
            }
            else
            {
                OdbcDataAdapter da = GetAdapterForTable(tableName);
                if (da == null)
                {
                    return;
                }

                DataSet ds = GetDataSetForTable(da, tableName);
                DataTable table = GetDataTable(ds, tableName);

                OdbcDataAdapter dda = GetAdapterForTable(destTableName);
                if (dda == null)
                {
                    return;
                }

                DataSet dds = GetDataSetForTable(dda, destTableName);
                DataTable destTable = GetDataTable(dds, destTableName);
                DataRow row = table.Rows[rowNumber];

                if (destType == PathType.Table)
                {
                    DataRow destRow = destTable.NewRow();

                    destRow.ItemArray = row.ItemArray;
                }
                else
                {
                    DataRow destRow = destTable.Rows[destRowNumber];

                    destRow.ItemArray = row.ItemArray;
                }

                // Update the changes
                if (ShouldProcess(path, "MoveItem"))
                {
                    WriteItemObject(row, path, false);
                    dda.Update(dds, destTableName);
                }
            }
        }
```

See Also

Writing a container provider

Provider Samples

Article • 09/17/2021

This section includes samples of providers that access a Microsoft Access database. These samples include provider classes that derive from all the base provider classes.

In This Section

This section includes the following topics:

AccessDBProviderSample01 Sample This sample shows how to declare the provider class that derives directly from the System.Management.Automation.Provider.Cmdletprovider class. It is included here only for completeness.

AccessDBProviderSample02 This sample shows how to overwrite the System.Management.Automation.Provider.Drivecmdletprovider.Newdrive* and System.Management.Automation.Provider.Drivecmdletprovider.Removedrive* methods to support calls to the `New-PSDrive` and `Remove-PSDrive` cmdlets. The provider class in this sample derives from the System.Management.Automation.Provider.Drivecmdletprovider class.

AccessDBProviderSample03 This sample shows how to overwrite the System.Management.Automation.Provider.Itemcmdletprovider.Getitem* and System.Management.Automation.Provider.Itemcmdletprovider.Setitem* methods to support calls to the `Get-Item` and `Set-Item` cmdlets. The provider class in this sample derives from the System.Management.Automation.Provider.Itemcmdletprovider class.

AccessDBProviderSample04 This sample shows how to overwrite container methods to support calls to the `Copy-Item`, `Get-ChildItem`, `New-Item`, and `Remove-Item` cmdlets. These methods should be implemented when the data store contains items that are containers. A container is a group of child items under a common parent item. The provider class in this sample derives from the System.Management.Automation.Provider.Containercmdletprovider class.

AccessDBProviderSample05 This sample shows how to overwrite container methods to support calls to the `Move-Item` and `Join-Path` cmdlets. These methods should be implemented when the user needs to move items within a container and if the data store contains nested containers. The provider class in this sample derives from the System.Management.Automation.Provider.Navigationcmdletprovider class.

AccessDBProviderSample06 This sample shows how to overwrite content methods to support calls to the `Clear-Content`, `Get-Content`, and `Set-Content` cmdlets. These methods should be implemented when the user needs to manage the content of the items in the data store. The provider class in this sample derives from the System.Management.Automation.Provider.Navigationcmdletprovider class, and it implements the System.Management.Automation.Provider.Icontentcmdletprovider interface.

See Also

Writing a Windows PowerShell Provider

AccessDBProviderSample01

Article • 09/17/2021

This sample shows how to declare a provider class that derives directly from the System.Management.Automation.Provider.Cmdletprovider class. It is included here only for completeness.

Demonstrates

> **ⓘ Important**
>
> Your provider class will most likely derive from one of the following classes and possibly implement other provider interfaces:
>
> - **System.Management.Automation.Provider.Itemcmdletprovider** class. See **AccessDBProviderSample03**.
> - **System.Management.Automation.Provider.Containercmdletprovider** class. See **AccessDBProviderSample04**.
> - **System.Management.Automation.Provider.Navigationcmdletprovider** class. See **AccessDBProviderSample05**.
>
> For more information about choosing which provider class to derive from based on provider features, see **Designing Your Windows PowerShell Provider**.

This sample demonstrates the following:

- Declaring the `CmdletProvider` attribute.
- Defining a provider class that derives directly from the System.Management.Automation.Provider.Cmdletprovider class.

Example

This sample shows how to define a provider class and how to declare the `CmdletProvider` attribute.

C#

```
using System.Management.Automation;
using System.Management.Automation.Provider;
```

```
using System.ComponentModel;


namespace Microsoft.Samples.PowerShell.Providers
{
   #region AccessDBProvider

    /// <summary>
   /// Simple provider.
   /// </summary>
   [CmdletProvider("AccessDB", ProviderCapabilities.None)]
   public class AccessDBProvider : CmdletProvider
   {

   }

   #endregion AccessDBProvider
}
```

See Also

System.Management.Automation.Provider.Itemcmdletprovider

System.Management.Automation.Provider.Containercmdletprovider

System.Management.Automation.Provider.Navigationcmdletprovider

Designing Your Windows PowerShell Provider

AccessDBProviderSample02

Article • 09/17/2021

This sample shows how to overwrite the System.Management.Automation.Provider.Drivecmdletprovider.Newdrive* and System.Management.Automation.Provider.Drivecmdletprovider.Removedrive* methods to support calls to the `New-PSDrive` and `Remove-PSDrive` cmdlets. The provider class in this sample derives from the System.Management.Automation.Provider.Drivecmdletprovider class.

Demonstrates

> **Important**
>
> Your provider class will most likely derive from one of the following classes and possibly implement other provider interfaces:
>
> - **System.Management.Automation.Provider.Itemcmdletprovider** class. See **AccessDBProviderSample03**.
> - **System.Management.Automation.Provider.Containercmdletprovider** class. See **AccessDBProviderSample04**.
> - **System.Management.Automation.Provider.Navigationcmdletprovider** class. See **AccessDBProviderSample05**.
>
> For more information about choosing which provider class to derive from based on provider features, see **Designing Your Windows PowerShell Provider**.

This sample demonstrates the following:

- Declaring the `CmdletProvider` attribute.
- Defining a provider class that drives from the System.Management.Automation.Provider.Drivecmdletprovider class.
- Overwriting the System.Management.Automation.Provider.Drivecmdletprovider.Newdrive* method to support creating new drives. (This sample does not show how to add dynamic parameters to the `New-PSDrive` cmdlet.)

- Overwriting the System.Management.Automation.Provider.Drivecmdletprovider.Removedrive* method to support removing existing drives.

Example

This sample shows how to overwrite the System.Management.Automation.Provider.Drivecmdletprovider.Newdrive* and System.Management.Automation.Provider.Drivecmdletprovider.Removedrive* methods. For this sample provider, when a drive is created its connection information is stored in an `AccessDBPsDriveInfo` object.

C#

```
using System;
using System.IO;
using System.Data;
using System.Data.Odbc;
using System.Management.Automation;
using System.Management.Automation.Provider;
using System.ComponentModel;

namespace Microsoft.Samples.PowerShell.Providers
{
   #region AccessDBProvider

    /// <summary>
   /// A PowerShell Provider which acts upon a access data store.
   /// </summary>
   /// <remarks>
   /// This example only demonstrates the drive overrides
   /// </remarks>
   [CmdletProvider("AccessDB", ProviderCapabilities.None)]
   public class AccessDBProvider : DriveCmdletProvider
   {
       #region Drive Manipulation

       /// <summary>
       /// Create a new drive.  Create a connection to the database file and
set
       /// the Connection property in the PSDriveInfo.
       /// </summary>
       /// <param name="drive">
       /// Information describing the drive to add.
       /// </param>
       /// <returns>The added drive.</returns>
       protected override PSDriveInfo NewDrive(PSDriveInfo drive)
       {
           // check if drive object is null
           if (drive == null)
```

```
            {
                WriteError(new ErrorRecord(
                    new ArgumentNullException("drive"),
                    "NullDrive",
                    ErrorCategory.InvalidArgument,
                    null)
                );

                return null;
            }

            // check if drive root is not null or empty
            // and if its an existing file
            if (String.IsNullOrEmpty(drive.Root) || (File.Exists(drive.Root)
== false))
            {
                WriteError(new ErrorRecord(
                    new ArgumentException("drive.Root"),
                    "NoRoot",
                    ErrorCategory.InvalidArgument,
                    drive)
                );

                return null;
            }

            // create a new drive and create an ODBC connection to the new
drive
            AccessDBPSDriveInfo accessDBPSDriveInfo = new
AccessDBPSDriveInfo(drive);

            OdbcConnectionStringBuilder builder = new
OdbcConnectionStringBuilder();

            builder.Driver = "Microsoft Access Driver (*.mdb)";
            builder.Add("DBQ", drive.Root);

            OdbcConnection conn = new
OdbcConnection(builder.ConnectionString);
            conn.Open();
            accessDBPSDriveInfo.Connection = conn;

            return accessDBPSDriveInfo;
        } // NewDrive

        /// <summary>
        /// Removes a drive from the provider.
        /// </summary>
        /// <param name="drive">The drive to remove.</param>
        /// <returns>The drive removed.</returns>
        protected override PSDriveInfo RemoveDrive(PSDriveInfo drive)
        {
            // check if drive object is null
            if (drive == null)
            {
```

```
                WriteError(new ErrorRecord(
                    new ArgumentNullException("drive"),
                    "NullDrive",
                    ErrorCategory.InvalidArgument,
                    drive)
                );

               return null;
            }

            // close ODBC connection to the drive
            AccessDBPSDriveInfo accessDBPSDriveInfo = drive as
AccessDBPSDriveInfo;

            if (accessDBPSDriveInfo == null)
            {
                return null;
            }
            accessDBPSDriveInfo.Connection.Close();

            return accessDBPSDriveInfo;
        } // RemoveDrive

        #endregion Drive Manipulation

    } // AccessDBProvider

    #endregion AccessDBProvider

    #region AccessDBPSDriveInfo

    /// <summary>
    /// Any state associated with the drive should be held here.
    /// In this case, it's the connection to the database.
    /// </summary>
    internal class AccessDBPSDriveInfo : PSDriveInfo
    {
        private OdbcConnection connection;

        /// <summary>
        /// ODBC connection information.
        /// </summary>
        public OdbcConnection Connection
        {
            get { return connection; }
            set { connection = value; }
        }

        /// <summary>
        /// Constructor that takes one argument
        /// </summary>
        /// <param name="driveInfo">Drive provided by this provider</param>
        public AccessDBPSDriveInfo(PSDriveInfo driveInfo)
            : base(driveInfo)
        { }
```

```
    } // class AccessDBPSDriveInfo

    #endregion AccessDBPSDriveInfo
}
```

See Also

System.Management.Automation.Provider.Itemcmdletprovider

System.Management.Automation.Provider.Containercmdletprovider

System.Management.Automation.Provider.Navigationcmdletprovider

Designing Your Windows PowerShell Provider

AccessDBProviderSample03

Article • 09/17/2021

This sample shows how to overwrite the System.Management.Automation.Provider.Itemcmdletprovider.Getitem* and System.Management.Automation.Provider.Itemcmdletprovider.Setitem* methods to support calls to the `Get-Item` and `Set-Item` cmdlets. The provider class in this sample derives from the System.Management.Automation.Provider.Itemcmdletprovider class.

Demonstrates

> **Important**
>
> Your provider class will most likely derive from one of the following classes and possibly implement other provider interfaces:
>
> - **System.Management.Automation.Provider.Itemcmdletprovider** class.
> - **System.Management.Automation.Provider.Containercmdletprovider** class. See **AccessDBProviderSample04**.
> - **System.Management.Automation.Provider.Navigationcmdletprovider** class. See **AccessDBProviderSample05**.
>
> For more information about choosing which provider class to derive from based on provider features, see **Designing Your Windows PowerShell Provider**.

This sample demonstrates the following:

- Declaring the `CmdletProvider` attribute.
- Defining a provider class that derives from the System.Management.Automation.Provider.Itemcmdletprovider class.
- Overwriting the System.Management.Automation.Provider.Drivecmdletprovider.Newdrive* method to change the behavior of the `New-PSDrive` cmdlet, allowing the user to create new drives. (This sample does not show how to add dynamic parameters to the `New-PSDrive` cmdlet.)
- Overwriting the System.Management.Automation.Provider.Drivecmdletprovider.Removedrive* method to support removing existing drives.

- Overwriting the System.Management.Automation.Provider.Itemcmdletprovider.Getitem* method to change the behavior of the `Get-Item` cmdlet, allowing the user to retrieve items from the data store. (This sample does not show how to add dynamic parameters to the `Get-Item` cmdlet.)
- Overwriting the System.Management.Automation.Provider.Itemcmdletprovider.Setitem* method to change the behavior of the `Set-Item` cmdlet, allowing the user to update the items in the data store. (This sample does not show how to add dynamic parameters to the `Get-Item` cmdlet.)
- Overwriting the System.Management.Automation.Provider.Itemcmdletprovider.Itemexists* method to change the behavior of the `Test-Path` cmdlet. (This sample does not show how to add dynamic parameters to the `Test-Path` cmdlet.)
- Overwriting the System.Management.Automation.Provider.Itemcmdletprovider.Isvalidpath* method to determine if the provided path is valid.

Example

This sample shows how to overwrite the methods needed to get and set items in a Microsoft Access data base.

C#

```
using System;
using System.IO;
using System.Data;
using System.Data.Odbc;
using System.Collections.ObjectModel;
using System.Text;
using System.Diagnostics;
using System.Text.RegularExpressions;
using System.Management.Automation;
using System.Management.Automation.Provider;
using System.ComponentModel;
using System.Globalization;

namespace Microsoft.Samples.PowerShell.Providers
{
   #region AccessDBProvider

    /// <summary>
    /// A PowerShell Provider which acts upon a access database.
    /// </summary>
    /// <remarks>
```

```
    /// This example implements the item overloads.
    /// </remarks>
   [CmdletProvider("AccessDB", ProviderCapabilities.None)]

   public class AccessDBProvider : ItemCmdletProvider
   {
      #region Drive Manipulation

       /// <summary>
       /// Create a new drive.  Create a connection to the database file and
set
       /// the Connection property in the PSDriveInfo.
       /// </summary>
       /// <param name="drive">
       /// Information describing the drive to add.
       /// </param>
       /// <returns>The added drive.</returns>
       protected override PSDriveInfo NewDrive(PSDriveInfo drive)
       {
           // check if drive object is null
           if (drive == null)
           {
               WriteError(new ErrorRecord(
                   new ArgumentNullException("drive"),
                   "NullDrive",
                   ErrorCategory.InvalidArgument,
                   null)
               );

               return null;
           }

           // check if drive root is not null or empty
           // and if its an existing file
           if (String.IsNullOrEmpty(drive.Root) || (File.Exists(drive.Root)
== false))
           {
               WriteError(new ErrorRecord(
                   new ArgumentException("drive.Root"),
                   "NoRoot",
                   ErrorCategory.InvalidArgument,
                   drive)
               );

               return null;
           }

           // create a new drive and create an ODBC connection to the new
drive
           AccessDBPSDriveInfo accessDBPSDriveInfo = new
AccessDBPSDriveInfo(drive);

           OdbcConnectionStringBuilder builder = new
OdbcConnectionStringBuilder();
```

```
            builder.Driver = "Microsoft Access Driver (*.mdb)";
            builder.Add("DBQ", drive.Root);

            OdbcConnection conn = new
OdbcConnection(builder.ConnectionString);
            conn.Open();
            accessDBPSDriveInfo.Connection = conn;

            return accessDBPSDriveInfo;
        } // NewDrive

        /// <summary>
        /// Removes a drive from the provider.
        /// </summary>
        /// <param name="drive">The drive to remove.</param>
        /// <returns>The drive removed.</returns>
        protected override PSDriveInfo RemoveDrive(PSDriveInfo drive)
        {
            // check if drive object is null
            if (drive == null)
            {
                WriteError(new ErrorRecord(
                    new ArgumentNullException("drive"),
                    "NullDrive",
                    ErrorCategory.InvalidArgument,
                    drive)
                );

                return null;
            }

            // close ODBC connection to the drive
            AccessDBPSDriveInfo accessDBPSDriveInfo = drive as
AccessDBPSDriveInfo;

            if (accessDBPSDriveInfo == null)
            {
                return null;
            }
            accessDBPSDriveInfo.Connection.Close();

            return accessDBPSDriveInfo;
        } // RemoveDrive

        #endregion Drive Manipulation

        #region Item Methods

       /// <summary>
       /// Retrieves an item using the specified path.
       /// </summary>
       /// <param name="path">The path to the item to return.</param>
       protected override void GetItem(string path)
       {
           // check if the path represented is a drive
```

```
            if (PathIsDrive(path))
            {
                WriteItemObject(this.PSDriveInfo, path, true);
                return;
            }// if (PathIsDrive...

             // Get table name and row information from the path and do
             // necessary actions
             string tableName;
             int rowNumber;

             PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

             if (type == PathType.Table)
             {
                 DatabaseTableInfo table = GetTable(tableName);
                 WriteItemObject(table, path, true);
             }
             else if (type == PathType.Row)
             {
                 DatabaseRowInfo row = GetRow(tableName, rowNumber);
                 WriteItemObject(row, path, false);
             }
             else
             {
                 ThrowTerminatingInvalidPathException(path);
             }

        } // GetItem

        /// <summary>
        /// Set the content of a row of data specified by the supplied path
        /// parameter.
        /// </summary>
        /// <param name="path">Specifies the path to the row whose columns
        /// will be updated.</param>
        /// <param name="values">Comma separated string of values</param>
        protected override void SetItem(string path, object values)
        {
            // Get type, table name and row number from the path specified
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type != PathType.Row)
            {
                WriteError(new ErrorRecord(new NotSupportedException(
                      "SetNotSupported"), "",
                   ErrorCategory.InvalidOperation, path));

                return;
            }
```

```
            // Get in-memory representation of table
            OdbcDataAdapter da = GetAdapterForTable(tableName);

            if (da == null)
            {
                return;
            }
            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);

            if (rowNumber >= table.Rows.Count)
            {
                // The specified row number has to be available. If not
                // NewItem has to be used to add a new row
                throw new ArgumentException("Row specified is not
available");
            } // if (rowNum...

            string[] colValues = (values as string).Split(',');

            // set the specified row
            DataRow row = table.Rows[rowNumber];

            for (int i = 0; i < colValues.Length; i++)
            {
                row[i] = colValues[i];
            }

            // Update the table
            if (ShouldProcess(path, "SetItem"))
            {
                da.Update(ds, tableName);
            }

        } // SetItem

        /// <summary>
        /// Test to see if the specified item exists.
        /// </summary>
        /// <param name="path">The path to the item to verify.</param>
        /// <returns>True if the item is found.</returns>
        protected override bool ItemExists(string path)
        {
            // check if the path represented is a drive
            if (PathIsDrive(path))
            {
                return true;
            }

            // Obtain type, table name and row number from path
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
```

```
rowNumber);

            DatabaseTableInfo table = GetTable(tableName);

            if (type == PathType.Table)
            {
                // if specified path represents a table then
DatabaseTableInfo
                // object for the same should exist
                if (table != null)
                {
                    return true;
                }
            }
            else if (type == PathType.Row)
            {
                // if specified path represents a row then DatabaseTableInfo
should
                // exist for the table and then specified row number must be
within
                // the maximum row count in the table
                if (table != null && rowNumber < table.RowCount)
                {
                    return true;
                }
            }

            return false;

        } // ItemExists

        /// <summary>
        /// Test to see if the specified path is syntactically valid.
        /// </summary>
        /// <param name="path">The path to validate.</param>
        /// <returns>True if the specified path is valid.</returns>
        protected override bool IsValidPath(string path)
        {
            bool result = true;

            // check if the path is null or empty
            if (String.IsNullOrEmpty(path))
            {
                result = false;
            }

            // convert all separators in the path to a uniform one
            path = NormalizePath(path);

            // split the path into individual chunks
            string[] pathChunks = path.Split(pathSeparator.ToCharArray());

            foreach (string pathChunk in pathChunks)
            {
                if (pathChunk.Length == 0)
```

```
                {
                    result = false;
                }
            }
            return result;
        } // IsValidPath

        #endregion Item Overloads

        #region Helper Methods

        /// <summary>
        /// Checks if a given path is actually a drive name.
        /// </summary>
        /// <param name="path">The path to check.</param>
        /// <returns>
        /// True if the path given represents a drive, false otherwise.
        /// </returns>
        private bool PathIsDrive(string path)
        {
            // Remove the drive name and first path separator.  If the
            // path is reduced to nothing, it is a drive. Also if its
            // just a drive then there wont be any path separators
            if (String.IsNullOrEmpty(
                        path.Replace(this.PSDriveInfo.Root, "")) ||
                String.IsNullOrEmpty(
                        path.Replace(this.PSDriveInfo.Root + pathSeparator,
"""))

               )
            {
                return true;
            }
            else
            {
                return false;
            }
        } // PathIsDrive

        /// <summary>
        /// Breaks up the path into individual elements.
        /// </summary>
        /// <param name="path">The path to split.</param>
        /// <returns>An array of path segments.</returns>
        private string[] ChunkPath(string path)
        {
            // Normalize the path before splitting
            string normalPath = NormalizePath(path);

            // Return the path with the drive name and first path
            // separator character removed, split by the path separator.
            string pathNoDrive = normalPath.Replace(this.PSDriveInfo.Root
                                        + pathSeparator, "");

            return pathNoDrive.Split(pathSeparator.ToCharArray());
```

```
        } // ChunkPath

        /// <summary>
        /// Adapts the path, making sure the correct path separator
        /// character is used.
        /// </summary>
        /// <param name="path"></param>
        /// <returns></returns>
        private string NormalizePath(string path)
        {
            string result = path;

            if (!String.IsNullOrEmpty(path))
            {
                result = path.Replace("/", pathSeparator);
            }

            return result;
        } // NormalizePath

        /// <summary>
        /// Chunks the path and returns the table name and the row number
        /// from the path
        /// </summary>
        /// <param name="path">Path to chunk and obtain information</param>
        /// <param name="tableName">Name of the table as represented in the
        /// path</param>
        /// <param name="rowNumber">Row number obtained from the path</param>
        /// <returns>what the path represents</returns>
        private PathType GetNamesFromPath(string path, out string tableName,
out int rowNumber)
        {
            PathType retVal = PathType.Invalid;
            rowNumber = -1;
            tableName = null;

            // Check if the path specified is a drive
            if (PathIsDrive(path))
            {
                return PathType.Database;
            }

            // chunk the path into parts
            string[] pathChunks = ChunkPath(path);

            switch (pathChunks.Length)
            {
                case 1:
                    {
                        string name = pathChunks[0];

                        if (TableNameIsValid(name))
                        {
                            tableName = name;
                            retVal = PathType.Table;
```

```
                    }
                }
                break;

            case 2:
                {
                    string name = pathChunks[0];

                    if (TableNameIsValid(name))
                    {
                        tableName = name;
                    }

                    int number = SafeConvertRowNumber(pathChunks[1]);

                    if (number >= 0)
                    {
                        rowNumber = number;
                        retVal = PathType.Row;
                    }
                    else
                    {
                        WriteError(new ErrorRecord(
                            new ArgumentException("Row number is not
valid"),
                            "RowNumberNotValid",
                            ErrorCategory.InvalidArgument,
                            path));
                    }
                }
                break;

            default:
                {
                    WriteError(new ErrorRecord(
                        new ArgumentException("The path supplied has too
many segments"),
                        "PathNotValid",
                        ErrorCategory.InvalidArgument,
                        path));
                }
                break;
        } // switch(pathChunks...

        return retVal;
    } // GetNamesFromPath

    /// <summary>
    /// Throws an argument exception stating that the specified path does
    /// not represent either a table or a row
    /// </summary>
    /// <param name="path">path which is invalid</param>
    private void ThrowTerminatingInvalidPathException(string path)
    {
        StringBuilder message = new StringBuilder("Path must represent
```

```
either a table or a row :");
            message.Append(path);

            throw new ArgumentException(message.ToString());
        }

        /// <summary>
        /// Retrieve the list of tables from the database.
        /// </summary>
        /// <returns>
        /// Collection of DatabaseTableInfo objects, each object representing
        /// information about one database table
        /// </returns>
        private Collection<DatabaseTableInfo> GetTables()
        {
            Collection<DatabaseTableInfo> results =
                    new Collection<DatabaseTableInfo>();

            // using ODBC connection to the database and get the schema of
tables
            AccessDBPSDriveInfo di = this.PSDriveInfo as AccessDBPSDriveInfo;

            if (di == null)
            {
                return null;
            }

            OdbcConnection connection = di.Connection;
            DataTable dt = connection.GetSchema("Tables");
            int count;

            // iterate through all rows in the schema and create
DatabaseTableInfo
            // objects which represents a table
            foreach (DataRow dr in dt.Rows)
            {
                String tableName = dr["TABLE_NAME"] as String;
                DataColumnCollection columns = null;

                // find the number of rows in the table
                try
                {
                    String cmd = "Select count(*) from \"" + tableName + "\"";
                    OdbcCommand command = new OdbcCommand(cmd, connection);

                    count = (Int32)command.ExecuteScalar();
                }
                catch
                {
                    count = 0;
                }

                // create DatabaseTableInfo object representing the table
                DatabaseTableInfo table =
                        new DatabaseTableInfo(dr, tableName, count, columns);
```

```
                results.Add(table);
            } // foreach (DataRow...

            return results;
        } // GetTables

        /// <summary>
        /// Return row information from a specified table.
        /// </summary>
        /// <param name="tableName">The name of the database table from
        /// which to retrieve rows.</param>
        /// <returns>Collection of row information objects.</returns>
        private Collection<DatabaseRowInfo> GetRows(string tableName)
        {
            Collection<DatabaseRowInfo> results =
                        new Collection<DatabaseRowInfo>();

            // Obtain rows in the table and add it to the collection
            try
            {
                OdbcDataAdapter da = GetAdapterForTable(tableName);

                if (da == null)
                {
                    return null;
                }

                DataSet ds = GetDataSetForTable(da, tableName);
                DataTable table = GetDataTable(ds, tableName);

                int i = 0;
                foreach (DataRow row in table.Rows)
                {
                    results.Add(new DatabaseRowInfo(row,
i.ToString(CultureInfo.CurrentCulture)));
                    i++;
                } // foreach (DataRow...
            }
            catch (Exception e)
            {
                WriteError(new ErrorRecord(e, "CannotAccessSpecifiedRows",
                    ErrorCategory.InvalidOperation, tableName));
            }

            return results;

        } // GetRows

        /// <summary>
        /// Retrieve information about a single table.
        /// </summary>
        /// <param name="tableName">The table for which to retrieve
        /// data.</param>
        /// <returns>Table information.</returns>
```

```
        private DatabaseTableInfo GetTable(string tableName)
        {
            foreach (DatabaseTableInfo table in GetTables())
            {
                if (String.Equals(tableName, table.Name,
StringComparison.OrdinalIgnoreCase))
                {
                    return table;
                }
            }

            return null;
        } // GetTable

        /// <summary>
        /// Obtain a data adapter for the specified Table
        /// </summary>
        /// <param name="tableName">Name of the table to obtain the
        /// adapter for</param>
        /// <returns>Adapter object for the specified table</returns>
        /// <remarks>An adapter serves as a bridge between a DataSet (in
memory
        /// representation of table) and the data source</remarks>
        private OdbcDataAdapter GetAdapterForTable(string tableName)
        {
            OdbcDataAdapter da = null;
            AccessDBPSDriveInfo di = this.PSDriveInfo as AccessDBPSDriveInfo;

            if (di == null || !TableNameIsValid(tableName) ||
!TableIsPresent(tableName))
            {
                return null;
            }

            OdbcConnection connection = di.Connection;

            try
            {
                // Create a odbc data adpater. This can be sued to update the
                // data source with the records that will be created here
                // using data sets
                string sql = "Select * from " + tableName;
                da = new OdbcDataAdapter(new OdbcCommand(sql, connection));

                // Create a odbc command builder object. This will create sql
                // commands automatically for a single table, thus
                // eliminating the need to create new sql statements for
                // every operation to be done.
                OdbcCommandBuilder cmd = new OdbcCommandBuilder(da);

                // Open the connection if its not already open
                if (connection.State != ConnectionState.Open)
                {
                    connection.Open();
                }
```

```
            }
            catch (Exception e)
            {
                WriteError(new ErrorRecord(e, "CannotAccessSpecifiedTable",
                  ErrorCategory.InvalidOperation, tableName));
            }

            return da;
        } // GetAdapterForTable

        /// <summary>
        /// Gets the DataSet (in memory representation) for the table
        /// for the specified adapter
        /// </summary>
        /// <param name="adapter">Adapter to be used for obtaining
        /// the table</param>
        /// <param name="tableName">Name of the table for which a
        /// DataSet is required</param>
        /// <returns>The DataSet with the filled in schema</returns>
        private DataSet GetDataSetForTable(OdbcDataAdapter adapter, string
tableName)
        {
            Debug.Assert(adapter != null);

            // Create a dataset object which will provide an in-memory
            // representation of the data being worked upon in the
            // data source.
            DataSet ds = new DataSet();

            // Create a table named "Table" which will contain the same
            // schema as in the data source.
            //adapter.FillSchema(ds, SchemaType.Source);
            adapter.Fill(ds, tableName);
            ds.Locale = CultureInfo.InvariantCulture;

            return ds;
        } //GetDataSetForTable

        /// <summary>
        /// Get the DataTable object which can be used to operate on
        /// for the specified table in the data source
        /// </summary>
        /// <param name="ds">DataSet object which contains the tables
        /// schema</param>
        /// <param name="tableName">Name of the table</param>
        /// <returns>Corresponding DataTable object representing
        /// the table</returns>
        ///
        private DataTable GetDataTable(DataSet ds, string tableName)
        {
            Debug.Assert(ds != null);
            Debug.Assert(tableName != null);

            DataTable table = ds.Tables[tableName];
            table.Locale = CultureInfo.InvariantCulture;
```

```
            return table;
        } // GetDataTable

        /// <summary>
        /// Retrieves a single row from the named table.
        /// </summary>
        /// <param name="tableName">The table that contains the
        /// numbered row.</param>
        /// <param name="row">The index of the row to return.</param>
        /// <returns>The specified table row.</returns>
        private DatabaseRowInfo GetRow(string tableName, int row)
        {
            Collection<DatabaseRowInfo> di = GetRows(tableName);

            // if the row is invalid write an appropriate error else return
the
            // corresponding row information
            if (row < di.Count && row >= 0)
            {
                return di[row];
            }
            else
            {
                WriteError(new ErrorRecord(
                   new ItemNotFoundException(),
                   "RowNotFound",
                   ErrorCategory.ObjectNotFound,
                   row.ToString(CultureInfo.CurrentCulture))
                );
            }

            return null;
        } // GetRow

        /// <summary>
        /// Method to safely convert a string representation of a row number
        /// into its Int32 equivalent
        /// </summary>
        /// <param name="rowNumberAsStr">String representation of the row
        /// number</param>
        /// <remarks>If there is an exception, -1 is returned</remarks>
        private int SafeConvertRowNumber(string rowNumberAsStr)
        {
            int rowNumber = -1;
            try
            {
                rowNumber = Convert.ToInt32(rowNumberAsStr,
CultureInfo.CurrentCulture);
            }
            catch (FormatException fe)
            {
                WriteError(new ErrorRecord(fe, "RowStringFormatNotValid",
                    ErrorCategory.InvalidData, rowNumberAsStr));
            }
```

```
            catch (OverflowException oe)
            {
                WriteError(new ErrorRecord(oe,
"RowStringConversionToNumberFailed",
                    ErrorCategory.InvalidData, rowNumberAsStr));
            }

            return rowNumber;
        } // SafeConvertRowNumber

        /// <summary>
        /// Check if a table name is valid
        /// </summary>
        /// <param name="tableName">Table name to validate</param>
        /// <remarks>Helps to check for SQL injection attacks</remarks>
        private bool TableNameIsValid(string tableName)
        {
            Regex exp = new Regex(pattern, RegexOptions.Compiled |
RegexOptions.IgnoreCase);

            if (exp.IsMatch(tableName))
            {
                return true;
            }
            WriteError(new ErrorRecord(
                new ArgumentException("Table name not valid"),
"TableNameNotValid",
                    ErrorCategory.InvalidArgument, tableName));
            return false;
        } // TableNameIsValid

        /// <summary>
        /// Checks to see if the specified table is present in the
        /// database
        /// </summary>
        /// <param name="tableName">Name of the table to check</param>
        /// <returns>true, if table is present, false otherwise</returns>
        private bool TableIsPresent(string tableName)
        {
            // using ODBC connection to the database and get the schema of
tables
            AccessDBPSDriveInfo di = this.PSDriveInfo as AccessDBPSDriveInfo;
            if (di == null)
            {
                return false;
            }

            OdbcConnection connection = di.Connection;
            DataTable dt = connection.GetSchema("Tables");

            // check if the specified tableName is available
            // in the list of tables present in the database
            foreach (DataRow dr in dt.Rows)
            {
                string name = dr["TABLE_NAME"] as string;
```

```
                if (name.Equals(tableName,
StringComparison.OrdinalIgnoreCase))
                {
                    return true;
                }
            }

            WriteError(new ErrorRecord(
                new ArgumentException("Specified Table is not present in
database"), "TableNotAvailable",
                     ErrorCategory.InvalidArgument, tableName));

            return false;
        }// TableIsPresent

        #endregion Helper Methods

        #region Private Properties

        private string pathSeparator = "\\";
        private static string pattern = @"^[a-z]+[0-9]*_*$";

        private enum PathType { Database, Table, Row, Invalid };

        #endregion Private Properties
    }

     #endregion AccessDBProvider

     #region Helper Classes

    #region AccessDBPSDriveInfo

    /// <summary>
     /// Any state associated with the drive should be held here.
     /// In this case, it's the connection to the database.
     /// </summary>
     internal class AccessDBPSDriveInfo : PSDriveInfo
     {
         private OdbcConnection connection;

         /// <summary>
         /// ODBC connection information.
         /// </summary>
         public OdbcConnection Connection
         {
             get { return connection; }
             set { connection = value; }
         }

         /// <summary>
         /// Constructor that takes one argument
         /// </summary>
         /// <param name="driveInfo">Drive provided by this provider</param>
         public AccessDBPSDriveInfo(PSDriveInfo driveInfo)
```

```
            : base(driveInfo)
        { }

    } // class AccessDBPSDriveInfo

    #endregion AccessDBPSDriveInfo

    #region DatabaseTableInfo

    /// <summary>
    /// Contains information specific to the database table.
    /// Similar to the DirectoryInfo class.
    /// </summary>
    public class DatabaseTableInfo
    {
        /// <summary>
        /// Row from the "tables" schema
        /// </summary>
        public DataRow Data
        {
            get
            {
                return data;
            }
            set
            {
                data = value;
            }
        }
        private DataRow data;

        /// <summary>
        /// The table name.
        /// </summary>
        public string Name
        {
            get
            {
                return name;
            }
            set
            {
                name = value;
            }
        }
        private String name;

        /// <summary>
        /// The number of rows in the table.
        /// </summary>
        public int RowCount
        {
            get
            {
                return rowCount;
```

```
            }
            set
            {
                rowCount = value;
            }
        }
        private int rowCount;

        /// <summary>
        /// The column definitions for the table.
        /// </summary>
        public DataColumnCollection Columns
        {
            get
            {
                return columns;
            }
            set
            {
                columns = value;
            }
        }
        private DataColumnCollection columns;

        /// <summary>
        /// Constructor.
        /// </summary>
        /// <param name="row">The row definition.</param>
        /// <param name="name">The table name.</param>
        /// <param name="rowCount">The number of rows in the table.</param>
        /// <param name="columns">Information on the column tables.</param>
        public DatabaseTableInfo(DataRow row, string name, int rowCount,
                                 DataColumnCollection columns)
        {
            Name = name;
            Data = row;
            RowCount = rowCount;
            Columns = columns;
        } // DatabaseTableInfo
    } // class DatabaseTableInfo

    #endregion DatabaseTableInfo

    #region DatabaseRowInfo

    /// <summary>
    /// Contains information specific to an individual table row.
    /// Analogous to the FileInfo class.
    /// </summary>
    public class DatabaseRowInfo
    {
        /// <summary>
        /// Row data information.
        /// </summary>
        public DataRow Data
```

```
        {
            get
            {
                return data;
            }
            set
            {
                data = value;
            }
        }
        private DataRow data;

        /// <summary>
        /// The row index.
        /// </summary>
        public string RowNumber
        {
            get
            {
                return rowNumber;
            }
            set
            {
                rowNumber = value;
            }
        }
        private string rowNumber;

        /// <summary>
        /// Constructor.
        /// </summary>
        /// <param name="row">The row information.</param>
        /// <param name="name">The row index.</param>
        public DatabaseRowInfo(DataRow row, string name)
        {
            RowNumber = name;
            Data = row;
        } // DatabaseRowInfo
    } // class DatabaseRowInfo

    #endregion DatabaseRowInfo

    #endregion Helper Classes
}
```

See Also

System.Management.Automation.Provider.Itemcmdletprovider

System.Management.Automation.Provider.Containercmdletprovider

System.Management.Automation.Provider.Navigationcmdletprovider

AccessDBProviderSample04

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This sample shows how to overwrite container methods to support calls to the `Copy-Item`, `Get-ChildItem`, `New-Item`, and `Remove-Item` cmdlets. These methods should be implemented when the data store contains items that are containers. A container is a group of child items under a common parent item. The provider class in this sample derives from the System.Management.Automation.Provider.Containercmdletprovider class.

Demonstrates

> **Important**
>
> Your provider class will most likely derive from the **System.Management.Automation.Provider.Navigationcmdletprovider**

This sample demonstrates the following:

- Declaring the `CmdletProvider` attribute.
- Defining a provider class that derives from the System.Management.Automation.Provider.Containercmdletprovider class.
- Overwriting the System.Management.Automation.Provider.ContainerCmdletProvider.CopyItem method to change the behavior of the `Copy-Item` cmdlet which allows the user to copy items from one location to another. (This sample does not show how to add dynamic parameters to the `Copy-Item` cmdlet.)
- Overwriting the System.Management.Automation.Provider.Containercmdletprovider.Getchilditems* method to change the behavior of the Get-ChildItems cmdlet, which allows the user to retrieve the child items of the parent item. (This sample does not show how to add dynamic parameters to the Get-ChildItems cmdlet.)
- Overwriting the System.Management.Automation.Provider.Containercmdletprovider.Getchildnames* method to change the behavior of the Get-ChildItems cmdlet when the `Name` parameter of the cmdlet is specified.
- Overwriting the System.Management.Automation.Provider.Containercmdletprovider.Newitem*

method to change the behavior of the `New-Item` cmdlet, which allows the user to add items to the data store. (This sample does not show how to add dynamic parameters to the `New-Item` cmdlet.)

- Overwriting the System.Management.Automation.Provider.Containercmdletprovider.Removeitem* method to change the behavior of the `Remove-Item` cmdlet. (This sample does not show how to add dynamic parameters to the `Remove-Item` cmdlet.)

Example

This sample shows how to overwrite the methods needed to copy, create, and remove items, as well as methods for getting the child items of a parent item.

C#

```
using System;
using System.IO;
using System.Data;
using System.Data.Odbc;
using System.Data.OleDb;
using System.Diagnostics;
using System.Collections.ObjectModel;
using System.Text;
using System.Text.RegularExpressions;
using System.Management.Automation;
using System.Management.Automation.Provider;
using System.ComponentModel;
using System.Globalization;

namespace Microsoft.Samples.PowerShell.Providers
{
   #region AccessDBProvider

    /// <summary>
   /// A PowerShell Provider which acts upon an Access database
   /// </summary>
   /// <remarks>
   /// This example implements the container overloads</remarks>
   [CmdletProvider("AccessDB", ProviderCapabilities.None)]
   public class AccessDBProvider : ContainerCmdletProvider
   {

       #region Drive Manipulation

       /// <summary>
       /// Create a new drive.  Create a connection to the database file and
set
       /// the Connection property in the PSDriveInfo.
       /// </summary>
```

```
        /// <param name="drive">
        /// Information describing the drive to add.
        /// </param>
        /// <returns>The added drive.</returns>
        protected override PSDriveInfo NewDrive(PSDriveInfo drive)
        {
            // check if drive object is null
            if (drive == null)
            {
                WriteError(new ErrorRecord(
                    new ArgumentNullException("drive"),
                    "NullDrive",
                    ErrorCategory.InvalidArgument,
                    null)
                );

                return null;
            }

            // check if drive root is not null or empty
            // and if its an existing file
            if (String.IsNullOrEmpty(drive.Root) || (File.Exists(drive.Root)
== false))
            {
                WriteError(new ErrorRecord(
                    new ArgumentException("drive.Root"),
                    "NoRoot",
                    ErrorCategory.InvalidArgument,
                    drive)
                );

                return null;
            }


            // create a new drive and create an ODBC connection to the new
drive
            AccessDBPSDriveInfo accessDBPSDriveInfo = new
AccessDBPSDriveInfo(drive);

            OdbcConnectionStringBuilder builder = new
OdbcConnectionStringBuilder();

            builder.Driver = "Microsoft Access Driver (*.mdb)";
            builder.Add("DBQ", drive.Root);

            OdbcConnection conn = new
OdbcConnection(builder.ConnectionString);
            conn.Open();
            accessDBPSDriveInfo.Connection = conn;

            return accessDBPSDriveInfo;
        } // NewDrive

        /// <summary>
```

```
        /// Removes a drive from the provider.
        /// </summary>
        /// <param name="drive">The drive to remove.</param>
        /// <returns>The drive removed.</returns>
        protected override PSDriveInfo RemoveDrive(PSDriveInfo drive)
        {
            // check if drive object is null
            if (drive == null)
            {
                WriteError(new ErrorRecord(
                    new ArgumentNullException("drive"),
                    "NullDrive",
                    ErrorCategory.InvalidArgument,
                    drive)
                );

                return null;
            }

            // close ODBC connection to the drive
            AccessDBPSDriveInfo accessDBPSDriveInfo = drive as
AccessDBPSDriveInfo;

            if (accessDBPSDriveInfo == null)
            {
                return null;
            }
            accessDBPSDriveInfo.Connection.Close();

            return accessDBPSDriveInfo;
        } // RemoveDrive

        #endregion Drive Manipulation

        #region Item Methods

        /// <summary>
        /// Retrieves an item using the specified path.
        /// </summary>
        /// <param name="path">The path to the item to return.</param>
        protected override void GetItem(string path)
        {
            // check if the path represented is a drive
            if (PathIsDrive(path))
            {
                WriteItemObject(this.PSDriveInfo, path, true);
                return;
            }// if (PathIsDrive...

            // Get table name and row information from the path and do
            // necessary actions
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
```

```
rowNumber);

            if (type == PathType.Table)
            {
                DatabaseTableInfo table = GetTable(tableName);
                WriteItemObject(table, path, true);
            }
            else if (type == PathType.Row)
            {
                DatabaseRowInfo row = GetRow(tableName, rowNumber);
                WriteItemObject(row, path, false);
            }
            else
            {
                ThrowTerminatingInvalidPathException(path);
            }

        } // GetItem

        /// <summary>
        /// Set the content of a row of data specified by the supplied path
        /// parameter.
        /// </summary>
        /// <param name="path">Specifies the path to the row whose columns
        /// will be updated.</param>
        /// <param name="values">Comma separated string of values</param>
        protected override void SetItem(string path, object values)
        {
            // Get type, table name and row number from the path specified
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type != PathType.Row)
            {
                WriteError(new ErrorRecord(new NotSupportedException(
                      "SetNotSupported"), "",
                   ErrorCategory.InvalidOperation, path));

                return;
            }

            // Get in-memory representation of table
            OdbcDataAdapter da = GetAdapterForTable(tableName);

            if (da == null)
            {
                return;
            }
            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);

            if (rowNumber >= table.Rows.Count)
```

```
            {
                // The specified row number has to be available. If not
                // NewItem has to be used to add a new row
                throw new ArgumentException("Row specified is not
available");
            } // if (rowNum...

            string[] colValues = (values as string).Split(',');

            // set the specified row
            DataRow row = table.Rows[rowNumber];

            for (int i = 0; i < colValues.Length; i++)
            {
                row[i] = colValues[i];
            }

            // Update the table
            if (ShouldProcess(path, "SetItem"))
            {
                da.Update(ds, tableName);
            }

        } // SetItem

        /// <summary>
        /// Test to see if the specified item exists.
        /// </summary>
        /// <param name="path">The path to the item to verify.</param>
        /// <returns>True if the item is found.</returns>
        protected override bool ItemExists(string path)
        {
            // check if the path represented is a drive
            if (PathIsDrive(path))
            {
                return true;
            }

            // Obtain type, table name and row number from path
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            DatabaseTableInfo table = GetTable(tableName);

            if (type == PathType.Table)
            {
                // if specified path represents a table then
DatabaseTableInfo
                // object for the same should exist
                if (table != null)
                {
                    return true;
```

```
                }
            }
            else if (type == PathType.Row)
            {
                // if specified path represents a row then DatabaseTableInfo
should
                // exist for the table and then specified row number must be
within
                // the maximum row count in the table
                if (table != null && rowNumber < table.RowCount)
                {
                    return true;
                }
            }

            return false;

        } // ItemExists

        /// <summary>
        /// Test to see if the specified path is syntactically valid.
        /// </summary>
        /// <param name="path">The path to validate.</param>
        /// <returns>True if the specified path is valid.</returns>
        protected override bool IsValidPath(string path)
        {
            bool result = true;

            // check if the path is null or empty
            if (String.IsNullOrEmpty(path))
            {
                result = false;
            }

            // convert all separators in the path to a uniform one
            path = NormalizePath(path);

            // split the path into individual chunks
            string[] pathChunks = path.Split(pathSeparator.ToCharArray());

            foreach (string pathChunk in pathChunks)
            {
                if (pathChunk.Length == 0)
                {
                    result = false;
                }
            }
            return result;
        } // IsValidPath

        #endregion Item Overloads

        #region Container Overloads

        /// <summary>
```

```
        /// Return either the tables in the database or the datarows
        /// </summary>
        /// <param name="path">The path to the parent</param>
        /// <param name="recurse">True to return all child items recursively.
        /// </param>
        protected override void GetChildItems(string path, bool recurse)
        {
            // If path represented is a drive then the children in the path
are
            // tables. Hence all tables in the drive represented will have to
be
            // returned
            if (PathIsDrive(path))
            {
                foreach (DatabaseTableInfo table in GetTables())
                {
                    WriteItemObject(table, path, true);

                    // if the specified item exists and recurse has been set
then
                    // all child items within it have to be obtained as well
                    if (ItemExists(path) && recurse)
                    {
                        GetChildItems(path + pathSeparator + table.Name,
recurse);
                    }
                } // foreach (DatabaseTableInfo...
            } // if (PathIsDrive...
            else
            {
                // Get the table name, row number and type of path from the
                // path specified
                string tableName;
                int rowNumber;

                PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

                if (type == PathType.Table)
                {
                    // Obtain all the rows within the table
                    foreach (DatabaseRowInfo row in GetRows(tableName))
                    {
                        WriteItemObject(row, path + pathSeparator +
row.RowNumber,
                                        false);
                    } // foreach (DatabaseRowInfo...
                }
                else if (type == PathType.Row)
                {
                    // In this case the user has directly specified a row,
hence
                    // just give that particular row
                    DatabaseRowInfo row = GetRow(tableName, rowNumber);
                    WriteItemObject(row, path + pathSeparator +
```

```
row.RowNumber,
                                false);
                }
                else
                {
                    // In this case, the path specified is not valid
                    ThrowTerminatingInvalidPathException(path);
                }
            } // else
        } // GetChildItems

        /// <summary>
        /// Return the names of all child items.
        /// </summary>
        /// <param name="path">The root path.</param>
        /// <param name="returnContainers">Not used.</param>
        protected override void GetChildNames(string path,
                                      ReturnContainers returnContainers)
        {
            // If the path represented is a drive, then the child items are
            // tables. get the names of all the tables in the drive.
            if (PathIsDrive(path))
            {
                foreach (DatabaseTableInfo table in GetTables())
                {
                    WriteItemObject(table.Name, path, true);
                } // foreach (DatabaseTableInfo...
            } // if (PathIsDrive...
            else
            {
                // Get type, table name and row number from path specified
                string tableName;
                int rowNumber;

                PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

                if (type == PathType.Table)
                {
                    // Get all the rows in the table and then write out the
                    // row numbers.
                    foreach (DatabaseRowInfo row in GetRows(tableName))
                    {
                        WriteItemObject(row.RowNumber, path, false);
                    } // foreach (DatabaseRowInfo...
                }
                else if (type == PathType.Row)
                {
                    // In this case the user has directly specified a row,
hence
                    // just give that particular row
                    DatabaseRowInfo row = GetRow(tableName, rowNumber);

                    WriteItemObject(row.RowNumber, path, false);
                }
```

```
                else
                {
                    ThrowTerminatingInvalidPathException(path);
                }
            } // else
        } // GetChildNames

        /// <summary>
        /// Determines if the specified path has child items.
        /// </summary>
        /// <param name="path">The path to examine.</param>
        /// <returns>
        /// True if the specified path has child items.
        /// </returns>
        protected override bool HasChildItems(string path)
        {
            if (PathIsDrive(path))
            {
                return true;
            }

            return (ChunkPath(path).Length == 1);
        } // HasChildItems

        /// <summary>
        /// Creates a new item at the specified path.
        /// </summary>
        ///
        /// <param name="path">
        /// The path to the new item.
        /// </param>
        ///
        /// <param name="type">
        /// Type for the object to create. "Table" for creating a new table
and
        /// "Row" for creating a new row in a table.
        /// </param>
        ///
        /// <param name="newItemValue">
        /// Object for creating new instance of a type at the specified path.
For
        /// creating a "Table" the object parameter is ignored and for
creating
        /// a "Row" the object must be of type string which will contain
comma
        /// separated values of the rows to insert.
        /// </param>
        protected override void NewItem(string path, string type,
                                        object newItemValue)
        {
            string tableName;
            int rowNumber;

            PathType pt = GetNamesFromPath(path, out tableName, out
rowNumber);
```

```
            if (pt == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(path);
            }

            // Check if type is either "table" or "row", if not throw an
            // exception
            if (!String.Equals(type, "table",
StringComparison.OrdinalIgnoreCase)
                && !String.Equals(type, "row",
StringComparison.OrdinalIgnoreCase))
            {
                WriteError(new ErrorRecord
                                    (new ArgumentException("Type must be either
a table or row"),
                                        "CannotCreateSpecifiedObject",
                                           ErrorCategory.InvalidArgument,
                                                path
                                     )
                           );

                throw new ArgumentException("This provider can only create
items of type \"table\" or \"row\"");
            }

            // Path type is the type of path of the container. So if a drive
            // is specified, then a table can be created under it and if a
table
            // is specified, then a row can be created under it. For the sake
of
            // completeness, if a row is specified, then if the row specified
by
            // the path does not exist, a new row is created. However, the
row
            // number may not match as the row numbers only get incremented
based
            // on the number of rows

            if (PathIsDrive(path))
            {
                if (String.Equals(type, "table",
StringComparison.OrdinalIgnoreCase))
                {
                    // Execute command using ODBC connection to create a
table
                    try
                    {
                        // create the table using an sql statement
                        string newTableName = newItemValue.ToString();

                        if (!TableNameIsValid(newTableName))
                        {
                            return;
                        }
```

```
                        string sql = "create table " + newTableName
                                                + " (ID INT)";

                        // Create the table using the Odbc connection from
the
                        // drive.
                        AccessDBPSDriveInfo di = this.PSDriveInfo as
AccessDBPSDriveInfo;

                        if (di == null)
                        {
                            return;
                        }
                        OdbcConnection connection = di.Connection;

                        if (ShouldProcess(newTableName, "create"))
                        {
                            OdbcCommand cmd = new OdbcCommand(sql,
connection);
                            cmd.ExecuteScalar();
                        }
                    }
                    catch (Exception ex)
                    {
                        WriteError(new ErrorRecord(ex,
"CannotCreateSpecifiedTable",
                                    ErrorCategory.InvalidOperation, path)
                                    );
                    }
                } // if (String...
                else if (String.Equals(type, "row",
StringComparison.OrdinalIgnoreCase))
                {
                    throw new
                        ArgumentException("A row cannot be created under a
database, specify a path that represents a Table");
                }
            }// if (PathIsDrive...
            else
            {
                if (String.Equals(type, "table",
StringComparison.OrdinalIgnoreCase))
                {
                    if (rowNumber < 0)
                    {
                        throw new
                            ArgumentException("A table cannot be created
within another table, specify a path that represents a database");
                    }
                    else
                    {
                        throw new
                            ArgumentException("A table cannot be created
inside a row, specify a path that represents a database");
                    }
```

```
                } //if (String.Equals....
                // if path specified is a row, create a new row
                else if (String.Equals(type, "row",
StringComparison.OrdinalIgnoreCase))
                {
                    // The user is required to specify the values to be
inserted
                    // into the table in a single string separated by commas
                    string value = newItemValue as string;

                    if (String.IsNullOrEmpty(value))
                    {
                        throw new
                            ArgumentException("Value argument must have comma
separated values of each column in a row");
                    }
                    string[] rowValues = value.Split(',');

                    OdbcDataAdapter da = GetAdapterForTable(tableName);

                    if (da == null)
                    {
                        return;
                    }

                    DataSet ds = GetDataSetForTable(da, tableName);
                    DataTable table = GetDataTable(ds, tableName);

                    if (rowValues.Length != table.Columns.Count)
                    {
                        string message =
                             String.Format(CultureInfo.CurrentCulture,
                                           "The table has {0} columns and
the value specified must have so many comma separated values",
                                               table.Columns.Count);

                        throw new ArgumentException(message);
                    }

                    if (!Force && (rowNumber >=0 && rowNumber <
table.Rows.Count))
                    {
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                                      "The row {0} already
exists. To create a new row specify row number as {1}, or specify path to a
table, or use the -Force parameter",
                                                          rowNumber,
table.Rows.Count);

                        throw new ArgumentException(message);
                    }

                    if (rowNumber > table.Rows.Count)
                    {
```

```
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                                "To create a new row specify row
number as {0}, or specify path to a table",
                                                    table.Rows.Count);

                        throw new ArgumentException(message);
                    }

                    // Create a new row and update the row with the input
                    // provided by the user
                    DataRow row = table.NewRow();
                    for (int i = 0; i < rowValues.Length; i++)
                    {
                        row[i] = rowValues[i];
                    }
                    table.Rows.Add(row);

                    if (ShouldProcess(tableName, "update rows"))
                    {
                        // Update the table from memory back to the data
source
                        da.Update(ds, tableName);
                    }

                }// else if (String...
            }// else ...

        } // NewItem

        /// <summary>
        /// Copies an item at the specified path to the location specified
        /// </summary>
        ///
        /// <param name="path">
        /// Path of the item to copy
        /// </param>
        ///
        /// <param name="copyPath">
        /// Path of the item to copy to
        /// </param>
        ///
        /// <param name="recurse">
        /// Tells the provider to recurse subcontainers when copying
        /// </param>
        ///
        protected override void CopyItem(string path, string copyPath, bool
recurse)
        {
            string tableName, copyTableName;
            int rowNumber, copyRowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);
            PathType copyType = GetNamesFromPath(copyPath, out copyTableName,
```

```
out copyRowNumber);

            if (type == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(path);
            }

            if (type == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(copyPath);
            }

            // Get the table and the table to copy to
            OdbcDataAdapter da = GetAdapterForTable(tableName);
            if (da == null)
            {
                return;
            }

            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);

            OdbcDataAdapter cda = GetAdapterForTable(copyTableName);
            if (cda == null)
            {
                return;
            }

            DataSet cds = GetDataSetForTable(cda, copyTableName);
            DataTable copyTable = GetDataTable(cds, copyTableName);

            // if source represents a table
            if (type == PathType.Table)
            {
                // if copyPath does not represent a table
                if (copyType != PathType.Table)
                {
                    ArgumentException e = new ArgumentException("Table can
only be copied on to another table location");

                    WriteError(new ErrorRecord(e, "PathNotValid",
                        ErrorCategory.InvalidArgument, copyPath));

                    throw e;
                }

                // if table already exists then force parameter should be set
                // to force a copy
                if (!Force && GetTable(copyTableName) != null)
                {
                    throw new ArgumentException("Specified path already
exists");
                }

                for (int i = 0; i < table.Rows.Count; i++)
```

```
                {
                    DataRow row = table.Rows[i];
                    DataRow copyRow = copyTable.NewRow();

                    copyRow.ItemArray = row.ItemArray;
                    copyTable.Rows.Add(copyRow);
                }
            } // if (type == ...
            // if source represents a row
            else
            {
                if (copyType == PathType.Row)
                {
                    if (!Force && (copyRowNumber < copyTable.Rows.Count))
                    {
                        throw new ArgumentException("Specified path already
exists.");
                    }

                    DataRow row = table.Rows[rowNumber];
                    DataRow copyRow = null;

                    if (copyRowNumber < copyTable.Rows.Count)
                    {
                        // copy to an existing row
                        copyRow = copyTable.Rows[copyRowNumber];
                        copyRow.ItemArray = row.ItemArray;
                        copyRow[0] = GetNextID(copyTable);
                    }
                    else if (copyRowNumber == copyTable.Rows.Count)
                    {
                        // copy to the next row in the table that will
                        // be created
                        copyRow = copyTable.NewRow();
                        copyRow.ItemArray = row.ItemArray;
                        copyRow[0] = GetNextID(copyTable);
                        copyTable.Rows.Add(copyRow);
                    }
                    else
                    {
                        // attempting to copy to a nonexistent row or a row
                        // that cannot be created now - throw an exception
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                                "The item cannot be specified
to the copied row. Specify row number as {0}, or specify a path to the
table.",
                                                        table.Rows.Count);

                        throw new ArgumentException(message);
                    }
                }
                else
                {
                    // destination path specified represents a table,
```

```
                    // create a new row and copy the item
                    DataRow copyRow = copyTable.NewRow();
                    copyRow.ItemArray = table.Rows[rowNumber].ItemArray;
                    copyRow[0] = GetNextID(copyTable);
                    copyTable.Rows.Add(copyRow);
                }
            }

            if (ShouldProcess(copyTableName, "CopyItems"))
            {
                cda.Update(cds, copyTableName);
            }

        } //CopyItem

        /// <summary>
        /// Removes (deletes) the item at the specified path
        /// </summary>
        ///
        /// <param name="path">
        /// The path to the item to remove.
        /// </param>
        ///
        /// <param name="recurse">
        /// True if all children in a subtree should be removed, false if
only
        /// the item at the specified path should be removed. Is applicable
        /// only for container (table) items. Its ignored otherwise (even if
        /// specified).
        /// </param>
        ///
        /// <remarks>
        /// There are no elements in this store which are hidden from the
user.
        /// Hence this method will not check for the presence of the Force
        /// parameter
        /// </remarks>
        ///
        protected override void RemoveItem(string path, bool recurse)
        {
            string tableName;
            int rowNumber = 0;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type == PathType.Table)
            {
                // if recurse flag has been specified, delete all the rows as
well
                if (recurse)
                {
                    OdbcDataAdapter da = GetAdapterForTable(tableName);
                    if (da == null)
                    {
```

```
                    return;
                }

                DataSet ds = GetDataSetForTable(da, tableName);
                DataTable table = GetDataTable(ds, tableName);

                for (int i = 0; i < table.Rows.Count; i++)
                {
                    table.Rows[i].Delete();
                }

                if (ShouldProcess(path, "RemoveItem"))
                {
                    da.Update(ds, tableName);
                    RemoveTable(tableName);
                }
            }//if (recurse...
            else
            {
                // Remove the table
                if (ShouldProcess(path, "RemoveItem"))
                {
                    RemoveTable(tableName);
                }
            }
        }
        else if (type == PathType.Row)
        {
            OdbcDataAdapter da = GetAdapterForTable(tableName);
            if (da == null)
            {
                return;
            }

            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);

            table.Rows[rowNumber].Delete();

            if (ShouldProcess(path, "RemoveItem"))
            {
                da.Update(ds, tableName);
            }
        }
        else
        {
            ThrowTerminatingInvalidPathException(path);
        }

    } // RemoveItem

    #endregion Container Overloads

    #region Helper Methods
```

```
        /// <summary>
        /// Checks if a given path is actually a drive name.
        /// </summary>
        /// <param name="path">The path to check.</param>
        /// <returns>
        /// True if the path given represents a drive, false otherwise.
        /// </returns>
        private bool PathIsDrive(string path)
        {
            // Remove the drive name and first path separator.  If the
            // path is reduced to nothing, it is a drive. Also if its
            // just a drive then there wont be any path separators
            if (String.IsNullOrEmpty(
                        path.Replace(this.PSDriveInfo.Root, "")) ||
                String.IsNullOrEmpty(
                        path.Replace(this.PSDriveInfo.Root + pathSeparator,
""))

                )
            {
                return true;
            }
            else
            {
                return false;
            }
        } // PathIsDrive

        /// <summary>
        /// Breaks up the path into individual elements.
        /// </summary>
        /// <param name="path">The path to split.</param>
        /// <returns>An array of path segments.</returns>
        private string[] ChunkPath(string path)
        {
            // Normalize the path before splitting
            string normalPath = NormalizePath(path);

            // Return the path with the drive name and first path
            // separator character removed, split by the path separator.
            string pathNoDrive = normalPath.Replace(this.PSDriveInfo.Root
                                        + pathSeparator, "");

            return pathNoDrive.Split(pathSeparator.ToCharArray());
        } // ChunkPath

        /// <summary>
        /// Adapts the path, making sure the correct path separator
        /// character is used.
        /// </summary>
        /// <param name="path"></param>
        /// <returns></returns>
        private string NormalizePath(string path)
        {
            string result = path;
```

```
            if (!String.IsNullOrEmpty(path))
            {
                result = path.Replace("/", pathSeparator);
            }

            return result;
        } // NormalizePath

        /// <summary>
        /// Chunks the path and returns the table name and the row number
        /// from the path
        /// </summary>
        /// <param name="path">Path to chunk and obtain information</param>
        /// <param name="tableName">Name of the table as represented in the
        /// path</param>
        /// <param name="rowNumber">Row number obtained from the path</param>
        /// <returns>what the path represents</returns>
        private PathType GetNamesFromPath(string path, out string tableName,
out int rowNumber)
        {
            PathType retVal = PathType.Invalid;
            rowNumber = -1;
            tableName = null;

            // Check if the path specified is a drive
            if (PathIsDrive(path))
            {
                return PathType.Database;
            }

            // chunk the path into parts
            string[] pathChunks = ChunkPath(path);

            switch (pathChunks.Length)
            {
                case 1:
                    {
                        string name = pathChunks[0];

                        if (TableNameIsValid(name))
                        {
                            tableName = name;
                            retVal = PathType.Table;
                        }
                    }
                    break;

                case 2:
                    {
                        string name = pathChunks[0];

                        if (TableNameIsValid(name))
                        {
                            tableName = name;
```

```
                        }

                        int number = SafeConvertRowNumber(pathChunks[1]);

                        if (number >= 0)
                        {
                            rowNumber = number;
                            retVal = PathType.Row;
                        }
                        else
                        {
                            WriteError(new ErrorRecord(
                                new ArgumentException("Row number is not
valid"),
                                "RowNumberNotValid",
                                ErrorCategory.InvalidArgument,
                                path));
                        }
                    }
                    break;

                default:
                    {
                        WriteError(new ErrorRecord(
                            new ArgumentException("The path supplied has too
many segments"),
                            "PathNotValid",
                            ErrorCategory.InvalidArgument,
                            path));
                    }
                    break;
            } // switch(pathChunks...

            return retVal;
        } // GetNamesFromPath

        /// <summary>
        /// Throws an argument exception stating that the specified path does
        /// not represent either a table or a row
        /// </summary>
        /// <param name="path">path which is invalid</param>
        private void ThrowTerminatingInvalidPathException(string path)
        {
            StringBuilder message = new StringBuilder("Path must represent
either a table or a row :");
            message.Append(path);

            throw new ArgumentException(message.ToString());
        }

        /// <summary>
        /// Retrieve the list of tables from the database.
        /// </summary>
        /// <returns>
        /// Collection of DatabaseTableInfo objects, each object representing
```

```
        /// information about one database table
        /// </returns>
        private Collection<DatabaseTableInfo> GetTables()
        {
            Collection<DatabaseTableInfo> results =
                    new Collection<DatabaseTableInfo>();

            // using ODBC connection to the database and get the schema of
tables
            AccessDBPSDriveInfo di = this.PSDriveInfo as AccessDBPSDriveInfo;

            if (di == null)
            {
                return null;
            }

            OdbcConnection connection = di.Connection;
            DataTable dt = connection.GetSchema("Tables");
            int count;

            // iterate through all rows in the schema and create
DatabaseTableInfo
            // objects which represents a table
            foreach (DataRow dr in dt.Rows)
            {
                String tableName = dr["TABLE_NAME"] as String;
                DataColumnCollection columns = null;

                // find the number of rows in the table
                try
                {
                    String cmd = "Select count(*) from \"" + tableName +
"\"";
                    OdbcCommand command = new OdbcCommand(cmd, connection);

                    count = (Int32)command.ExecuteScalar();
                }
                catch
                {
                    count = 0;
                }

                // create DatabaseTableInfo object representing the table
                DatabaseTableInfo table =
                        new DatabaseTableInfo(dr, tableName, count, columns);

                results.Add(table);
            } // foreach (DataRow...

            return results;
        } // GetTables

        /// <summary>
        /// Return row information from a specified table.
        /// </summary>
```

```
        /// <param name="tableName">The name of the database table from
        /// which to retrieve rows.</param>
        /// <returns>Collection of row information objects.</returns>
        private Collection<DatabaseRowInfo> GetRows(string tableName)
        {
            Collection<DatabaseRowInfo> results =
                        new Collection<DatabaseRowInfo>();

            // Obtain rows in the table and add it to the collection
            try
            {
                OdbcDataAdapter da = GetAdapterForTable(tableName);

                if (da == null)
                {
                    return null;
                }

                DataSet ds = GetDataSetForTable(da, tableName);
                DataTable table = GetDataTable(ds, tableName);

                int i = 0;
                foreach (DataRow row in table.Rows)
                {
                    results.Add(new DatabaseRowInfo(row,
i.ToString(CultureInfo.CurrentCulture)));
                    i++;
                } // foreach (DataRow...
            }
            catch (Exception e)
            {
                WriteError(new ErrorRecord(e, "CannotAccessSpecifiedRows",
                    ErrorCategory.InvalidOperation, tableName));
            }

            return results;

        } // GetRows

        /// <summary>
        /// Retrieve information about a single table.
        /// </summary>
        /// <param name="tableName">The table for which to retrieve
        /// data.</param>
        /// <returns>Table information.</returns>
        private DatabaseTableInfo GetTable(string tableName)
        {
            foreach (DatabaseTableInfo table in GetTables())
            {
                if (String.Equals(tableName, table.Name,
StringComparison.OrdinalIgnoreCase))
                {
                    return table;
                }
            }
```

```
            return null;
        } // GetTable

        /// <summary>
        /// Removes the specified table from the database
        /// </summary>
        /// <param name="tableName">Name of the table to remove</param>
        private void RemoveTable(string tableName)
        {
            // validate if tablename is valid and if table is present
            if (String.IsNullOrEmpty(tableName) ||
!TableNameIsValid(tableName) || !TableIsPresent(tableName))
            {
                return;
            }

            // Execute command using ODBC connection to remove a table
            try
            {
                // delete the table using an sql statement
                string sql = "drop table " + tableName;

                AccessDBPSDriveInfo di = this.PSDriveInfo as
AccessDBPSDriveInfo;

                if (di == null)
                {
                    return;
                }
                OdbcConnection connection = di.Connection;

                OdbcCommand cmd = new OdbcCommand(sql, connection);
                cmd.ExecuteScalar();
            }
            catch (Exception ex)
            {
                WriteError(new ErrorRecord(ex, "CannotRemoveSpecifiedTable",
                          ErrorCategory.InvalidOperation, null)
                          );
            }

        } // RemoveTable

        /// <summary>
        /// Obtain a data adapter for the specified Table
        /// </summary>
        /// <param name="tableName">Name of the table to obtain the
        /// adapter for</param>
        /// <returns>Adapter object for the specified table</returns>
        /// <remarks>An adapter serves as a bridge between a DataSet (in
memory
        /// representation of table) and the data source</remarks>
        private OdbcDataAdapter GetAdapterForTable(string tableName)
        {
```

```
            OdbcDataAdapter da = null;
            AccessDBPSDriveInfo di = this.PSDriveInfo as AccessDBPSDriveInfo;

            if (di == null || !TableNameIsValid(tableName)
||!TableIsPresent(tableName))
            {
                return null;
            }

            OdbcConnection connection = di.Connection;

            try
            {
                // Create a odbc data adpater. This can be sued to update the
                // data source with the records that will be created here
                // using data sets
                string sql = "Select * from " + tableName;
                da = new OdbcDataAdapter(new OdbcCommand(sql, connection));

                // Create a odbc command builder object. This will create sql
                // commands automatically for a single table, thus
                // eliminating the need to create new sql statements for
                // every operation to be done.
                OdbcCommandBuilder cmd = new OdbcCommandBuilder(da);

                // Set the delete cmd for the table here
                sql = "Delete from " + tableName + " where ID = ?";
                da.DeleteCommand = new OdbcCommand(sql, connection);

                // Specify a DeleteCommand parameter based on the "ID"
                // column
                da.DeleteCommand.Parameters.Add(new OdbcParameter());
                da.DeleteCommand.Parameters[0].SourceColumn = "ID";

                // Create an InsertCommand based on the sql string
                // Insert into "tablename" values (?,?,?)" where
                // ? represents a column in the table. Note that
                // the number of ? will be equal to the number of
                // columnds
                DataSet ds = new DataSet();

                da.FillSchema(ds, SchemaType.Source);
                ds.Locale = CultureInfo.InvariantCulture;

                sql = "Insert into " + tableName + " values ( ";
                for (int i = 0; i < ds.Tables["Table"].Columns.Count; i++)
                {
                    sql += "?, ";
                }
                sql = sql.Substring(0, sql.Length - 2);
                sql += ")";
                da.InsertCommand = new OdbcCommand(sql, connection);

                // Create parameters for the InsertCommand based on the
                // captions of each column
```

```
                for (int i = 0; i < ds.Tables["Table"].Columns.Count; i++)
                {
                    da.InsertCommand.Parameters.Add(new OdbcParameter());
                    da.InsertCommand.Parameters[i].SourceColumn =
                                    ds.Tables["Table"].Columns[i].Caption;

                }

                // Open the connection if its not already open
                if (connection.State != ConnectionState.Open)
                {
                    connection.Open();
                }
            }
            catch (Exception e)
            {
                WriteError(new ErrorRecord(e, "CannotAccessSpecifiedTable",
                  ErrorCategory.InvalidOperation, tableName));
            }

            return da;
        } // GetAdapterForTable

        /// <summary>
        /// Gets the DataSet (in memory representation) for the table
        /// for the specified adapter
        /// </summary>
        /// <param name="adapter">Adapter to be used for obtaining
        /// the table</param>
        /// <param name="tableName">Name of the table for which a
        /// DataSet is required</param>
        /// <returns>The DataSet with the filled in schema</returns>
        private DataSet GetDataSetForTable(OdbcDataAdapter adapter, string
tableName)
        {
            Debug.Assert(adapter != null);

            // Create a dataset object which will provide an in-memory
            // representation of the data being worked upon in the
            // data source.
            DataSet ds = new DataSet();

            // Create a table named "Table" which will contain the same
            // schema as in the data source.
            //adapter.FillSchema(ds, SchemaType.Source);
            adapter.Fill(ds, tableName);
            ds.Locale = CultureInfo.InvariantCulture;

            return ds;
        } //GetDataSetForTable

        /// <summary>
        /// Get the DataTable object which can be used to operate on
        /// for the specified table in the data source
        /// </summary>
```

```
        /// <param name="ds">DataSet object which contains the tables
        /// schema</param>
        /// <param name="tableName">Name of the table</param>
        /// <returns>Corresponding DataTable object representing
        /// the table</returns>
        ///
        private DataTable GetDataTable(DataSet ds, string tableName)
        {
            Debug.Assert(ds != null);
            Debug.Assert(tableName != null);

            DataTable table = ds.Tables[tableName];
            table.Locale = CultureInfo.InvariantCulture;

            return table;
        } // GetDataTable

        /// <summary>
        /// Retrieves a single row from the named table.
        /// </summary>
        /// <param name="tableName">The table that contains the
        /// numbered row.</param>
        /// <param name="row">The index of the row to return.</param>
        /// <returns>The specified table row.</returns>
        private DatabaseRowInfo GetRow(string tableName, int row)
        {
            Collection<DatabaseRowInfo> di = GetRows(tableName);

            // if the row is invalid write an appropriate error else return
the
            // corresponding row information
            if (row < di.Count && row >= 0)
            {
                return di[row];
            }
            else
            {
                WriteError(new ErrorRecord(
                   new ItemNotFoundException(),
                   "RowNotFound",
                   ErrorCategory.ObjectNotFound,
                   row.ToString(CultureInfo.CurrentCulture))
                );
            }

            return null;
        } // GetRow

        /// <summary>
        /// Method to safely convert a string representation of a row number
        /// into its Int32 equivalent
        /// </summary>
        /// <param name="rowNumberAsStr">String representation of the row
        /// number</param>
        /// <remarks>If there is an exception, -1 is returned</remarks>
```

```
        private int SafeConvertRowNumber(string rowNumberAsStr)
        {
            int rowNumber = -1;
            try
            {
                rowNumber = Convert.ToInt32(rowNumberAsStr,
CultureInfo.CurrentCulture);
            }
            catch (FormatException fe)
            {
                WriteError(new ErrorRecord(fe, "RowStringFormatNotValid",
                    ErrorCategory.InvalidData, rowNumberAsStr));
            }
            catch (OverflowException oe)
            {
                WriteError(new ErrorRecord(oe,
"RowStringConversionToNumberFailed",
                    ErrorCategory.InvalidData, rowNumberAsStr));
            }

            return rowNumber;
        } // SafeConvertRowNumber

        /// <summary>
        /// Check if a table name is valid
        /// </summary>
        /// <param name="tableName">Table name to validate</param>
        /// <remarks>Helps to check for SQL injection attacks</remarks>
        private bool TableNameIsValid(string tableName)
        {
            Regex exp = new Regex(pattern, RegexOptions.Compiled |
RegexOptions.IgnoreCase);

            if (exp.IsMatch(tableName))
            {
                return true;
            }
            WriteError(new ErrorRecord(
                new ArgumentException("Table name not valid"),
"TableNameNotValid",
                     ErrorCategory.InvalidArgument, tableName));
            return false;
        } // TableNameIsValid

        /// <summary>
        /// Checks to see if the specified table is present in the
        /// database
        /// </summary>
        /// <param name="tableName">Name of the table to check</param>
        /// <returns>true, if table is present, false otherwise</returns>
        private bool TableIsPresent(string tableName)
        {
            // using ODBC connection to the database and get the schema of
tables
            AccessDBPSDriveInfo di = this.PSDriveInfo as AccessDBPSDriveInfo;
```

```
            if (di == null)
            {
                return false;
            }

            OdbcConnection connection = di.Connection;
            DataTable dt = connection.GetSchema("Tables");

            // check if the specified tableName is available
            // in the list of tables present in the database
            foreach (DataRow dr in dt.Rows)
            {
                string name = dr["TABLE_NAME"] as string;
                if (name.Equals(tableName,
StringComparison.OrdinalIgnoreCase))
                {
                    return true;
                }
            }

            WriteError(new ErrorRecord(
                new ArgumentException("Specified Table is not present in
database"), "TableNotAvailable",
                     ErrorCategory.InvalidArgument, tableName));

            return false;
        }// TableIsPresent

        /// <summary>
        /// Gets the next available ID in the table
        /// </summary>
        /// <param name="table">DataTable object representing the table to
        /// search for ID</param>
        /// <returns>next available id</returns>
        private int GetNextID(DataTable table)
        {
            int big = 0;
            int id = 0;

            for (int i = 0; i < table.Rows.Count; i++)
            {
                DataRow row = table.Rows[i];

                object o = row["ID"];

                if (o.GetType().Name.Equals("Int16"))
                {
                    id = (int)(short)o;
                }
                else
                {
                    id = (int)o;
                }

                if (big < id)
```

```
                {
                    big = id;
                }
            }

            big++;
            return big;
        }

        #endregion Helper Methods

        #region Private Properties

        private string pathSeparator = "\\";
        private static string pattern = @"^[a-z]+[0-9]*_*$";

        private enum PathType { Database, Table, Row, Invalid };

        #endregion Private Properties
    }

    #endregion AccessDBProvider

    #region Helper Classes

    #region AccessDBPSDriveInfo

    /// <summary>
    /// Any state associated with the drive should be held here.
    /// In this case, it's the connection to the database.
    /// </summary>
    internal class AccessDBPSDriveInfo : PSDriveInfo
    {
        private OdbcConnection connection;

        /// <summary>
        /// ODBC connection information.
        /// </summary>
        public OdbcConnection Connection
        {
            get { return connection; }
            set { connection = value; }
        }

        /// <summary>
        /// Constructor that takes one argument
        /// </summary>
        /// <param name="driveInfo">Drive provided by this provider</param>
        public AccessDBPSDriveInfo(PSDriveInfo driveInfo)
            : base(driveInfo)
        { }

    } // class AccessDBPSDriveInfo

    #endregion AccessDBPSDriveInfo
```

```
#region DatabaseTableInfo

/// <summary>
/// Contains information specific to the database table.
/// Similar to the DirectoryInfo class.
/// </summary>
public class DatabaseTableInfo
{
    /// <summary>
    /// Row from the "tables" schema
    /// </summary>
    public DataRow Data
    {
        get
        {
            return data;
        }
        set
        {
            data = value;
        }
    }
    private DataRow data;

    /// <summary>
    /// The table name.
    /// </summary>
    public string Name
    {
        get
        {
            return name;
        }
        set
        {
            name = value;
        }
    }
    private String name;

    /// <summary>
    /// The number of rows in the table.
    /// </summary>
    public int RowCount
    {
        get
        {
            return rowCount;
        }
        set
        {
            rowCount = value;
        }
    }
```

```
        private int rowCount;

        /// <summary>
        /// The column definitions for the table.
        /// </summary>
        public DataColumnCollection Columns
        {
            get
            {
                return columns;
            }
            set
            {
                columns = value;
            }
        }
        private DataColumnCollection columns;

        /// <summary>
        /// Constructor.
        /// </summary>
        /// <param name="row">The row definition.</param>
        /// <param name="name">The table name.</param>
        /// <param name="rowCount">The number of rows in the table.</param>
        /// <param name="columns">Information on the column tables.</param>
        public DatabaseTableInfo(DataRow row, string name, int rowCount,
                                 DataColumnCollection columns)
        {
            Name = name;
            Data = row;
            RowCount = rowCount;
            Columns = columns;
        } // DatabaseTableInfo
    } // class DatabaseTableInfo

    #endregion DatabaseTableInfo

    #region DatabaseRowInfo

    /// <summary>
    /// Contains information specific to an individual table row.
    /// Analogous to the FileInfo class.
    /// </summary>
    public class DatabaseRowInfo
    {
        /// <summary>
        /// Row data information.
        /// </summary>
        public DataRow Data
        {
            get
            {
                return data;
            }
            set
```

```
            {
                data = value;
            }
        }
        private DataRow data;

        /// <summary>
        /// The row index.
        /// </summary>
        public string RowNumber
        {
            get
            {
                return rowNumber;
            }
            set
            {
                rowNumber = value;
            }
        }
        private string rowNumber;

        /// <summary>
        /// Constructor.
        /// </summary>
        /// <param name="row">The row information.</param>
        /// <param name="name">The row index.</param>
        public DatabaseRowInfo(DataRow row, string name)
        {
            RowNumber = name;
            Data = row;
        } // DatabaseRowInfo
    } // class DatabaseRowInfo

    #endregion DatabaseRowInfo

    #endregion Helper Classes
}
```

See Also

System.Management.Automation.Provider.Itemcmdletprovider

System.Management.Automation.Provider.Containercmdletprovider

System.Management.Automation.Provider.Navigationcmdletprovider

Designing Your Windows PowerShell Provider

AccessDBProviderSample05

Article • 09/17/2021

This sample shows how to overwrite container methods to support calls to the `Move-Item` and `Join-Path` cmdlets. These methods should be implemented when the user needs to move items within a container and if the data store contains nested containers. The provider class in this sample derives from the System.Management.Automation.Provider.Navigationcmdletprovider class.

Demonstrates

> **ⓘ Important**
>
> Your provider class will most likely derive from one of the following classes and possibly implement other provider interfaces:
>
> - **System.Management.Automation.Provider.Itemcmdletprovider** class. See **AccessDBProviderSample03**.
> - **System.Management.Automation.Provider.Containercmdletprovider** class. See **AccessDBProviderSample04**.
> - **System.Management.Automation.Provider.Navigationcmdletprovider** class.
>
> For more information about choosing which provider class to derive from based on provider features, see **Designing Your Windows PowerShell Provider**.

This sample demonstrates the following:

- Declaring the `CmdletProvider` attribute.
- Defining a provider class that derives from the System.Management.Automation.Provider.Navigationcmdletprovider class.
- Overwriting the System.Management.Automation.Provider.Navigationcmdletprovider.Moveitem* method to change the behavior of the `Move-Item` cmdlet, allowing the user to move items from one location to another. (This sample does not show how to add dynamic parameters to the `Move-Item` cmdlet.)
- Overwriting the System.Management.Automation.Provider.Navigationcmdletprovider.Makepath*

method to change the behavior of the `Join-Path` cmdlet.

- Overwriting the System.Management.Automation.Provider.Navigationcmdletprovider.Isitemcontainer* method.
- Overwriting the System.Management.Automation.Provider.Navigationcmdletprovider.Getchildname* method.
- Overwriting the System.Management.Automation.Provider.Navigationcmdletprovider.Getparentpath* method.
- Overwriting the System.Management.Automation.Provider.Navigationcmdletprovider.Normalizerelativepath* method.

Example

This sample shows how to overwrite the methods needed to move items in a Microsoft Access data base.

C#

```
using System;
using System.IO;
using System.Data;
using System.Data.Odbc;
using System.Diagnostics;
using System.Collections.ObjectModel;
using System.Text;
using System.Text.RegularExpressions;
using System.Management.Automation;
using System.Management.Automation.Provider;
using System.ComponentModel;
using System.Globalization;

namespace Microsoft.Samples.PowerShell.Providers
{
   #region AccessDBProvider

    /// <summary>
   /// This example implements the navigation methods.
   /// </summary>
   [CmdletProvider("AccessDB", ProviderCapabilities.None)]
   public class AccessDBProvider : NavigationCmdletProvider
   {
```

```
      #region Drive Manipulation

       /// <summary>
       /// Create a new drive.  Create a connection to the database file and
set
       /// the Connection property in the PSDriveInfo.
       /// </summary>
       /// <param name="drive">
       /// Information describing the drive to add.
       /// </param>
       /// <returns>The added drive.</returns>
       protected override PSDriveInfo NewDrive(PSDriveInfo drive)
       {
           // check if drive object is null
           if (drive == null)
           {
               WriteError(new ErrorRecord(
                   new ArgumentNullException("drive"),
                   "NullDrive",
                   ErrorCategory.InvalidArgument,
                   null)
               );

               return null;
           }

           // check if drive root is not null or empty
           // and if its an existing file
           if (String.IsNullOrEmpty(drive.Root) || (File.Exists(drive.Root)
== false))
           {
               WriteError(new ErrorRecord(
                   new ArgumentException("drive.Root"),
                   "NoRoot",
                   ErrorCategory.InvalidArgument,
                   drive)
               );

               return null;
           }


           // create a new drive and create an ODBC connection to the new
drive
           AccessDBPSDriveInfo accessDBPSDriveInfo = new
AccessDBPSDriveInfo(drive);

           OdbcConnectionStringBuilder builder = new
OdbcConnectionStringBuilder();

           builder.Driver = "Microsoft Access Driver (*.mdb)";
           builder.Add("DBQ", drive.Root);

           OdbcConnection conn = new
```

```
OdbcConnection(builder.ConnectionString);
            conn.Open();
            accessDBPSDriveInfo.Connection = conn;

            return accessDBPSDriveInfo;
        } // NewDrive

        /// <summary>
        /// Removes a drive from the provider.
        /// </summary>
        /// <param name="drive">The drive to remove.</param>
        /// <returns>The drive removed.</returns>
        protected override PSDriveInfo RemoveDrive(PSDriveInfo drive)
        {
            // check if drive object is null
            if (drive == null)
            {
                WriteError(new ErrorRecord(
                    new ArgumentNullException("drive"),
                    "NullDrive",
                    ErrorCategory.InvalidArgument,
                    drive)
                );

                return null;
            }

            // close ODBC connection to the drive
            AccessDBPSDriveInfo accessDBPSDriveInfo = drive as
AccessDBPSDriveInfo;

            if (accessDBPSDriveInfo == null)
            {
                return null;
            }
            accessDBPSDriveInfo.Connection.Close();

            return accessDBPSDriveInfo;
        } // RemoveDrive

        #endregion Drive Manipulation

       #region Item Methods

        /// <summary>
        /// Retrieves an item using the specified path.
        /// </summary>
        /// <param name="path">The path to the item to return.</param>
        protected override void GetItem(string path)
        {
            // check if the path represented is a drive
            if (PathIsDrive(path))
            {
                WriteItemObject(this.PSDriveInfo, path, true);
                return;
```

```
            }// if (PathIsDrive...

            // Get table name and row information from the path and do
            // necessary actions
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type == PathType.Table)
            {
                DatabaseTableInfo table = GetTable(tableName);
                WriteItemObject(table, path, true);
            }
            else if (type == PathType.Row)
            {
                DatabaseRowInfo row = GetRow(tableName, rowNumber);
                WriteItemObject(row, path, false);
            }
            else
            {
                ThrowTerminatingInvalidPathException(path);
            }

        } // GetItem

        /// <summary>
        /// Set the content of a row of data specified by the supplied path
        /// parameter.
        /// </summary>
        /// <param name="path">Specifies the path to the row whose columns
        /// will be updated.</param>
        /// <param name="values">Comma separated string of values</param>
        protected override void SetItem(string path, object values)
        {
            // Get type, table name and row number from the path specified
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type != PathType.Row)
            {
                WriteError(new ErrorRecord(new NotSupportedException(
                      "SetNotSupported"), "",
                   ErrorCategory.InvalidOperation, path));

                return;
            }

            // Get in-memory representation of table
            OdbcDataAdapter da = GetAdapterForTable(tableName);
```

```
            if (da == null)
            {
                return;
            }
            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);

            if (rowNumber >= table.Rows.Count)
            {
                // The specified row number has to be available. If not
                // NewItem has to be used to add a new row
                throw new ArgumentException("Row specified is not
available");
            } // if (rowNum...

            string[] colValues = (values as string).Split(',');

            // set the specified row
            DataRow row = table.Rows[rowNumber];

            for (int i = 0; i < colValues.Length; i++)
            {
                row[i] = colValues[i];
            }

            // Update the table
            if (ShouldProcess(path, "SetItem"))
            {
                da.Update(ds, tableName);
            }

        } // SetItem

        /// <summary>
        /// Test to see if the specified item exists.
        /// </summary>
        /// <param name="path">The path to the item to verify.</param>
        /// <returns>True if the item is found.</returns>
        protected override bool ItemExists(string path)
        {
            // check if the path represented is a drive
            if (PathIsDrive(path))
            {
                return true;
            }

            // Obtain type, table name and row number from path
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            DatabaseTableInfo table = GetTable(tableName);
```

```
            if (type == PathType.Table)
            {
                // if specified path represents a table then
DatabaseTableInfo
                // object for the same should exist
                if (table != null)
                {
                    return true;
                }
            }
            else if (type == PathType.Row)
            {
                // if specified path represents a row then DatabaseTableInfo
should
                // exist for the table and then specified row number must be
within
                // the maximum row count in the table
                if (table != null && rowNumber < table.RowCount)
                {
                    return true;
                }
            }

            return false;

        } // ItemExists

        /// <summary>
        /// Test to see if the specified path is syntactically valid.
        /// </summary>
        /// <param name="path">The path to validate.</param>
        /// <returns>True if the specified path is valid.</returns>
        protected override bool IsValidPath(string path)
        {
            bool result = true;

            // check if the path is null or empty
            if (String.IsNullOrEmpty(path))
            {
                result = false;
            }

            // convert all separators in the path to a uniform one
            path = NormalizePath(path);

            // split the path into individual chunks
            string[] pathChunks = path.Split(pathSeparator.ToCharArray());

            foreach (string pathChunk in pathChunks)
            {
                if (pathChunk.Length == 0)
                {
                    result = false;
                }
            }
```

```
            return result;
        } // IsValidPath

        #endregion Item Overloads

       #region Container Overloads

        /// <summary>
        /// Return either the tables in the database or the datarows
        /// </summary>
        /// <param name="path">The path to the parent</param>
        /// <param name="recurse">True to return all child items recursively.
        /// </param>
        protected override void GetChildItems(string path, bool recurse)
        {
            // If path represented is a drive then the children in the path
are
            // tables. Hence all tables in the drive represented will have to
be
            // returned
            if (PathIsDrive(path))
            {
                foreach (DatabaseTableInfo table in GetTables())
                {
                    WriteItemObject(table, path, true);

                    // if the specified item exists and recurse has been set
then
                    // all child items within it have to be obtained as well
                    if (ItemExists(path) && recurse)
                    {
                        GetChildItems(path + pathSeparator + table.Name,
recurse);
                    }
                } // foreach (DatabaseTableInfo...
            } // if (PathIsDrive...
            else
            {
                // Get the table name, row number and type of path from the
                // path specified
                string tableName;
                int rowNumber;

                PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

                if (type == PathType.Table)
                {
                    // Obtain all the rows within the table
                    foreach (DatabaseRowInfo row in GetRows(tableName))
                    {
                        WriteItemObject(row, path + pathSeparator +
row.RowNumber,
                                        false);
                    } // foreach (DatabaseRowInfo...
```

```
                }
                else if (type == PathType.Row)
                {
                    // In this case the user has directly specified a row,
hence
                    // just give that particular row
                    DatabaseRowInfo row = GetRow(tableName, rowNumber);
                    WriteItemObject(row, path + pathSeparator +
row.RowNumber,
                                    false);
                }
                else
                {
                    // In this case, the path specified is not valid
                    ThrowTerminatingInvalidPathException(path);
                }
            } // else
        } // GetChildItems

        /// <summary>
        /// Return the names of all child items.
        /// </summary>
        /// <param name="path">The root path.</param>
        /// <param name="returnContainers">Not used.</param>
        protected override void GetChildNames(string path,
                                      ReturnContainers returnContainers)
        {
            // If the path represented is a drive, then the child items are
            // tables. get the names of all the tables in the drive.
            if (PathIsDrive(path))
            {
                foreach (DatabaseTableInfo table in GetTables())
                {
                    WriteItemObject(table.Name, path, true);
                } // foreach (DatabaseTableInfo...
            } // if (PathIsDrive...
            else
            {
                // Get type, table name and row number from path specified
                string tableName;
                int rowNumber;

                PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

                if (type == PathType.Table)
                {
                    // Get all the rows in the table and then write out the
                    // row numbers.
                    foreach (DatabaseRowInfo row in GetRows(tableName))
                    {
                        WriteItemObject(row.RowNumber, path, false);
                    } // foreach (DatabaseRowInfo...
                }
                else if (type == PathType.Row)
```

```
                {
                    // In this case the user has directly specified a row,
hence
                    // just give that particular row
                    DatabaseRowInfo row = GetRow(tableName, rowNumber);

                    WriteItemObject(row.RowNumber, path, false);
                }
                else
                {
                    ThrowTerminatingInvalidPathException(path);
                }
            } // else
        } // GetChildNames

        /// <summary>
        /// Determines if the specified path has child items.
        /// </summary>
        /// <param name="path">The path to examine.</param>
        /// <returns>
        /// True if the specified path has child items.
        /// </returns>
        protected override bool HasChildItems(string path)
        {
            if (PathIsDrive(path))
            {
                return true;
            }

            return (ChunkPath(path).Length == 1);
        } // HasChildItems

        /// <summary>
        /// Creates a new item at the specified path.
        /// </summary>
        ///
        /// <param name="path">
        /// The path to the new item.
        /// </param>
        ///
        /// <param name="type">
        /// Type for the object to create. "Table" for creating a new table
and
        /// "Row" for creating a new row in a table.
        /// </param>
        ///
        /// <param name="newItemValue">
        /// Object for creating new instance of a type at the specified path.
For
        /// creating a "Table" the object parameter is ignored and for
creating
        /// a "Row" the object must be of type string which will contain
comma
        /// separated values of the rows to insert.
        /// </param>
```

```
        protected override void NewItem(string path, string type,
                                        object newItemValue)
        {
            string tableName;
            int rowNumber;

            PathType pt = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (pt == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(path);
            }

            // Check if type is either "table" or "row", if not throw an
            // exception
            if (!String.Equals(type, "table",
StringComparison.OrdinalIgnoreCase)
                && !String.Equals(type, "row",
StringComparison.OrdinalIgnoreCase))
            {
                WriteError(new ErrorRecord
                                    (new ArgumentException("Type must be either
a table or row"),
                                        "CannotCreateSpecifiedObject",
                                           ErrorCategory.InvalidArgument,
                                                path
                                     )
                           );

                throw new ArgumentException("This provider can only create
items of type \"table\" or \"row\"");
            }

            // Path type is the type of path of the container. So if a drive
            // is specified, then a table can be created under it and if a
table
            // is specified, then a row can be created under it. For the sake
of
            // completeness, if a row is specified, then if the row specified
by
            // the path does not exist, a new row is created. However, the
row
            // number may not match as the row numbers only get incremented
based
            // on the number of rows

            if (PathIsDrive(path))
            {
                if (String.Equals(type, "table",
StringComparison.OrdinalIgnoreCase))
                {
                    // Execute command using ODBC connection to create a
table
                    try
```

```
                    {
                        // create the table using an sql statement
                        string newTableName = newItemValue.ToString();
                        string sql = "create table " + newTableName
                                                + " (ID INT)";

                        // Create the table using the Odbc connection from
the
                        // drive.
                        AccessDBPSDriveInfo di = this.PSDriveInfo as
AccessDBPSDriveInfo;

                        if (di == null)
                        {
                            return;
                        }
                        OdbcConnection connection = di.Connection;

                        if (ShouldProcess(newTableName, "create"))
                        {
                            OdbcCommand cmd = new OdbcCommand(sql,
connection);

                            cmd.ExecuteScalar();
                        }
                    }
                    catch (Exception ex)
                    {
                        WriteError(new ErrorRecord(ex,
"CannotCreateSpecifiedTable",
                                    ErrorCategory.InvalidOperation, path)
                                    );
                    }
                } // if (String...
                else if (String.Equals(type, "row",
StringComparison.OrdinalIgnoreCase))
                {
                    throw new
                        ArgumentException("A row cannot be created under a
database, specify a path that represents a Table");
                }
            }// if (PathIsDrive...
            else
            {
                if (String.Equals(type, "table",
StringComparison.OrdinalIgnoreCase))
                {
                    if (rowNumber < 0)
                    {
                        throw new
                            ArgumentException("A table cannot be created
within another table, specify a path that represents a database");
                    }
                    else
                    {
                        throw new
```

```
                            ArgumentException("A table cannot be created
inside a row, specify a path that represents a database");
                    }
                } //if (String.Equals....
                // if path specified is a row, create a new row
                else if (String.Equals(type, "row",
StringComparison.OrdinalIgnoreCase))
                {
                    // The user is required to specify the values to be
inserted
                    // into the table in a single string separated by commas
                    string value = newItemValue as string;

                    if (String.IsNullOrEmpty(value))
                    {
                        throw new
                            ArgumentException("Value argument must have comma
separated values of each column in a row");
                    }
                    string[] rowValues = value.Split(',');

                    OdbcDataAdapter da = GetAdapterForTable(tableName);

                    if (da == null)
                    {
                        return;
                    }

                    DataSet ds = GetDataSetForTable(da, tableName);
                    DataTable table = GetDataTable(ds, tableName);

                    if (rowValues.Length != table.Columns.Count)
                    {
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                                "The table has {0} columns and
the value specified must have so many comma separated values",
                                                    table.Columns.Count);

                        throw new ArgumentException(message);
                    }

                    if (!Force && (rowNumber >= 0 && rowNumber <
table.Rows.Count))
                    {
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                                "The row {0} already exists. To
create a new row specify row number as {1}, or specify path to a table, or
use the -Force parameter",
                                                    rowNumber,
table.Rows.Count);

                        throw new ArgumentException(message);
                    }
```

```
                    if (rowNumber > table.Rows.Count)
                    {
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                                "To create a new row specify row
number as {0}, or specify path to a table",
                                                    table.Rows.Count);

                        throw new ArgumentException(message);
                    }

                    // Create a new row and update the row with the input
                    // provided by the user
                    DataRow row = table.NewRow();
                    for (int i = 0; i < rowValues.Length; i++)
                    {
                        row[i] = rowValues[i];
                    }
                    table.Rows.Add(row);

                    if (ShouldProcess(tableName, "update rows"))
                    {
                        // Update the table from memory back to the data
source
                        da.Update(ds, tableName);
                    }

                }// else if (String...
            }// else ...

        } // NewItem

        /// <summary>
        /// Copies an item at the specified path to the location specified
        /// </summary>
        ///
        /// <param name="path">
        /// Path of the item to copy
        /// </param>
        ///
        /// <param name="copyPath">
        /// Path of the item to copy to
        /// </param>
        ///
        /// <param name="recurse">
        /// Tells the provider to recurse subcontainers when copying
        /// </param>
        ///
        protected override void CopyItem(string path, string copyPath, bool
recurse)
        {
            string tableName, copyTableName;
            int rowNumber, copyRowNumber;
```

```
            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);
            PathType copyType = GetNamesFromPath(copyPath, out copyTableName,
out copyRowNumber);

            if (type == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(path);
            }

            if (type == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(copyPath);
            }

            // Get the table and the table to copy to
            OdbcDataAdapter da = GetAdapterForTable(tableName);
            if (da == null)
            {
                return;
            }

            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);

            OdbcDataAdapter cda = GetAdapterForTable(copyTableName);
            if (cda == null)
            {
                return;
            }

            DataSet cds = GetDataSetForTable(cda, copyTableName);
            DataTable copyTable = GetDataTable(cds, copyTableName);

            // if source represents a table
            if (type == PathType.Table)
            {
                // if copyPath does not represent a table
                if (copyType != PathType.Table)
                {
                    ArgumentException e = new ArgumentException("Table can
only be copied on to another table location");

                    WriteError(new ErrorRecord(e, "PathNotValid",
                        ErrorCategory.InvalidArgument, copyPath));

                    throw e;
                }

                // if table already exists then force parameter should be set
                // to force a copy
                if (!Force && GetTable(copyTableName) != null)
                {
                    throw new ArgumentException("Specified path already
exists");
```

```
                }

                for (int i = 0; i < table.Rows.Count; i++)
                {
                    DataRow row = table.Rows[i];
                    DataRow copyRow = copyTable.NewRow();

                    copyRow.ItemArray = row.ItemArray;
                    copyTable.Rows.Add(copyRow);
                }
            } // if (type == ...
            // if source represents a row
            else
            {
                if (copyType == PathType.Row)
                {
                    if (!Force && (copyRowNumber < copyTable.Rows.Count))
                    {
                        throw new ArgumentException("Specified path already
exists.");
                    }

                    DataRow row = table.Rows[rowNumber];
                    DataRow copyRow = null;

                    if (copyRowNumber < copyTable.Rows.Count)
                    {
                        // copy to an existing row
                        copyRow = copyTable.Rows[copyRowNumber];
                        copyRow.ItemArray = row.ItemArray;
                        copyRow[0] = GetNextID(copyTable);
                    }
                    else if (copyRowNumber == copyTable.Rows.Count)
                    {
                        // copy to the next row in the table that will
                        // be created
                        copyRow = copyTable.NewRow();
                        copyRow.ItemArray = row.ItemArray;
                        copyRow[0] = GetNextID(copyTable);
                        copyTable.Rows.Add(copyRow);
                    }
                    else
                    {
                        // attempting to copy to a nonexistent row or a row
                        // that cannot be created now - throw an exception
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                                "The item cannot be specified to
the copied row. Specify row number as {0}, or specify a path to the table.",
                                                    table.Rows.Count);

                        throw new ArgumentException(message);
                    }
                }
                else
```

```
                {
                    // destination path specified represents a table,
                    // create a new row and copy the item
                    DataRow copyRow = copyTable.NewRow();
                    copyRow.ItemArray = table.Rows[rowNumber].ItemArray;
                    copyRow[0] = GetNextID(copyTable);
                    copyTable.Rows.Add(copyRow);
                }
            }

            if (ShouldProcess(copyTableName, "CopyItems"))
            {
                cda.Update(cds, copyTableName);
            }

        } //CopyItem

        /// <summary>
        /// Removes (deletes) the item at the specified path
        /// </summary>
        ///
        /// <param name="path">
        /// The path to the item to remove.
        /// </param>
        ///
        /// <param name="recurse">
        /// True if all children in a subtree should be removed, false if
only
        /// the item at the specified path should be removed. Is applicable
        /// only for container (table) items. Its ignored otherwise (even if
        /// specified).
        /// </param>
        ///
        /// <remarks>
        /// There are no elements in this store which are hidden from the
user.
        /// Hence this method will not check for the presence of the Force
        /// parameter
        /// </remarks>
        ///
        protected override void RemoveItem(string path, bool recurse)
        {
            string tableName;
            int rowNumber = 0;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type == PathType.Table)
            {
                // if recurse flag has been specified, delete all the rows as
well
                if (recurse)
                {
                    OdbcDataAdapter da = GetAdapterForTable(tableName);
```

```
                if (da == null)
                {
                    return;
                }

                DataSet ds = GetDataSetForTable(da, tableName);
                DataTable table = GetDataTable(ds, tableName);

                for (int i = 0; i < table.Rows.Count; i++)
                {
                    table.Rows[i].Delete();
                }

                if (ShouldProcess(path, "RemoveItem"))
                {
                    da.Update(ds, tableName);
                    RemoveTable(tableName);
                }
            }//if (recurse...
            else
            {
                // Remove the table
                if (ShouldProcess(path, "RemoveItem"))
                {
                    RemoveTable(tableName);
                }
            }
        }
        else if (type == PathType.Row)
        {
            OdbcDataAdapter da = GetAdapterForTable(tableName);
            if (da == null)
            {
                return;
            }

            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);

            table.Rows[rowNumber].Delete();

            if (ShouldProcess(path, "RemoveItem"))
            {
                da.Update(ds, tableName);
            }
        }
        else
        {
            ThrowTerminatingInvalidPathException(path);
        }

    } // RemoveItem

    #endregion Container Overloads
```

```
      #region Navigation

      /// <summary>
      /// Determine if the path specified is that of a container.
      /// </summary>
      /// <param name="path">The path to check.</param>
      /// <returns>True if the path specifies a container.</returns>
      protected override bool IsItemContainer(string path)
      {
         if (PathIsDrive(path))
         {
             return true;
         }

         string[] pathChunks = ChunkPath(path);
         string tableName;
         int rowNumber;

         PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

         if (type == PathType.Table)
         {
            foreach (DatabaseTableInfo ti in GetTables())
            {
                if (string.Equals(ti.Name, tableName,
StringComparison.OrdinalIgnoreCase))
                {
                    return true;
                }
            } // foreach (DatabaseTableInfo...
         } // if (pathChunks...

         return false;
      } // IsItemContainer

       /// <summary>
       /// Get the name of the leaf element in the specified path
       /// </summary>
       ///
       /// <param name="path">
       /// The full or partial provider specific path
       /// </param>
       ///
       /// <returns>
       /// The leaf element in the path
       /// </returns>
       protected override string GetChildName(string path)
       {
           if (PathIsDrive(path))
           {
               return path;
           }

           string tableName;
```

```
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type == PathType.Table)
            {
                return tableName;
            }
            else if (type == PathType.Row)
            {
                return rowNumber.ToString(CultureInfo.CurrentCulture);
            }
            else
            {
                ThrowTerminatingInvalidPathException(path);
            }

            return null;
        }

        /// <summary>
        /// Removes the child segment of the path and returns the remaining
        /// parent portion
        /// </summary>
        ///
        /// <param name="path">
        /// A full or partial provider specific path. The path may be to an
        /// item that may or may not exist.
        /// </param>
        ///
        /// <param name="root">
        /// The fully qualified path to the root of a drive. This parameter
        /// may be null or empty if a mounted drive is not in use for this
        /// operation.  If this parameter is not null or empty the result
        /// of the method should not be a path to a container that is a
        /// parent or in a different tree than the root.
        /// </param>
        ///
        /// <returns></returns>

        protected override string GetParentPath(string path, string root)
        {
            // If root is specified then the path has to contain
            // the root. If not nothing should be returned
            if (!String.IsNullOrEmpty(root))
            {
                if (!path.Contains(root))
                {
                    return null;
                }
            }

            return path.Substring(0, path.LastIndexOf(pathSeparator,
StringComparison.OrdinalIgnoreCase));
```

```
        }

        /// <summary>
        /// Joins two strings with a provider specific path separator.
        /// </summary>
        ///
        /// <param name="parent">
        /// The parent segment of a path to be joined with the child.
        /// </param>
        ///
        /// <param name="child">
        /// The child segment of a path to be joined with the parent.
        /// </param>
        ///
        /// <returns>
        /// A string that represents the parent and child segments of the
path
        /// joined by a path separator.
        /// </returns>

        protected override string MakePath(string parent, string child)
        {
            string result;

            string normalParent = NormalizePath(parent);
            normalParent = RemoveDriveFromPath(normalParent);
            string normalChild = NormalizePath(child);
            normalChild = RemoveDriveFromPath(normalChild);

            if (String.IsNullOrEmpty(normalParent) &&
String.IsNullOrEmpty(normalChild))
            {
                result = String.Empty;
            }
            else if (String.IsNullOrEmpty(normalParent) &&
!String.IsNullOrEmpty(normalChild))
            {
                result = normalChild;
            }
            else if (!String.IsNullOrEmpty(normalParent) &&
String.IsNullOrEmpty(normalChild))
            {
                if (normalParent.EndsWith(pathSeparator,
StringComparison.OrdinalIgnoreCase))
                {
                    result = normalParent;
                }
                else
                {
                    result = normalParent + pathSeparator;
                }
            } // else if (!String...
            else
            {
                if (!normalParent.Equals(String.Empty) &&
```

```
                    !normalParent.EndsWith(pathSeparator,
StringComparison.OrdinalIgnoreCase))
                {
                    result = normalParent + pathSeparator;
                }
                else
                {
                    result = normalParent;
                }

                if (normalChild.StartsWith(pathSeparator,
StringComparison.OrdinalIgnoreCase))
                {
                    result += normalChild.Substring(1);
                }
                else
                {
                    result += normalChild;
                }
            } // else

            return result;
        } // MakePath

        /// <summary>
        /// Normalizes the path that was passed in and returns the normalized
        /// path as a relative path to the basePath that was passed.
        /// </summary>
        ///
        /// <param name="path">
        /// A fully qualified provider specific path to an item.  The item
        /// should exist or the provider should write out an error.
        /// </param>
        ///
        /// <param name="basepath">
        /// The path that the return value should be relative to.
        /// </param>
        ///
        /// <returns>
        /// A normalized path that is relative to the basePath that was
        /// passed.  The provider should parse the path parameter, normalize
        /// the path, and then return the normalized path relative to the
        /// basePath.
        /// </returns>

        protected override string NormalizeRelativePath(string path,
                                                         string basepath)
        {
            // Normalize the paths first
            string normalPath = NormalizePath(path);
            normalPath = RemoveDriveFromPath(normalPath);
            string normalBasePath = NormalizePath(basepath);
            normalBasePath = RemoveDriveFromPath(normalBasePath);

            if (String.IsNullOrEmpty(normalBasePath))
```

```
            {
                return normalPath;
            }
            else
            {
                if (!normalPath.Contains(normalBasePath))
                {
                    return null;
                }

                return normalPath.Substring(normalBasePath.Length +
pathSeparator.Length);
            }
        }

        /// <summary>
        /// Moves the item specified by the path to the specified destination
        /// </summary>
        ///
        /// <param name="path">
        /// The path to the item to be moved
        /// </param>
        ///
        /// <param name="destination">
        /// The path of the destination container
        /// </param>

        protected override void MoveItem(string path, string destination)
        {
            // Get type, table name and rowNumber from the path
            string tableName, destTableName;
            int rowNumber, destRowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            PathType destType = GetNamesFromPath(destination, out
destTableName,
                                        out destRowNumber);

            if (type == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(path);
            }

            if (destType == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(destination);
            }

            if (type == PathType.Table)
            {
                ArgumentException e = new ArgumentException("Move not
supported for tables");
```

```
                WriteError(new ErrorRecord(e, "MoveNotSupported",
                    ErrorCategory.InvalidArgument, path));

                throw e;
            }
            else
            {
                OdbcDataAdapter da = GetAdapterForTable(tableName);
                if (da == null)
                {
                    return;
                }

                DataSet ds = GetDataSetForTable(da, tableName);
                DataTable table = GetDataTable(ds, tableName);

                OdbcDataAdapter dda = GetAdapterForTable(destTableName);
                if (dda == null)
                {
                    return;
                }

                DataSet dds = GetDataSetForTable(dda, destTableName);
                DataTable destTable = GetDataTable(dds, destTableName);
                DataRow row = table.Rows[rowNumber];

                if (destType == PathType.Table)
                {
                    DataRow destRow = destTable.NewRow();

                    destRow.ItemArray = row.ItemArray;
                }
                else
                {
                    DataRow destRow = destTable.Rows[destRowNumber];

                    destRow.ItemArray = row.ItemArray;
                }

                // Update the changes
                if (ShouldProcess(path, "MoveItem"))
                {
                    WriteItemObject(row, path, false);
                    dda.Update(dds, destTableName);
                }
            }
        }

        #endregion Navigation

        #region Helper Methods

        /// <summary>
        /// Checks if a given path is actually a drive name.
        /// </summary>
```

```
        /// <param name="path">The path to check.</param>
        /// <returns>
        /// True if the path given represents a drive, false otherwise.
        /// </returns>
        private bool PathIsDrive(string path)
        {
            // Remove the drive name and first path separator.  If the
            // path is reduced to nothing, it is a drive. Also if its
            // just a drive then there wont be any path separators
            if (String.IsNullOrEmpty(
                        path.Replace(this.PSDriveInfo.Root, "")) ||
                String.IsNullOrEmpty(
                        path.Replace(this.PSDriveInfo.Root + pathSeparator,
""))

               )
            {
                return true;
            }
            else
            {
                return false;
            }
        } // PathIsDrive

        /// <summary>
        /// Breaks up the path into individual elements.
        /// </summary>
        /// <param name="path">The path to split.</param>
        /// <returns>An array of path segments.</returns>
        private string[] ChunkPath(string path)
        {
            // Normalize the path before splitting
            string normalPath = NormalizePath(path);

            // Return the path with the drive name and first path
            // separator character removed, split by the path separator.
            string pathNoDrive = normalPath.Replace(this.PSDriveInfo.Root
                                        + pathSeparator, "");

            return pathNoDrive.Split(pathSeparator.ToCharArray());
        } // ChunkPath

        /// <summary>
        /// Adapts the path, making sure the correct path separator
        /// character is used.
        /// </summary>
        /// <param name="path"></param>
        /// <returns></returns>
        private string NormalizePath(string path)
        {
            string result = path;

            if (!String.IsNullOrEmpty(path))
            {
```

```
                result = path.Replace("/", pathSeparator);
            }

            return result;
        } // NormalizePath

        /// <summary>
        /// Ensures that the drive is removed from the specified path
        /// </summary>
        ///
        /// <param name="path">Path from which drive needs to be
removed</param>
        /// <returns>Path with drive information removed</returns>
        private string RemoveDriveFromPath(string path)
        {
            string result = path;
            string root;

            if (this.PSDriveInfo == null)
            {
                root = String.Empty;
            }
            else
            {
                root = this.PSDriveInfo.Root;
            }

            if (result == null)
            {
                result = String.Empty;
            }

            if (result.Contains(root))
            {
                result = result.Substring(result.IndexOf(root,
StringComparison.OrdinalIgnoreCase) + root.Length);
            }

            return result;
        }

        /// <summary>
        /// Chunks the path and returns the table name and the row number
        /// from the path
        /// </summary>
        /// <param name="path">Path to chunk and obtain information</param>
        /// <param name="tableName">Name of the table as represented in the
        /// path</param>
        /// <param name="rowNumber">Row number obtained from the path</param>
        /// <returns>what the path represents</returns>
        private PathType GetNamesFromPath(string path, out string tableName,
out int rowNumber)
        {
            PathType retVal = PathType.Invalid;
            rowNumber = -1;
```

```
            tableName = null;

            // Check if the path specified is a drive
            if (PathIsDrive(path))
            {
                return PathType.Database;
            }

            // chunk the path into parts
            string[] pathChunks = ChunkPath(path);

            switch (pathChunks.Length)
            {
                case 1:
                    {
                        string name = pathChunks[0];

                        if (TableNameIsValid(name))
                        {
                            tableName = name;
                            retVal = PathType.Table;
                        }
                    }
                    break;

                case 2:
                    {
                        string name = pathChunks[0];

                        if (TableNameIsValid(name))
                        {
                            tableName = name;
                        }

                        int number = SafeConvertRowNumber(pathChunks[1]);

                        if (number >= 0)
                        {
                            rowNumber = number;
                            retVal = PathType.Row;
                        }
                        else
                        {
                            WriteError(new ErrorRecord(
                                new ArgumentException("Row number is not
valid"),

                                "RowNumberNotValid",
                                ErrorCategory.InvalidArgument,
                                path));
                        }
                    }
                    break;

                default:
                    {
```

```
                    WriteError(new ErrorRecord(
                        new ArgumentException("The path supplied has too
many segments"),
                        "PathNotValid",
                        ErrorCategory.InvalidArgument,
                        path));
                }
                break;
            } // switch(pathChunks...

            return retVal;
        } // GetNamesFromPath

        /// <summary>
        /// Throws an argument exception stating that the specified path does
        /// not represent either a table or a row
        /// </summary>
        /// <param name="path">path which is invalid</param>
        private void ThrowTerminatingInvalidPathException(string path)
        {
            StringBuilder message = new StringBuilder("Path must represent
either a table or a row :");
            message.Append(path);

            throw new ArgumentException(message.ToString());
        }

        /// <summary>
        /// Retrieve the list of tables from the database.
        /// </summary>
        /// <returns>
        /// Collection of DatabaseTableInfo objects, each object representing
        /// information about one database table
        /// </returns>
        private Collection<DatabaseTableInfo> GetTables()
        {
            Collection<DatabaseTableInfo> results =
                    new Collection<DatabaseTableInfo>();

            // using ODBC connection to the database and get the schema of
tables
            AccessDBPSDriveInfo di = this.PSDriveInfo as AccessDBPSDriveInfo;

            if (di == null)
            {
                return null;
            }

            OdbcConnection connection = di.Connection;
            DataTable dt = connection.GetSchema("Tables");
            int count;

            // iterate through all rows in the schema and create
DatabaseTableInfo
            // objects which represents a table
```

```
            foreach (DataRow dr in dt.Rows)
            {
                String tableName = dr["TABLE_NAME"] as String;
                DataColumnCollection columns = null;

                // find the number of rows in the table
                try
                {
                    String cmd = "Select count(*) from \"" + tableName + "\"";
                    OdbcCommand command = new OdbcCommand(cmd, connection);

                    count = (Int32)command.ExecuteScalar();
                }
                catch
                {
                    count = 0;
                }

                // create DatabaseTableInfo object representing the table
                DatabaseTableInfo table =
                        new DatabaseTableInfo(dr, tableName, count, columns);

                results.Add(table);
            } // foreach (DataRow...

            return results;
        } // GetTables

        /// <summary>
        /// Return row information from a specified table.
        /// </summary>
        /// <param name="tableName">The name of the database table from
        /// which to retrieve rows.</param>
        /// <returns>Collection of row information objects.</returns>
        private Collection<DatabaseRowInfo> GetRows(string tableName)
        {
            Collection<DatabaseRowInfo> results =
                        new Collection<DatabaseRowInfo>();

            // Obtain rows in the table and add it to the collection
            try
            {
                OdbcDataAdapter da = GetAdapterForTable(tableName);

                if (da == null)
                {
                    return null;
                }

                DataSet ds = GetDataSetForTable(da, tableName);
                DataTable table = GetDataTable(ds, tableName);

                int i = 0;
                foreach (DataRow row in table.Rows)
                {
```

```
                    results.Add(new DatabaseRowInfo(row,
i.ToString(CultureInfo.CurrentCulture)));
                    i++;
                } // foreach (DataRow...
            }
            catch (Exception e)
            {
                WriteError(new ErrorRecord(e, "CannotAccessSpecifiedRows",
                    ErrorCategory.InvalidOperation, tableName));
            }

            return results;

        } // GetRows

        /// <summary>
        /// Retrieve information about a single table.
        /// </summary>
        /// <param name="tableName">The table for which to retrieve
        /// data.</param>
        /// <returns>Table information.</returns>
        private DatabaseTableInfo GetTable(string tableName)
        {
            foreach (DatabaseTableInfo table in GetTables())
            {
                if (String.Equals(tableName, table.Name,
StringComparison.OrdinalIgnoreCase))
                {
                    return table;
                }
            }

            return null;
        } // GetTable

        /// <summary>
        /// Removes the specified table from the database
        /// </summary>
        /// <param name="tableName">Name of the table to remove</param>
        private void RemoveTable(string tableName)
        {
            // validate if tablename is valid and if table is present
            if (String.IsNullOrEmpty(tableName) ||
!TableNameIsValid(tableName) || !TableIsPresent(tableName))
            {
                return;
            }

            // Execute command using ODBC connection to remove a table
            try
            {
                // delete the table using an sql statement
                string sql = "drop table " + tableName;

                AccessDBPSDriveInfo di = this.PSDriveInfo as
```

```
AccessDBPSDriveInfo;

            if (di == null)
            {
                return;
            }
            OdbcConnection connection = di.Connection;

            OdbcCommand cmd = new OdbcCommand(sql, connection);
            cmd.ExecuteScalar();
        }
        catch (Exception ex)
        {
            WriteError(new ErrorRecord(ex, "CannotRemoveSpecifiedTable",
                      ErrorCategory.InvalidOperation, null)
                      );
        }

    } // RemoveTable

    /// <summary>
    /// Obtain a data adapter for the specified Table
    /// </summary>
    /// <param name="tableName">Name of the table to obtain the
    /// adapter for</param>
    /// <returns>Adapter object for the specified table</returns>
    /// <remarks>An adapter serves as a bridge between a DataSet (in
memory
    /// representation of table) and the data source</remarks>
    private OdbcDataAdapter GetAdapterForTable(string tableName)
    {
        OdbcDataAdapter da = null;
        AccessDBPSDriveInfo di = this.PSDriveInfo as AccessDBPSDriveInfo;

        if (di == null || !TableNameIsValid(tableName) ||
!TableIsPresent(tableName))
        {
            return null;
        }

        OdbcConnection connection = di.Connection;

        try
        {
            // Create a odbc data adpater. This can be sued to update the
            // data source with the records that will be created here
            // using data sets
            string sql = "Select * from " + tableName;
            da = new OdbcDataAdapter(new OdbcCommand(sql, connection));

            // Create a odbc command builder object. This will create sql
            // commands automatically for a single table, thus
            // eliminating the need to create new sql statements for
            // every operation to be done.
            OdbcCommandBuilder cmd = new OdbcCommandBuilder(da);
```

```
            // Set the delete cmd for the table here
            sql = "Delete from " + tableName + " where ID = ?";
            da.DeleteCommand = new OdbcCommand(sql, connection);

            // Specify a DeleteCommand parameter based on the "ID"
            // column
            da.DeleteCommand.Parameters.Add(new OdbcParameter());
            da.DeleteCommand.Parameters[0].SourceColumn = "ID";

            // Create an InsertCommand based on the sql string
            // Insert into "tablename" values (?,?,?)" where
            // ? represents a column in the table. Note that
            // the number of ? will be equal to the number of
            // columnds
            DataSet ds = new DataSet();

            da.FillSchema(ds, SchemaType.Source);
            ds.Locale = CultureInfo.InvariantCulture;

            sql = "Insert into " + tableName + " values ( ";
            for (int i = 0; i < ds.Tables["Table"].Columns.Count; i++)
            {
                sql += "?, ";
            }
            sql = sql.Substring(0, sql.Length - 2);
            sql += ")";
            da.InsertCommand = new OdbcCommand(sql, connection);

            // Create parameters for the InsertCommand based on the
            // captions of each column
            for (int i = 0; i < ds.Tables["Table"].Columns.Count; i++)
            {
                da.InsertCommand.Parameters.Add(new OdbcParameter());
                da.InsertCommand.Parameters[i].SourceColumn =
                                ds.Tables["Table"].Columns[i].Caption;

            }

            // Open the connection if its not already open
            if (connection.State != ConnectionState.Open)
            {
                connection.Open();
            }
        }
        catch (Exception e)
        {
            WriteError(new ErrorRecord(e, "CannotAccessSpecifiedTable",
              ErrorCategory.InvalidOperation, tableName));
        }

        return da;
    } // GetAdapterForTable

    /// <summary>
```

```
        /// Gets the DataSet (in memory representation) for the table
        /// for the specified adapter
        /// </summary>
        /// <param name="adapter">Adapter to be used for obtaining
        /// the table</param>
        /// <param name="tableName">Name of the table for which a
        /// DataSet is required</param>
        /// <returns>The DataSet with the filled in schema</returns>
        private DataSet GetDataSetForTable(OdbcDataAdapter adapter, string
tableName)
        {
            Debug.Assert(adapter != null);

            // Create a dataset object which will provide an in-memory
            // representation of the data being worked upon in the
            // data source.
            DataSet ds = new DataSet();

            // Create a table named "Table" which will contain the same
            // schema as in the data source.
            //adapter.FillSchema(ds, SchemaType.Source);
            adapter.Fill(ds, tableName);
            ds.Locale = CultureInfo.InvariantCulture;

            return ds;
        } //GetDataSetForTable

        /// <summary>
        /// Get the DataTable object which can be used to operate on
        /// for the specified table in the data source
        /// </summary>
        /// <param name="ds">DataSet object which contains the tables
        /// schema</param>
        /// <param name="tableName">Name of the table</param>
        /// <returns>Corresponding DataTable object representing
        /// the table</returns>
        ///
        private DataTable GetDataTable(DataSet ds, string tableName)
        {
            Debug.Assert(ds != null);
            Debug.Assert(tableName != null);

            DataTable table = ds.Tables[tableName];
            table.Locale = CultureInfo.InvariantCulture;

            return table;
        } // GetDataTable

        /// <summary>
        /// Retrieves a single row from the named table.
        /// </summary>
        /// <param name="tableName">The table that contains the
        /// numbered row.</param>
        /// <param name="row">The index of the row to return.</param>
        /// <returns>The specified table row.</returns>
```

```
        private DatabaseRowInfo GetRow(string tableName, int row)
        {
            Collection<DatabaseRowInfo> di = GetRows(tableName);

            // if the row is invalid write an appropriate error else return
the
            // corresponding row information
            if (row < di.Count && row >= 0)
            {
                return di[row];
            }
            else
            {
                WriteError(new ErrorRecord(
                   new ItemNotFoundException(),
                   "RowNotFound",
                   ErrorCategory.ObjectNotFound,
                   row.ToString(CultureInfo.CurrentCulture))
                );
            }

            return null;
        } // GetRow

        /// <summary>
        /// Method to safely convert a string representation of a row number
        /// into its Int32 equivalent
        /// </summary>
        /// <param name="rowNumberAsStr">String representation of the row
        /// number</param>
        /// <remarks>If there is an exception, -1 is returned</remarks>
        private int SafeConvertRowNumber(string rowNumberAsStr)
        {
            int rowNumber = -1;
            try
            {
                rowNumber = Convert.ToInt32(rowNumberAsStr,
CultureInfo.CurrentCulture);
            }
            catch (FormatException fe)
            {
                WriteError(new ErrorRecord(fe, "RowStringFormatNotValid",
                    ErrorCategory.InvalidData, rowNumberAsStr));
            }
            catch (OverflowException oe)
            {
                WriteError(new ErrorRecord(oe,
"RowStringConversionToNumberFailed",
                    ErrorCategory.InvalidData, rowNumberAsStr));
            }

            return rowNumber;
        } // SafeConvertRowNumber

        /// <summary>
```

```
        /// Check if a table name is valid
        /// </summary>
        /// <param name="tableName">Table name to validate</param>
        /// <remarks>Helps to check for SQL injection attacks</remarks>
        private bool TableNameIsValid(string tableName)
        {
            Regex exp = new Regex(pattern, RegexOptions.Compiled |
RegexOptions.IgnoreCase);

            if (exp.IsMatch(tableName))
            {
                return true;
            }
            WriteError(new ErrorRecord(
                new ArgumentException("Table name not valid"),
"TableNameNotValid",
                      ErrorCategory.InvalidArgument, tableName));
            return false;
        } // TableNameIsValid

        /// <summary>
        /// Checks to see if the specified table is present in the
        /// database
        /// </summary>
        /// <param name="tableName">Name of the table to check</param>
        /// <returns>true, if table is present, false otherwise</returns>
        private bool TableIsPresent(string tableName)
        {
            // using ODBC connection to the database and get the schema of
tables
            AccessDBPSDriveInfo di = this.PSDriveInfo as AccessDBPSDriveInfo;
            if (di == null)
            {
                return false;
            }

            OdbcConnection connection = di.Connection;
            DataTable dt = connection.GetSchema("Tables");

            // check if the specified tableName is available
            // in the list of tables present in the database
            foreach (DataRow dr in dt.Rows)
            {
                string name = dr["TABLE_NAME"] as string;
                if (name.Equals(tableName,
StringComparison.OrdinalIgnoreCase))
                {
                    return true;
                }
            }

            WriteError(new ErrorRecord(
                new ArgumentException("Specified Table is not present in
database"), "TableNotAvailable",
                      ErrorCategory.InvalidArgument, tableName));
```

```
            return false;
        }// TableIsPresent

        /// <summary>
        /// Gets the next available ID in the table
        /// </summary>
        /// <param name="table">DataTable object representing the table to
        /// search for ID</param>
        /// <returns>next available id</returns>
        private int GetNextID(DataTable table)
        {
            int big = 0;

            for (int i = 0; i < table.Rows.Count; i++)
            {
                DataRow row = table.Rows[i];

                int id = (int)row["ID"];

                if (big < id)
                {
                    big = id;
                }
            }

            big++;
            return big;
        }

        #endregion Helper Methods

        #region Private Properties

        private string pathSeparator = "\\";
        private static string pattern = @"^[a-z]+[0-9]*_*$";

         private enum PathType { Database, Table, Row, Invalid };

        #endregion Private Properties

    } // AccessDBProvider

     #endregion AccessDBProvider

    #region Helper Classes

    #region AccessDBPSDriveInfo

    /// <summary>
    /// Any state associated with the drive should be held here.
    /// In this case, it's the connection to the database.
    /// </summary>
    internal class AccessDBPSDriveInfo : PSDriveInfo
    {
```

```
        private OdbcConnection connection;

        /// <summary>
        /// ODBC connection information.
        /// </summary>
        public OdbcConnection Connection
        {
            get { return connection; }
            set { connection = value; }
        }

        /// <summary>
        /// Constructor that takes one argument
        /// </summary>
        /// <param name="driveInfo">Drive provided by this provider</param>
        public AccessDBPSDriveInfo(PSDriveInfo driveInfo)
            : base(driveInfo)
        { }

    } // class AccessDBPSDriveInfo

    #endregion AccessDBPSDriveInfo

    #region DatabaseTableInfo

    /// <summary>
    /// Contains information specific to the database table.
    /// Similar to the DirectoryInfo class.
    /// </summary>
    public class DatabaseTableInfo
    {
        /// <summary>
        /// Row from the "tables" schema
        /// </summary>
        public DataRow Data
        {
            get
            {
                return data;
            }
            set
            {
                data = value;
            }
        }
        private DataRow data;

        /// <summary>
        /// The table name.
        /// </summary>
        public string Name
        {
            get
            {
                return name;
```

```
        }
        set
        {
            name = value;
        }
    }
    private String name;

    /// <summary>
    /// The number of rows in the table.
    /// </summary>
    public int RowCount
    {
        get
        {
            return rowCount;
        }
        set
        {
            rowCount = value;
        }
    }
    private int rowCount;

    /// <summary>
    /// The column definitions for the table.
    /// </summary>
    public DataColumnCollection Columns
    {
        get
        {
            return columns;
        }
        set
        {
            columns = value;
        }
    }
    private DataColumnCollection columns;

    /// <summary>
    /// Constructor.
    /// </summary>
    /// <param name="row">The row definition.</param>
    /// <param name="name">The table name.</param>
    /// <param name="rowCount">The number of rows in the table.</param>
    /// <param name="columns">Information on the column tables.</param>
    public DatabaseTableInfo(DataRow row, string name, int rowCount,
                             DataColumnCollection columns)
    {
        Name = name;
        Data = row;
        RowCount = rowCount;
        Columns = columns;
    } // DatabaseTableInfo
```

```
    } // class DatabaseTableInfo

    #endregion DatabaseTableInfo

    #region DatabaseRowInfo

    /// <summary>
    /// Contains information specific to an individual table row.
    /// Analogous to the FileInfo class.
    /// </summary>
    public class DatabaseRowInfo
    {
        /// <summary>
        /// Row data information.
        /// </summary>
        public DataRow Data
        {
            get
            {
                return data;
            }
            set
            {
                data = value;
            }
        }
        private DataRow data;

        /// <summary>
        /// The row index.
        /// </summary>
        public string RowNumber
        {
            get
            {
                return rowNumber;
            }
            set
            {
                rowNumber = value;
            }
        }
        private string rowNumber;

        /// <summary>
        /// Constructor.
        /// </summary>
        /// <param name="row">The row information.</param>
        /// <param name="name">The row index.</param>
        public DatabaseRowInfo(DataRow row, string name)
        {
            RowNumber = name;
            Data = row;
        } // DatabaseRowInfo
    } // class DatabaseRowInfo
```

```
    #endregion DatabaseRowInfo

    #endregion Helper Classes
}
```

See Also

System.Management.Automation.Provider.Itemcmdletprovider

System.Management.Automation.Provider.Containercmdletprovider

System.Management.Automation.Provider.Navigationcmdletprovider

Designing Your Windows PowerShell Provider

AccessDBProviderSample06

Article • 09/17/2021

This sample shows how to overwrite content methods to support calls to the `Clear-Content`, `Get-Content`, and `Set-Content` cmdlets. These methods should be implemented when the user needs to manage the content of the items in the data store. The provider class in this sample derives from the System.Management.Automation.Provider.Navigationcmdletprovider class, and it implements the System.Management.Automation.Provider.Icontentcmdletprovider interface.

Demonstrates

> **ⓘ Important**
>
> Your provider class will most likely derive from one of the following classes and possibly implement other provider interfaces:
>
> - **System.Management.Automation.Provider.Itemcmdletprovider** class. See **AccessDBProviderSample03**.
> - **System.Management.Automation.Provider.Containercmdletprovider** class. See **AccessDBProviderSample04**.
> - **System.Management.Automation.Provider.Navigationcmdletprovider** class.
>
> For more information about choosing which provider class to derive from based on provider features, see **Designing Your Windows PowerShell Provider**.

This sample demonstrates the following:

- Declaring the `CmdletProvider` attribute.
- Defining a provider class that derives from the System.Management.Automation.Provider.Navigationcmdletprovider class and that declares the System.Management.Automation.Provider.Icontentcmdletprovider interface.
- Overwriting the System.Management.Automation.Provider.Icontentcmdletprovider.Clearcontent* method to change the behavior of the `Clear-Content` cmdlet, allowing the user to remove the content from an item. (This sample does not show how to add dynamic parameters to the `Clear-Content` cmdlet.)

- Overwriting the System.Management.Automation.Provider.Icontentcmdletprovider.Getcontentreader* method to change the behavior of the `Get-Content` cmdlet, allowing the user to retrieve the content of an item. (This sample does not show how to add dynamic parameters to the `Get-Content` cmdlet.).
- Overwriting the Microsoft.PowerShell.Commands.Filesystemprovider.Getcontentwriter* method to change the behavior of the `Set-Content` cmdlet, allowing the user to update the content of an item. (This sample does not show how to add dynamic parameters to the `Set-Content` cmdlet.)

Example

This sample shows how to overwrite the methods needed to clear, get, and set the content of items in a Microsoft Access data base.

C#

```
using System;
using System.IO;
using System.Data;
using System.Data.Odbc;
using System.Diagnostics;
using System.Collections;
using System.Collections.ObjectModel;
using System.Management.Automation;
using System.Management.Automation.Provider;
using System.Text;
using System.Text.RegularExpressions;
using System.ComponentModel;
using System.Globalization;

namespace Microsoft.Samples.PowerShell.Providers
{
   #region AccessDBProvider

   /// <summary>
   /// This example implements the content methods.
   /// </summary>
   [CmdletProvider("AccessDB", ProviderCapabilities.None)]
   public class AccessDBProvider : NavigationCmdletProvider,
IContentCmdletProvider
   {

       #region Drive Manipulation

        /// <summary>
        /// Create a new drive.  Create a connection to the database file
```

```
and set
        /// the Connection property in the PSDriveInfo.
        /// </summary>
        /// <param name="drive">
        /// Information describing the drive to add.
        /// </param>
        /// <returns>The added drive.</returns>
        protected override PSDriveInfo NewDrive(PSDriveInfo drive)
        {
            // check if drive object is null
            if (drive == null)
            {
                WriteError(new ErrorRecord(
                    new ArgumentNullException("drive"),
                    "NullDrive",
                    ErrorCategory.InvalidArgument,
                    null)
                );

                return null;
            }

            // check if drive root is not null or empty
            // and if its an existing file
            if (String.IsNullOrEmpty(drive.Root) || (File.Exists(drive.Root)
== false))
            {
                WriteError(new ErrorRecord(
                    new ArgumentException("drive.Root"),
                    "NoRoot",
                    ErrorCategory.InvalidArgument,
                    drive)
                );

                return null;
            }

            // create a new drive and create an ODBC connection to the new
drive
            AccessDBPSDriveInfo accessDBPSDriveInfo = new
AccessDBPSDriveInfo(drive);

            OdbcConnectionStringBuilder builder = new
OdbcConnectionStringBuilder();

            builder.Driver = "Microsoft Access Driver (*.mdb)";
            builder.Add("DBQ", drive.Root);

            OdbcConnection conn = new
OdbcConnection(builder.ConnectionString);
            conn.Open();
            accessDBPSDriveInfo.Connection = conn;

            return accessDBPSDriveInfo;
        } // NewDrive
```

```
        /// <summary>
        /// Removes a drive from the provider.
        /// </summary>
        /// <param name="drive">The drive to remove.</param>
        /// <returns>The drive removed.</returns>
        protected override PSDriveInfo RemoveDrive(PSDriveInfo drive)
        {
            // check if drive object is null
            if (drive == null)
            {
                WriteError(new ErrorRecord(
                    new ArgumentNullException("drive"),
                    "NullDrive",
                    ErrorCategory.InvalidArgument,
                    drive)
                );

                return null;
            }

            // close ODBC connection to the drive
            AccessDBPSDriveInfo accessDBPSDriveInfo = drive as
AccessDBPSDriveInfo;

            if (accessDBPSDriveInfo == null)
            {
                return null;
            }
            accessDBPSDriveInfo.Connection.Close();

            return accessDBPSDriveInfo;
        } // RemoveDrive

        #endregion Drive Manipulation

       #region Item Methods

        /// <summary>
        /// Retrieves an item using the specified path.
        /// </summary>
        /// <param name="path">The path to the item to return.</param>
        protected override void GetItem(string path)
        {
            // check if the path represented is a drive
            if (PathIsDrive(path))
            {
                WriteItemObject(this.PSDriveInfo, path, true);
                return;
            }// if (PathIsDrive...

            // Get table name and row information from the path and do
            // necessary actions
            string tableName;
            int rowNumber;
```

```
            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type == PathType.Table)
            {
                DatabaseTableInfo table = GetTable(tableName);
                WriteItemObject(table, path, true);
            }
            else if (type == PathType.Row)
            {
                DatabaseRowInfo row = GetRow(tableName, rowNumber);
                WriteItemObject(row, path, false);
            }
            else
            {
                ThrowTerminatingInvalidPathException(path);
            }

        } // GetItem

        /// <summary>
        /// Set the content of a row of data specified by the supplied path
        /// parameter.
        /// </summary>
        /// <param name="path">Specifies the path to the row whose columns
        /// will be updated.</param>
        /// <param name="values">Comma separated string of values</param>
        protected override void SetItem(string path, object values)
        {
            // Get type, table name and row number from the path specified
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type != PathType.Row)
            {
                WriteError(new ErrorRecord(new NotSupportedException(
                      "SetNotSupported"), "",
                   ErrorCategory.InvalidOperation, path));

                return;
            }

            // Get in-memory representation of table
            OdbcDataAdapter da = GetAdapterForTable(tableName);

            if (da == null)
            {
                return;
            }
            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);
```

```
            if (rowNumber >= table.Rows.Count)
            {
                // The specified row number has to be available. If not
                // NewItem has to be used to add a new row
                throw new ArgumentException("Row specified is not
available");
            } // if (rowNum...

            string[] colValues = (values as string).Split(',');

            // set the specified row
            DataRow row = table.Rows[rowNumber];

            for (int i = 0; i < colValues.Length; i++)
            {
                row[i] = colValues[i];
            }

            // Update the table
            if (ShouldProcess(path, "SetItem"))
            {
                da.Update(ds, tableName);
            }

        } // SetItem

        /// <summary>
        /// Test to see if the specified item exists.
        /// </summary>
        /// <param name="path">The path to the item to verify.</param>
        /// <returns>True if the item is found.</returns>
        protected override bool ItemExists(string path)
        {
            // check if the path represented is a drive
            if (PathIsDrive(path))
            {
                return true;
            }

            // Obtain type, table name and row number from path
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            DatabaseTableInfo table = GetTable(tableName);

            if (type == PathType.Table)
            {
                // if specified path represents a table then
DatabaseTableInfo
                // object for the same should exist
                if (table != null)
```

```
                {
                    return true;
                }
            }
            else if (type == PathType.Row)
            {
                // if specified path represents a row then DatabaseTableInfo
should
                // exist for the table and then specified row number must be
within
                // the maximum row count in the table
                if (table != null && rowNumber < table.RowCount)
                {
                    return true;
                }
            }

            return false;

        } // ItemExists

        /// <summary>
        /// Test to see if the specified path is syntactically valid.
        /// </summary>
        /// <param name="path">The path to validate.</param>
        /// <returns>True if the specified path is valid.</returns>
        protected override bool IsValidPath(string path)
        {
            bool result = true;

            // check if the path is null or empty
            if (String.IsNullOrEmpty(path))
            {
                result = false;
            }

            // convert all separators in the path to a uniform one
            path = NormalizePath(path);

            // split the path into individual chunks
            string[] pathChunks = path.Split(pathSeparator.ToCharArray());

            foreach (string pathChunk in pathChunks)
            {
                if (pathChunk.Length == 0)
                {
                    result = false;
                }
            }
            return result;
        } // IsValidPath

        #endregion Item Overloads

       #region Container Overloads
```

```
        /// <summary>
        /// Return either the tables in the database or the datarows
        /// </summary>
        /// <param name="path">The path to the parent</param>
        /// <param name="recurse">True to return all child items
recursively.
        /// </param>
        protected override void GetChildItems(string path, bool recurse)
        {
            // If path represented is a drive then the children in the path
are
            // tables. Hence all tables in the drive represented will have
to be
            // returned
            if (PathIsDrive(path))
            {
                foreach (DatabaseTableInfo table in GetTables())
                {
                    WriteItemObject(table, path, true);

                    // if the specified item exists and recurse has been set
then
                    // all child items within it have to be obtained as well
                    if (ItemExists(path) && recurse)
                    {
                        GetChildItems(path + pathSeparator + table.Name,
recurse);
                    }
                } // foreach (DatabaseTableInfo...
            } // if (PathIsDrive...
            else
            {
                // Get the table name, row number and type of path from the
                // path specified
                string tableName;
                int rowNumber;

                PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

                if (type == PathType.Table)
                {
                    // Obtain all the rows within the table
                    foreach (DatabaseRowInfo row in GetRows(tableName))
                    {
                        WriteItemObject(row, path + pathSeparator +
row.RowNumber,
                                        false);
                    } // foreach (DatabaseRowInfo...
                }
                else if (type == PathType.Row)
                {
                    // In this case the user has directly specified a row,
hence
```

```
                    // just give that particular row
                    DatabaseRowInfo row = GetRow(tableName, rowNumber);
                    WriteItemObject(row, path + pathSeparator +
row.RowNumber,
                                    false);
                }
                else
                {
                    // In this case, the path specified is not valid
                    ThrowTerminatingInvalidPathException(path);
                }
            } // else
        } // GetChildItems

        /// <summary>
        /// Return the names of all child items.
        /// </summary>
        /// <param name="path">The root path.</param>
        /// <param name="returnContainers">Not used.</param>
        protected override void GetChildNames(string path,
                                              ReturnContainers returnContainers)
        {
            // If the path represented is a drive, then the child items are
            // tables. get the names of all the tables in the drive.
            if (PathIsDrive(path))
            {
                foreach (DatabaseTableInfo table in GetTables())
                {
                    WriteItemObject(table.Name, path, true);
                } // foreach (DatabaseTableInfo...
            } // if (PathIsDrive...
            else
            {
                // Get type, table name and row number from path specified
                string tableName;
                int rowNumber;

                PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

                if (type == PathType.Table)
                {
                    // Get all the rows in the table and then write out the
                    // row numbers.
                    foreach (DatabaseRowInfo row in GetRows(tableName))
                    {
                        WriteItemObject(row.RowNumber, path, false);
                    } // foreach (DatabaseRowInfo...
                }
                else if (type == PathType.Row)
                {
                    // In this case the user has directly specified a row,
hence
                    // just give that particular row
                    DatabaseRowInfo row = GetRow(tableName, rowNumber);
```

```
                    WriteItemObject(row.RowNumber, path, false);
                }
                else
                {
                    ThrowTerminatingInvalidPathException(path);
                }
            } // else
        } // GetChildNames

        /// <summary>
        /// Determines if the specified path has child items.
        /// </summary>
        /// <param name="path">The path to examine.</param>
        /// <returns>
        /// True if the specified path has child items.
        /// </returns>
        protected override bool HasChildItems(string path)
        {
            if (PathIsDrive(path))
            {
                return true;
            }

            return (ChunkPath(path).Length == 1);
        } // HasChildItems

        /// <summary>
        /// Creates a new item at the specified path.
        /// </summary>
        ///
        /// <param name="path">
        /// The path to the new item.
        /// </param>
        ///
        /// <param name="type">
        /// Type for the object to create. "Table" for creating a new table
and
        /// "Row" for creating a new row in a table.
        /// </param>
        ///
        /// <param name="newItemValue">
        /// Object for creating new instance of a type at the specified
path. For
        /// creating a "Table" the object parameter is ignored and for
creating
        /// a "Row" the object must be of type string which will contain
comma
        /// separated values of the rows to insert.
        /// </param>
        protected override void NewItem(string path, string type,
                                        object newItemValue)
        {
            string tableName;
            int rowNumber;
```

```
            PathType pt = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (pt == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(path);
            }

            // Check if type is either "table" or "row", if not throw an
            // exception
            if (!String.Equals(type, "table",
StringComparison.OrdinalIgnoreCase)
                && !String.Equals(type, "row",
StringComparison.OrdinalIgnoreCase))
            {
                WriteError(new ErrorRecord
                                    (new ArgumentException("Type must be
either a table or row"),
                                        "CannotCreateSpecifiedObject",
                                           ErrorCategory.InvalidArgument,
                                                path
                                     )
                           );

                throw new ArgumentException("This provider can only create
items of type \"table\" or \"row\"");
            }

            // Path type is the type of path of the container. So if a drive
            // is specified, then a table can be created under it and if a
table
            // is specified, then a row can be created under it. For the
sake of
            // completeness, if a row is specified, then if the row
specified by
            // the path does not exist, a new row is created. However, the
row
            // number may not match as the row numbers only get incremented
based
            // on the number of rows

            if (PathIsDrive(path))
            {
                if (String.Equals(type, "table",
StringComparison.OrdinalIgnoreCase))
                {
                    // Execute command using ODBC connection to create a
table
                    try
                    {
                        // create the table using an sql statement
                        string newTableName = newItemValue.ToString();
                        string sql = "create table " + newTableName
                                            + " (ID INT)";
```

```
                        // Create the table using the Odbc connection from
the
                        // drive.
                        AccessDBPSDriveInfo di = this.PSDriveInfo as
AccessDBPSDriveInfo;

                        if (di == null)
                        {
                            return;
                        }
                        OdbcConnection connection = di.Connection;

                        if (ShouldProcess(newTableName, "create"))
                        {
                            OdbcCommand cmd = new OdbcCommand(sql,
connection);

                            cmd.ExecuteScalar();
                        }
                    }
                    catch (Exception ex)
                    {
                        WriteError(new ErrorRecord(ex,
"CannotCreateSpecifiedTable",
                                    ErrorCategory.InvalidOperation, path)
                                    );
                    }
                } // if (String...
                else if (String.Equals(type, "row",
StringComparison.OrdinalIgnoreCase))
                {
                    throw new
                        ArgumentException("A row cannot be created under a
database, specify a path that represents a Table");
                }
            }// if (PathIsDrive...
            else
            {
                if (String.Equals(type, "table",
StringComparison.OrdinalIgnoreCase))
                {
                    if (rowNumber < 0)
                    {
                        throw new
                            ArgumentException("A table cannot be created
within another table, specify a path that represents a database");
                    }
                    else
                    {
                        throw new
                            ArgumentException("A table cannot be created
inside a row, specify a path that represents a database");
                    }
                } //if (String.Equals....
                // if path specified is a row, create a new row
```

```
                else if (String.Equals(type, "row",
StringComparison.OrdinalIgnoreCase))
                {
                    // The user is required to specify the values to be
inserted
                    // into the table in a single string separated by commas
                    string value = newItemValue as string;

                    if (String.IsNullOrEmpty(value))
                    {
                        throw new
                            ArgumentException("Value argument must have
comma separated values of each column in a row");
                    }
                    string[] rowValues = value.Split(',');

                    OdbcDataAdapter da = GetAdapterForTable(tableName);

                    if (da == null)
                    {
                        return;
                    }

                    DataSet ds = GetDataSetForTable(da, tableName);
                    DataTable table = GetDataTable(ds, tableName);

                    if (rowValues.Length != table.Columns.Count)
                    {
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                              "The table has {0} columns and
the value specified must have so many comma separated values",
                                                  table.Columns.Count);

                        throw new ArgumentException(message);
                    }

                    if (!Force && (rowNumber >= 0 && rowNumber <
table.Rows.Count))
                    {
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                              "The row {0} already exists. To
create a new row specify row number as {1}, or specify path to a table, or
use the -Force parameter",
                                                  rowNumber,
table.Rows.Count);

                        throw new ArgumentException(message);
                    }

                    if (rowNumber > table.Rows.Count)
                    {
                        string message =
String.Format(CultureInfo.CurrentCulture,
```

```
                                                "To create a new row specify row
number as {0}, or specify path to a table",
                                                    table.Rows.Count);

                        throw new ArgumentException(message);
                    }

                    // Create a new row and update the row with the input
                    // provided by the user
                    DataRow row = table.NewRow();
                    for (int i = 0; i < rowValues.Length; i++)
                    {
                        row[i] = rowValues[i];
                    }
                    table.Rows.Add(row);

                    if (ShouldProcess(tableName, "update rows"))
                    {
                        // Update the table from memory back to the data
source
                        da.Update(ds, tableName);
                    }

                }// else if (String...
            }// else ...

        } // NewItem

        /// <summary>
        /// Copies an item at the specified path to the location specified
        /// </summary>
        ///
        /// <param name="path">
        /// Path of the item to copy
        /// </param>
        ///
        /// <param name="copyPath">
        /// Path of the item to copy to
        /// </param>
        ///
        /// <param name="recurse">
        /// Tells the provider to recurse subcontainers when copying
        /// </param>
        ///
        protected override void CopyItem(string path, string copyPath, bool
recurse)
        {
            string tableName, copyTableName;
            int rowNumber, copyRowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);
            PathType copyType = GetNamesFromPath(copyPath, out
copyTableName, out copyRowNumber);
```

```
            if (type == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(path);
            }

            if (type == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(copyPath);
            }

            // Get the table and the table to copy to
            OdbcDataAdapter da = GetAdapterForTable(tableName);
            if (da == null)
            {
                return;
            }

            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);

            OdbcDataAdapter cda = GetAdapterForTable(copyTableName);
            if (cda == null)
            {
                return;
            }

            DataSet cds = GetDataSetForTable(cda, copyTableName);
            DataTable copyTable = GetDataTable(cds, copyTableName);

            // if source represents a table
            if (type == PathType.Table)
            {
                // if copyPath does not represent a table
                if (copyType != PathType.Table)
                {
                    ArgumentException e = new ArgumentException("Table can
only be copied on to another table location");

                    WriteError(new ErrorRecord(e, "PathNotValid",
                        ErrorCategory.InvalidArgument, copyPath));

                    throw e;
                }

                // if table already exists then force parameter should be
set
                // to force a copy
                if (!Force && GetTable(copyTableName) != null)
                {
                    throw new ArgumentException("Specified path already
exists");
                }

                for (int i = 0; i < table.Rows.Count; i++)
                {
```

```
                    DataRow row = table.Rows[i];
                    DataRow copyRow = copyTable.NewRow();

                    copyRow.ItemArray = row.ItemArray;
                    copyTable.Rows.Add(copyRow);
                }
            } // if (type == ...
            // if source represents a row
            else
            {
                if (copyType == PathType.Row)
                {
                    if (!Force && (copyRowNumber < copyTable.Rows.Count))
                    {
                        throw new ArgumentException("Specified path already
exists.");
                    }

                    DataRow row = table.Rows[rowNumber];
                    DataRow copyRow = null;

                    if (copyRowNumber < copyTable.Rows.Count)
                    {
                        // copy to an existing row
                        copyRow = copyTable.Rows[copyRowNumber];
                        copyRow.ItemArray = row.ItemArray;
                        copyRow[0] = GetNextID(copyTable);
                    }
                    else if (copyRowNumber == copyTable.Rows.Count)
                    {
                        // copy to the next row in the table that will
                        // be created
                        copyRow = copyTable.NewRow();
                        copyRow.ItemArray = row.ItemArray;
                        copyRow[0] = GetNextID(copyTable);
                        copyTable.Rows.Add(copyRow);
                    }
                    else
                    {
                        // attempting to copy to a nonexistent row or a row
                        // that cannot be created now - throw an exception
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                                "The item cannot be specified to
the copied row. Specify row number as {0}, or specify a path to the table.",
                                                    table.Rows.Count);

                        throw new ArgumentException(message);
                    }
                }
                else
                {
                    // destination path specified represents a table,
                    // create a new row and copy the item
                    DataRow copyRow = copyTable.NewRow();
```

```
                    copyRow.ItemArray = table.Rows[rowNumber].ItemArray;
                    copyRow[0] = GetNextID(copyTable);
                    copyTable.Rows.Add(copyRow);
                }
            }

            if (ShouldProcess(copyTableName, "CopyItems"))
            {
                cda.Update(cds, copyTableName);
            }

        } //CopyItem

        /// <summary>
        /// Removes (deletes) the item at the specified path
        /// </summary>
        ///
        /// <param name="path">
        /// The path to the item to remove.
        /// </param>
        ///
        /// <param name="recurse">
        /// True if all children in a subtree should be removed, false if
only
        /// the item at the specified path should be removed. Is applicable
        /// only for container (table) items. Its ignored otherwise (even if
        /// specified).
        /// </param>
        ///
        /// <remarks>
        /// There are no elements in this store which are hidden from the
user.
        /// Hence this method will not check for the presence of the Force
        /// parameter
        /// </remarks>
        ///
        protected override void RemoveItem(string path, bool recurse)
        {
            string tableName;
            int rowNumber = 0;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type == PathType.Table)
            {
                // if recurse flag has been specified, delete all the rows
as well
                if (recurse)
                {
                    OdbcDataAdapter da = GetAdapterForTable(tableName);
                    if (da == null)
                    {
                        return;
                    }
```

```
                DataSet ds = GetDataSetForTable(da, tableName);
                DataTable table = GetDataTable(ds, tableName);

                for (int i = 0; i < table.Rows.Count; i++)
                {
                    table.Rows[i].Delete();
                }

                if (ShouldProcess(path, "RemoveItem"))
                {
                    da.Update(ds, tableName);
                    RemoveTable(tableName);
                }
            }//if (recurse...
            else
            {
                // Remove the table
                if (ShouldProcess(path, "RemoveItem"))
                {
                    RemoveTable(tableName);
                }
            }
        }
        else if (type == PathType.Row)
        {
            OdbcDataAdapter da = GetAdapterForTable(tableName);
            if (da == null)
            {
                return;
            }

            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);

            table.Rows[rowNumber].Delete();

            if (ShouldProcess(path, "RemoveItem"))
            {
                da.Update(ds, tableName);
            }
        }
        else
        {
            ThrowTerminatingInvalidPathException(path);
        }

    } // RemoveItem

    #endregion Container Overloads

#region Navigation

    /// <summary>
    /// Determine if the path specified is that of a container.
```

```
        /// </summary>
        /// <param name="path">The path to check.</param>
        /// <returns>True if the path specifies a container.</returns>
        protected override bool IsItemContainer(string path)
        {
            if (PathIsDrive(path))
            {
                return true;
            }

            string[] pathChunks = ChunkPath(path);
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type == PathType.Table)
            {
                foreach (DatabaseTableInfo ti in GetTables())
                {
                    if (string.Equals(ti.Name, tableName,
StringComparison.OrdinalIgnoreCase))
                    {
                        return true;
                    }
                } // foreach (DatabaseTableInfo...
            } // if (pathChunks...

            return false;
        } // IsItemContainer

        /// <summary>
        /// Get the name of the leaf element in the specified path
        /// </summary>
        ///
        /// <param name="path">
        /// The full or partial provider specific path
        /// </param>
        ///
        /// <returns>
        /// The leaf element in the path
        /// </returns>
        protected override string GetChildName(string path)
        {
            if (PathIsDrive(path))
            {
                return path;
            }

            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);
```

```
            if (type == PathType.Table)
            {
                return tableName;
            }
            else if (type == PathType.Row)
            {
                return rowNumber.ToString(CultureInfo.CurrentCulture);
            }
            else
            {
                ThrowTerminatingInvalidPathException(path);
            }

            return null;
        }

        /// <summary>
        /// Removes the child segment of the path and returns the remaining
        /// parent portion
        /// </summary>
        ///
        /// <param name="path">
        /// A full or partial provider specific path. The path may be to an
        /// item that may or may not exist.
        /// </param>
        ///
        /// <param name="root">
        /// The fully qualified path to the root of a drive. This parameter
        /// may be null or empty if a mounted drive is not in use for this
        /// operation.  If this parameter is not null or empty the result
        /// of the method should not be a path to a container that is a
        /// parent or in a different tree than the root.
        /// </param>
        ///
        /// <returns></returns>

        protected override string GetParentPath(string path, string root)
        {
            // If root is specified then the path has to contain
            // the root. If not nothing should be returned
            if (!String.IsNullOrEmpty(root))
            {
                if (!path.Contains(root))
                {
                    return null;
                }
            }

            return path.Substring(0, path.LastIndexOf(pathSeparator,
StringComparison.OrdinalIgnoreCase));
        }

        /// <summary>
        /// Joins two strings with a provider specific path separator.
```

```
        /// </summary>
        ///
        /// <param name="parent">
        /// The parent segment of a path to be joined with the child.
        /// </param>
        ///
        /// <param name="child">
        /// The child segment of a path to be joined with the parent.
        /// </param>
        ///
        /// <returns>
        /// A string that represents the parent and child segments of the
path
        /// joined by a path separator.
        /// </returns>

        protected override string MakePath(string parent, string child)
        {
            string result;

            string normalParent = NormalizePath(parent);
            normalParent = RemoveDriveFromPath(normalParent);
            string normalChild = NormalizePath(child);
            normalChild = RemoveDriveFromPath(normalChild);

            if (String.IsNullOrEmpty(normalParent) &&
String.IsNullOrEmpty(normalChild))
            {
                result = String.Empty;
            }
            else if (String.IsNullOrEmpty(normalParent) &&
!String.IsNullOrEmpty(normalChild))
            {
                result = normalChild;
            }
            else if (!String.IsNullOrEmpty(normalParent) &&
String.IsNullOrEmpty(normalChild))
            {
                if (normalParent.EndsWith(pathSeparator,
StringComparison.OrdinalIgnoreCase))
                {
                    result = normalParent;
                }
                else
                {
                    result = normalParent + pathSeparator;
                }
            } // else if (!String...
            else
            {
                if (!normalParent.Equals(String.Empty,
StringComparison.OrdinalIgnoreCase) &&
                    !normalParent.EndsWith(pathSeparator,
StringComparison.OrdinalIgnoreCase))
                {
```

```
                    result = normalParent + pathSeparator;
                }
                else
                {
                    result = normalParent;
                }

                if (normalChild.StartsWith(pathSeparator,
StringComparison.OrdinalIgnoreCase))
                {
                    result += normalChild.Substring(1);
                }
                else
                {
                    result += normalChild;
                }
            } // else

            return result;
        } // MakePath

        /// <summary>
        /// Normalizes the path that was passed in and returns the
normalized
        /// path as a relative path to the basePath that was passed.
        /// </summary>
        ///
        /// <param name="path">
        /// A fully qualified provider specific path to an item.  The item
        /// should exist or the provider should write out an error.
        /// </param>
        ///
        /// <param name="basepath">
        /// The path that the return value should be relative to.
        /// </param>
        ///
        /// <returns>
        /// A normalized path that is relative to the basePath that was
        /// passed.  The provider should parse the path parameter, normalize
        /// the path, and then return the normalized path relative to the
        /// basePath.
        /// </returns>

        protected override string NormalizeRelativePath(string path,
                                                         string
basepath)
        {
            // Normalize the paths first
            string normalPath = NormalizePath(path);
            normalPath = RemoveDriveFromPath(normalPath);
            string normalBasePath = NormalizePath(basepath);
            normalBasePath = RemoveDriveFromPath(normalBasePath);

            if (String.IsNullOrEmpty(normalBasePath))
            {
```

```
                return normalPath;
            }
            else
            {
                if (!normalPath.Contains(normalBasePath))
                {
                    return null;
                }

                return normalPath.Substring(normalBasePath.Length +
pathSeparator.Length);
            }
        }

        /// <summary>
        /// Moves the item specified by the path to the specified
destination
        /// </summary>
        ///
        /// <param name="path">
        /// The path to the item to be moved
        /// </param>
        ///
        /// <param name="destination">
        /// The path of the destination container
        /// </param>

        protected override void MoveItem(string path, string destination)
        {
            // Get type, table name and rowNumber from the path
            string tableName, destTableName;
            int rowNumber, destRowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            PathType destType = GetNamesFromPath(destination, out
destTableName,
                                        out destRowNumber);

            if (type == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(path);
            }

            if (destType == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(destination);
            }

            if (type == PathType.Table)
            {
                ArgumentException e = new ArgumentException("Move not
supported for tables");
```

```
                WriteError(new ErrorRecord(e, "MoveNotSupported",
                    ErrorCategory.InvalidArgument, path));

                throw e;
            }
            else
            {
                OdbcDataAdapter da = GetAdapterForTable(tableName);
                if (da == null)
                {
                    return;
                }

                DataSet ds = GetDataSetForTable(da, tableName);
                DataTable table = GetDataTable(ds, tableName);

                OdbcDataAdapter dda = GetAdapterForTable(destTableName);
                if (dda == null)
                {
                    return;
                }

                DataSet dds = GetDataSetForTable(dda, destTableName);
                DataTable destTable = GetDataTable(dds, destTableName);
                DataRow row = table.Rows[rowNumber];

                if (destType == PathType.Table)
                {
                    DataRow destRow = destTable.NewRow();

                    destRow.ItemArray = row.ItemArray;
                }
                else
                {
                    DataRow destRow = destTable.Rows[destRowNumber];

                    destRow.ItemArray = row.ItemArray;
                }

                // Update the changes
                if (ShouldProcess(path, "MoveItem"))
                {
                    WriteItemObject(row, path, false);
                    dda.Update(dds, destTableName);
                }
            }
        }

        #endregion Navigation

    #region Helper Methods

        /// <summary>
        /// Checks if a given path is actually a drive name.
        /// </summary>
```

```
        /// <param name="path">The path to check.</param>
        /// <returns>
        /// True if the path given represents a drive, false otherwise.
        /// </returns>
        private bool PathIsDrive(string path)
        {
            // Remove the drive name and first path separator.  If the
            // path is reduced to nothing, it is a drive. Also if its
            // just a drive then there wont be any path separators
            if (String.IsNullOrEmpty(
                        path.Replace(this.PSDriveInfo.Root, "")) ||
                String.IsNullOrEmpty(
                        path.Replace(this.PSDriveInfo.Root + pathSeparator,
""))

               )
            {
                return true;
            }
            else
            {
                return false;
            }
        } // PathIsDrive

        /// <summary>
        /// Breaks up the path into individual elements.
        /// </summary>
        /// <param name="path">The path to split.</param>
        /// <returns>An array of path segments.</returns>
        private string[] ChunkPath(string path)
        {
            // Normalize the path before splitting
            string normalPath = NormalizePath(path);

            // Return the path with the drive name and first path
            // separator character removed, split by the path separator.
            string pathNoDrive = normalPath.Replace(this.PSDriveInfo.Root
                                        + pathSeparator, "");

            return pathNoDrive.Split(pathSeparator.ToCharArray());
        } // ChunkPath

        /// <summary>
        /// Adapts the path, making sure the correct path separator
        /// character is used.
        /// </summary>
        /// <param name="path"></param>
        /// <returns></returns>
        private string NormalizePath(string path)
        {
            string result = path;

            if (!String.IsNullOrEmpty(path))
            {
```

```
                result = path.Replace("/", pathSeparator);
            }

            return result;
        } // NormalizePath

        /// <summary>
        /// Ensures that the drive is removed from the specified path
        /// </summary>
        ///
        /// <param name="path">Path from which drive needs to be
removed</param>
        /// <returns>Path with drive information removed</returns>
        private string RemoveDriveFromPath(string path)
        {
            string result = path;
            string root;

            if (this.PSDriveInfo == null)
            {
                root = String.Empty;
            }
            else
            {
                root = this.PSDriveInfo.Root;
            }

            if (result == null)
            {
                result = String.Empty;
            }

            if (result.Contains(root))
            {
                result = result.Substring(result.IndexOf(root,
StringComparison.OrdinalIgnoreCase) + root.Length);
            }

            return result;
        }

        /// <summary>
        /// Chunks the path and returns the table name and the row number
        /// from the path
        /// </summary>
        /// <param name="path">Path to chunk and obtain information</param>
        /// <param name="tableName">Name of the table as represented in the
        /// path</param>
        /// <param name="rowNumber">Row number obtained from the
path</param>
        /// <returns>what the path represents</returns>
        public PathType GetNamesFromPath(string path, out string tableName,
out int rowNumber)
        {
            PathType retVal = PathType.Invalid;
```

```
            rowNumber = -1;
            tableName = null;

            // Check if the path specified is a drive
            if (PathIsDrive(path))
            {
                return PathType.Database;
            }

            // chunk the path into parts
            string[] pathChunks = ChunkPath(path);

            switch (pathChunks.Length)
            {
                case 1:
                    {
                        string name = pathChunks[0];

                        if (TableNameIsValid(name))
                        {
                            tableName = name;
                            retVal = PathType.Table;
                        }
                    }
                    break;

                case 2:
                    {
                        string name = pathChunks[0];

                        if (TableNameIsValid(name))
                        {
                            tableName = name;
                        }

                        int number = SafeConvertRowNumber(pathChunks[1]);

                        if (number >= 0)
                        {
                            rowNumber = number;
                            retVal = PathType.Row;
                        }
                        else
                        {
                            WriteError(new ErrorRecord(
                                new ArgumentException("Row number is not
valid"),
                                "RowNumberNotValid",
                                ErrorCategory.InvalidArgument,
                                path));
                        }
                    }
                    break;

                default:
```

```
                    {
                        WriteError(new ErrorRecord(
                            new ArgumentException("The path supplied has too
many segments"),
                            "PathNotValid",
                            ErrorCategory.InvalidArgument,
                            path));
                    }
                    break;
            } // switch(pathChunks...

            return retVal;
        } // GetNamesFromPath

        /// <summary>
        /// Throws an argument exception stating that the specified path
does
        /// not represent either a table or a row
        /// </summary>
        /// <param name="path">path which is invalid</param>
        private void ThrowTerminatingInvalidPathException(string path)
        {
            StringBuilder message = new StringBuilder("Path must represent
either a table or a row :");
            message.Append(path);

            throw new ArgumentException(message.ToString());
        }

        /// <summary>
        /// Retrieve the list of tables from the database.
        /// </summary>
        /// <returns>
        /// Collection of DatabaseTableInfo objects, each object
representing
        /// information about one database table
        /// </returns>
        internal Collection<DatabaseTableInfo> GetTables()
        {
            Collection<DatabaseTableInfo> results =
                    new Collection<DatabaseTableInfo>();

            // using ODBC connection to the database and get the schema of
tables
            AccessDBPSDriveInfo di = this.PSDriveInfo as
AccessDBPSDriveInfo;

            if (di == null)
            {
                return null;
            }

            OdbcConnection connection = di.Connection;
            DataTable dt = connection.GetSchema("Tables");
            int count;
```

```
            // iterate through all rows in the schema and create
DatabaseTableInfo
            // objects which represents a table
            foreach (DataRow dr in dt.Rows)
            {
                String tableName = dr["TABLE_NAME"] as String;
                DataColumnCollection columns = null;

                // find the number of rows in the table
                try
                {
                    String cmd = "Select count(*) from \"" + tableName +
"\"";
                    OdbcCommand command = new OdbcCommand(cmd, connection);

                    count = (Int32)command.ExecuteScalar();
                }
                catch
                {
                    count = 0;
                }

                // create DatabaseTableInfo object representing the table
                DatabaseTableInfo table =
                        new DatabaseTableInfo(dr, tableName, count,
columns);

                results.Add(table);
            } // foreach (DataRow...

            return results;
        } // GetTables

        /// <summary>
        /// Return row information from a specified table.
        /// </summary>
        /// <param name="tableName">The name of the database table from
        /// which to retrieve rows.</param>
        /// <returns>Collection of row information objects.</returns>
        public Collection<DatabaseRowInfo> GetRows(string tableName)
        {
            Collection<DatabaseRowInfo> results =
                        new Collection<DatabaseRowInfo>();

            // Obtain rows in the table and add it to the collection
            try
            {
                OdbcDataAdapter da = GetAdapterForTable(tableName);

                if (da == null)
                {
                    return null;
                }
```

```
                DataSet ds = GetDataSetForTable(da, tableName);
                DataTable table = GetDataTable(ds, tableName);

                int i = 0;
                foreach (DataRow row in table.Rows)
                {
                    results.Add(new DatabaseRowInfo(row,
i.ToString(CultureInfo.CurrentCulture)));
                    i++;
                } // foreach (DataRow...
            }
            catch (Exception e)
            {
                WriteError(new ErrorRecord(e, "CannotAccessSpecifiedRows",
                    ErrorCategory.InvalidOperation, tableName));
            }

            return results;

        } // GetRows

        /// <summary>
        /// Retrieve information about a single table.
        /// </summary>
        /// <param name="tableName">The table for which to retrieve
        /// data.</param>
        /// <returns>Table information.</returns>
        private DatabaseTableInfo GetTable(string tableName)
        {
            foreach (DatabaseTableInfo table in GetTables())
            {
                if (String.Equals(tableName, table.Name,
StringComparison.OrdinalIgnoreCase))
                {
                    return table;
                }
            }

            return null;
        } // GetTable

        /// <summary>
        /// Removes the specified table from the database
        /// </summary>
        /// <param name="tableName">Name of the table to remove</param>
        private void RemoveTable(string tableName)
        {
            // validate if tablename is valid and if table is present
            if (String.IsNullOrEmpty(tableName) ||
!TableNameIsValid(tableName) || !TableIsPresent(tableName))
            {
                return;
            }

            // Execute command using ODBC connection to remove a table
```

```
            try
            {
                // delete the table using an sql statement
                string sql = "drop table " + tableName;

                AccessDBPSDriveInfo di = this.PSDriveInfo as
AccessDBPSDriveInfo;

                if (di == null)
                {
                    return;
                }
                OdbcConnection connection = di.Connection;

                OdbcCommand cmd = new OdbcCommand(sql, connection);
                cmd.ExecuteScalar();
            }
            catch (Exception ex)
            {
                WriteError(new ErrorRecord(ex, "CannotRemoveSpecifiedTable",
                          ErrorCategory.InvalidOperation, null)
                          );
            }

        } // RemoveTable

        /// <summary>
        /// Obtain a data adapter for the specified Table
        /// </summary>
        /// <param name="tableName">Name of the table to obtain the
        /// adapter for</param>
        /// <returns>Adapter object for the specified table</returns>
        /// <remarks>An adapter serves as a bridge between a DataSet (in
memory
        /// representation of table) and the data source</remarks>
        internal OdbcDataAdapter GetAdapterForTable(string tableName)
        {
            OdbcDataAdapter da = null;
            AccessDBPSDriveInfo di = this.PSDriveInfo as
AccessDBPSDriveInfo;

            if (di == null || !TableNameIsValid(tableName) ||
!TableIsPresent(tableName))
            {
                return null;
            }

            OdbcConnection connection = di.Connection;

            try
            {
                // Create a odbc data adpater. This can be sued to update
the
                // data source with the records that will be created here
                // using data sets
```

```
                string sql = "Select * from " + tableName;
                da = new OdbcDataAdapter(new OdbcCommand(sql, connection));

                // Create a odbc command builder object. This will create
sql
                // commands automatically for a single table, thus
                // eliminating the need to create new sql statements for
                // every operation to be done.
                OdbcCommandBuilder cmd = new OdbcCommandBuilder(da);

                // Set the delete cmd for the table here
                sql = "Delete from " + tableName + " where ID = ?";
                da.DeleteCommand = new OdbcCommand(sql, connection);

                // Specify a DeleteCommand parameter based on the "ID"
                // column
                da.DeleteCommand.Parameters.Add(new OdbcParameter());
                da.DeleteCommand.Parameters[0].SourceColumn = "ID";

                // Create an InsertCommand based on the sql string
                // Insert into "tablename" values (?,?,?)" where
                // ? represents a column in the table. Note that
                // the number of ? will be equal to the number of
                // columnds
                DataSet ds = new DataSet();
                ds.Locale = CultureInfo.InvariantCulture;

                da.FillSchema(ds, SchemaType.Source);

                sql = "Insert into " + tableName + " values ( ";
                for (int i = 0; i < ds.Tables["Table"].Columns.Count; i++)
                {
                    sql += "?, ";
                }
                sql = sql.Substring(0, sql.Length - 2);
                sql += ")";
                da.InsertCommand = new OdbcCommand(sql, connection);

                // Create parameters for the InsertCommand based on the
                // captions of each column
                for (int i = 0; i < ds.Tables["Table"].Columns.Count; i++)
                {
                    da.InsertCommand.Parameters.Add(new OdbcParameter());
                    da.InsertCommand.Parameters[i].SourceColumn =
                                    ds.Tables["Table"].Columns[i].Caption;

                }

                // Open the connection if its not already open
                if (connection.State != ConnectionState.Open)
                {
                    connection.Open();
                }
            }
            catch (Exception e)
```

```
            {
                WriteError(new ErrorRecord(e, "CannotAccessSpecifiedTable",
                  ErrorCategory.InvalidOperation, tableName));
            }

            return da;
        } // GetAdapterForTable

        /// <summary>
        /// Gets the DataSet (in memory representation) for the table
        /// for the specified adapter
        /// </summary>
        /// <param name="adapter">Adapter to be used for obtaining
        /// the table</param>
        /// <param name="tableName">Name of the table for which a
        /// DataSet is required</param>
        /// <returns>The DataSet with the filled in schema</returns>
        internal DataSet GetDataSetForTable(OdbcDataAdapter adapter, string
tableName)
        {
            Debug.Assert(adapter != null);

            // Create a dataset object which will provide an in-memory
            // representation of the data being worked upon in the
            // data source.
            DataSet ds = new DataSet();

            // Create a table named "Table" which will contain the same
            // schema as in the data source.
            //adapter.FillSchema(ds, SchemaType.Source);
            adapter.Fill(ds, tableName);
            ds.Locale = CultureInfo.InvariantCulture;

            return ds;
        } //GetDataSetForTable

        /// <summary>
        /// Get the DataTable object which can be used to operate on
        /// for the specified table in the data source
        /// </summary>
        /// <param name="ds">DataSet object which contains the tables
        /// schema</param>
        /// <param name="tableName">Name of the table</param>
        /// <returns>Corresponding DataTable object representing
        /// the table</returns>
        ///
        internal DataTable GetDataTable(DataSet ds, string tableName)
        {
            Debug.Assert(ds != null);
            Debug.Assert(tableName != null);

            DataTable table = ds.Tables[tableName];
            table.Locale = CultureInfo.InvariantCulture;

            return table;
```

```
        } // GetDataTable

        /// <summary>
        /// Retrieves a single row from the named table.
        /// </summary>
        /// <param name="tableName">The table that contains the
        /// numbered row.</param>
        /// <param name="row">The index of the row to return.</param>
        /// <returns>The specified table row.</returns>
        private DatabaseRowInfo GetRow(string tableName, int row)
        {
            Collection<DatabaseRowInfo> di = GetRows(tableName);

            // if the row is invalid write an appropriate error else return
the
            // corresponding row information
            if (row < di.Count && row >= 0)
            {
                return di[row];
            }
            else
            {
                WriteError(new ErrorRecord(
                   new ItemNotFoundException(),
                   "RowNotFound",
                   ErrorCategory.ObjectNotFound,
                   row.ToString(CultureInfo.CurrentCulture))
                );
            }

            return null;
        } // GetRow

        /// <summary>
        /// Method to safely convert a string representation of a row number
        /// into its Int32 equivalent
        /// </summary>
        /// <param name="rowNumberAsStr">String representation of the row
        /// number</param>
        /// <remarks>If there is an exception, -1 is returned</remarks>
        private int SafeConvertRowNumber(string rowNumberAsStr)
        {
            int rowNumber = -1;
            try
            {
                rowNumber = Convert.ToInt32(rowNumberAsStr,
CultureInfo.CurrentCulture);
            }
            catch (FormatException fe)
            {
                WriteError(new ErrorRecord(fe, "RowStringFormatNotValid",
                    ErrorCategory.InvalidData, rowNumberAsStr));
            }
            catch (OverflowException oe)
            {
```

```
                WriteError(new ErrorRecord(oe,
"RowStringConversionToNumberFailed",
                    ErrorCategory.InvalidData, rowNumberAsStr));
            }

            return rowNumber;
        } // 1


        /// <summary>
        /// Check if a table name is valid
        /// </summary>
        /// <param name="tableName">Table name to validate</param>
        /// <remarks>Helps to check for SQL injection attacks</remarks>
        private bool TableNameIsValid(string tableName)
        {
            Regex exp = new Regex(pattern, RegexOptions.Compiled |
RegexOptions.IgnoreCase);

            if (exp.IsMatch(tableName))
            {
                return true;
            }
            WriteError(new ErrorRecord(
                new ArgumentException("Table name not valid"),
"TableNameNotValid",
                    ErrorCategory.InvalidArgument, tableName));
            return false;
        } // TableNameIsValid

        /// <summary>
        /// Checks to see if the specified table is present in the
        /// database
        /// </summary>
        /// <param name="tableName">Name of the table to check</param>
        /// <returns>true, if table is present, false otherwise</returns>
        private bool TableIsPresent(string tableName)
        {
            // using ODBC connection to the database and get the schema of
tables
            AccessDBPSDriveInfo di = this.PSDriveInfo as AccessDBPSDriveInfo;
            if (di == null)
            {
                return false;
            }

            OdbcConnection connection = di.Connection;
            DataTable dt = connection.GetSchema("Tables");

            // check if the specified tableName is available
            // in the list of tables present in the database
            foreach (DataRow dr in dt.Rows)
            {
                string name = dr["TABLE_NAME"] as string;
                if (name.Equals(tableName,
```

```
StringComparison.OrdinalIgnoreCase))
                {
                    return true;
                }
            }

            WriteError(new ErrorRecord(
                new ArgumentException("Specified Table is not present in
database"), "TableNotAvailable",
                      ErrorCategory.InvalidArgument, tableName));

            return false;
        }// TableIsPresent

        /// <summary>
        /// Gets the next available ID in the table
        /// </summary>
        /// <param name="table">DataTable object representing the table to
        /// search for ID</param>
        /// <returns>next available id</returns>
        private int GetNextID(DataTable table)
        {
            int big = 0;

            for (int i = 0; i < table.Rows.Count; i++)
            {
                DataRow row = table.Rows[i];

                int id = (int)row["ID"];

                if (big < id)
                {
                    big = id;
                }
            }

            big++;
            return big;
        }
        #endregion Helper Methods

        #region Content Methods

        /// <summary>
        /// Clear the contents at the specified location. In this case,
clearing
        /// the item amounts to clearing a row
        /// </summary>
        /// <param name="path">The path to the content to clear.</param>
        public void ClearContent(string path)
        {
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
```

```
rowNumber);

            if (type != PathType.Table)
            {
                WriteError(new ErrorRecord(
                    new InvalidOperationException("Operation not supported.
Content can be cleared only for table"),
                        "NotValidRow", ErrorCategory.InvalidArgument,
                            path));
                return;
            }

            OdbcDataAdapter da = GetAdapterForTable(tableName);

            if (da == null)
            {
                return;
            }

            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);

            // Clear contents at the specified location
            for (int i = 0; i < table.Rows.Count; i++)
            {
                table.Rows[i].Delete();
            }

            if (ShouldProcess(path, "ClearContent"))
            {
                da.Update(ds, tableName);
            }

        } // ClearContent

        /// <summary>
        /// Not implemented.
        /// </summary>
        /// <param name="path"></param>
        /// <returns></returns>
        public object ClearContentDynamicParameters(string path)
        {
            return null;
        }

        /// <summary>
        /// Get a reader at the path specified.
        /// </summary>
        /// <param name="path">The path from which to read.</param>
        /// <returns>A content reader used to read the data.</returns>
        public IContentReader GetContentReader(string path)
        {
            string tableName;
            int rowNumber;
```

```
            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(path);
            }
            else if (type == PathType.Row)
            {
                throw new InvalidOperationException("contents can be obtained
only for tables");
            }

            return new AccessDBContentReader(path, this);
        } // GetContentReader

        /// <summary>
        /// Not implemented.
        /// </summary>
        /// <param name="path"></param>
        /// <returns></returns>
        public object GetContentReaderDynamicParameters(string path)
        {
            return null;
        }

        /// <summary>
        /// Get an object used to write content.
        /// </summary>
        /// <param name="path">The root path at which to write.</param>
        /// <returns>A content writer for writing.</returns>
        public IContentWriter GetContentWriter(string path)
        {
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(path);
            }
            else if (type == PathType.Row)
            {
                throw new InvalidOperationException("contents can be added
only to tables");
            }

            return new AccessDBContentWriter(path, this);
        }

        /// <summary>
        /// Not implemented.
        /// </summary>
```

```
        /// <param name="path"></param>
        /// <returns></returns>
        public object GetContentWriterDynamicParameters(string path)
        {
            return null;
        }

        #endregion Content Methods

        #region Private Properties

        private string pathSeparator = "\\";
        private static string pattern = @"^[a-z]+[0-9]*_*$";

        #endregion Private Properties

    } // AccessDBProvider

    #endregion AccessDBProvider

     #region Helper Classes

    #region Public Enumerations

    /// <summary>
    /// Type of item represented by the path
    /// </summary>
    public enum PathType
    {
        /// <summary>
        /// Represents a database
        /// </summary>
        Database,
        /// <summary>
        /// Represents a table
        /// </summary>
        Table,
        /// <summary>
        /// Represents a row
        /// </summary>
        Row,
        /// <summary>
        /// Represents an invalid path
        /// </summary>
        Invalid
    };

    #endregion Public Enumerations

     #region AccessDBPSDriveInfo

     /// <summary>
     /// Any state associated with the drive should be held here.
     /// In this case, it's the connection to the database.
     /// </summary>
```

```
internal class AccessDBPSDriveInfo : PSDriveInfo
{
    private OdbcConnection connection;

    /// <summary>
    /// ODBC connection information.
    /// </summary>
    public OdbcConnection Connection
    {
        get { return connection; }
        set { connection = value; }
    }

    /// <summary>
    /// Constructor that takes one argument
    /// </summary>
    /// <param name="driveInfo">Drive provided by this provider</param>
    public AccessDBPSDriveInfo(PSDriveInfo driveInfo)
        : base(driveInfo)
    { }

} // class AccessDBPSDriveInfo

#endregion AccessDBPSDriveInfo

#region DatabaseTableInfo

/// <summary>
/// Contains information specific to the database table.
/// Similar to the DirectoryInfo class.
/// </summary>
public class DatabaseTableInfo
{
    /// <summary>
    /// Row from the "tables" schema
    /// </summary>
    public DataRow Data
    {
        get
        {
            return data;
        }
        set
        {
            data = value;
        }
    }
    private DataRow data;

    /// <summary>
    /// The table name.
    /// </summary>
    public string Name
    {
        get
```

```
            {
                return name;
            }
            set
            {
                name = value;
            }
        }
        private String name;

        /// <summary>
        /// The number of rows in the table.
        /// </summary>
        public int RowCount
        {
            get
            {
                return rowCount;
            }
            set
            {
                rowCount = value;
            }
        }
        private int rowCount;

        /// <summary>
        /// The column definitions for the table.
        /// </summary>
        public DataColumnCollection Columns
        {
            get
            {
                return columns;
            }
            set
            {
                columns = value;
            }
        }
        private DataColumnCollection columns;

        /// <summary>
        /// Constructor.
        /// </summary>
        /// <param name="row">The row definition.</param>
        /// <param name="name">The table name.</param>
        /// <param name="rowCount">The number of rows in the table.</param>
        /// <param name="columns">Information on the column tables.</param>
        public DatabaseTableInfo(DataRow row, string name, int rowCount,
                        DataColumnCollection columns)
        {
            Name = name;
            Data = row;
            RowCount = rowCount;
```

```
            Columns = columns;
        } // DatabaseTableInfo
    } // class DatabaseTableInfo

    #endregion DatabaseTableInfo

    #region DatabaseRowInfo

    /// <summary>
    /// Contains information specific to an individual table row.
    /// Analogous to the FileInfo class.
    /// </summary>
    public class DatabaseRowInfo
    {
        /// <summary>
        /// Row data information.
        /// </summary>
        public DataRow Data
        {
            get
            {
                return data;
            }
            set
            {
                data = value;
            }
        }
        private DataRow data;

        /// <summary>
        /// The row index.
        /// </summary>
        public string RowNumber
        {
            get
            {
                return rowNumber;
            }
            set
            {
                rowNumber = value;
            }
        }
        private string rowNumber;

        /// <summary>
        /// Constructor.
        /// </summary>
        /// <param name="row">The row information.</param>
        /// <param name="name">The row index.</param>
        public DatabaseRowInfo(DataRow row, string name)
        {
            RowNumber = name;
            Data = row;
```

```
        } // DatabaseRowInfo
    } // class DatabaseRowInfo

    #endregion DatabaseRowInfo

    #region AccessDBContentReader

    /// <summary>
    /// Content reader used to retrieve data from this provider.
    /// </summary>
    public class AccessDBContentReader : IContentReader
    {
        // A provider instance is required so as to get "content"
        private AccessDBProvider provider;
        private string path;
        private long currentOffset;

        internal AccessDBContentReader(string path, AccessDBProvider
provider)
        {
            this.path = path;
            this.provider = provider;
        }

        /// <summary>
        /// Read the specified number of rows from the source.
        /// </summary>
        /// <param name="readCount">The number of items to
        /// return.</param>
        /// <returns>An array of elements read.</returns>
        public IList Read(long readCount)
        {
            // Read the number of rows specified by readCount and increment
            // offset
            string tableName;
            int rowNumber;
            PathType type = provider.GetNamesFromPath(path, out tableName,
out rowNumber);

            Collection<DatabaseRowInfo> rows =
                provider.GetRows(tableName);
            Collection<DataRow> results = new Collection<DataRow>();

            if (currentOffset < 0 || currentOffset >= rows.Count)
            {
                return null;
            }

            int rowsRead = 0;

            while (rowsRead < readCount && currentOffset < rows.Count)
            {
                results.Add(rows[(int)currentOffset].Data);
                rowsRead++;
                currentOffset++;
```

```
            }

            return results;
        } // Read

        /// <summary>
        /// Moves the content reader specified number of rows from the
        /// origin
        /// </summary>
        /// <param name="offset">Number of rows to offset</param>
        /// <param name="origin">Starting row from which to offset</param>
        public void Seek(long offset, System.IO.SeekOrigin origin)
        {
            // get the number of rows in the table which will help in
            // calculating current position
            string tableName;
            int rowNumber;

            PathType type = provider.GetNamesFromPath(path, out tableName,
out rowNumber);

            if (type == PathType.Invalid)
            {
                throw new ArgumentException("Path specified must represent a
table or a row :" + path);
            }

            if (type == PathType.Table)
            {
                Collection<DatabaseRowInfo> rows =
provider.GetRows(tableName);

                int numRows = rows.Count;

                if (offset > rows.Count)
                {
                    throw new
                           ArgumentException(
                               "Offset cannot be greater than the number of
rows available"
                                                );
                }

                if (origin == System.IO.SeekOrigin.Begin)
                {
                    // starting from Beginning with an index 0, the current
offset
                    // has to be advanced to offset - 1
                    currentOffset = offset - 1;
                }
                else if (origin == System.IO.SeekOrigin.End)
                {
                    // starting from the end which is numRows - 1, the
current
                    // offset is so much less than numRows - 1
```

```
                    currentOffset = numRows - 1 - offset;
                }
                else
                {
                    // calculate from the previous value of current offset
                    // advancing forward always
                    currentOffset += offset;
                }
            } // if (type...
            else
            {
                // for row, the offset will always be set to 0
                currentOffset = 0;
            }

        } // Seek

        /// <summary>
        /// Closes the content reader, so all members are reset
        /// </summary>
        public void Close()
        {
            Dispose();
        } // Close

        /// <summary>
        /// Dispose any resources being used
        /// </summary>
        public void Dispose()
        {
            Seek(0, System.IO.SeekOrigin.Begin);

            GC.SuppressFinalize(this);
        } // Dispose
    } // AccessDBContentReader

    #endregion AccessDBContentReader

    #region AccessDBContentWriter

    /// <summary>
    /// Content writer used to write data in this provider.
    /// </summary>
    public class AccessDBContentWriter : IContentWriter
    {
        // A provider instance is required so as to get "content"
        private AccessDBProvider provider;
        private string path;
        private long currentOffset;

        internal AccessDBContentWriter(string path, AccessDBProvider
provider)
        {
            this.path = path;
            this.provider = provider;
```

```
        }

        /// <summary>
        /// Write the specified row contents in the source
        /// </summary>
        /// <param name="content"> The contents to be written to the source.
        /// </param>
        /// <returns>An array of elements which were successfully written to
        /// the source</returns>
        ///
        public IList Write(IList content)
        {
            if (content == null)
            {
                return null;
            }

            // Get the total number of rows currently available it will
            // determine how much to overwrite and how much to append at
            // the end
            string tableName;
            int rowNumber;
            PathType type = provider.GetNamesFromPath(path, out tableName,
out rowNumber);

            if (type == PathType.Table)
            {
                OdbcDataAdapter da = provider.GetAdapterForTable(tableName);
                if (da == null)
                {
                    return null;
                }

                DataSet ds = provider.GetDataSetForTable(da, tableName);
                DataTable table = provider.GetDataTable(ds, tableName);

                string[] colValues = (content[0] as string).Split(',');

                // set the specified row
                DataRow row = table.NewRow();

                for (int i = 0; i < colValues.Length; i++)
                {
                    if (!String.IsNullOrEmpty(colValues[i]))
                    {
                        row[i] = colValues[i];
                    }
                }

                //table.Rows.InsertAt(row, rowNumber);
                // Update the table
                table.Rows.Add(row);
                da.Update(ds, tableName);

            }
```

```
            else
            {
                throw new InvalidOperationException("Operation not
supported. Content can be added only for tables");
            }

            return null;
        } // Write

        /// <summary>
        /// Moves the content reader specified number of rows from the
        /// origin
        /// </summary>
        /// <param name="offset">Number of rows to offset</param>
        /// <param name="origin">Starting row from which to offset</param>
        public void Seek(long offset, System.IO.SeekOrigin origin)
        {
            // get the number of rows in the table which will help in
            // calculating current position
            string tableName;
            int rowNumber;

            PathType type = provider.GetNamesFromPath(path, out tableName,
out rowNumber);

            if (type == PathType.Invalid)
            {
                throw new ArgumentException("Path specified should represent
either a table or a row : " + path);
            }

            Collection<DatabaseRowInfo> rows =
                   provider.GetRows(tableName);

            int numRows = rows.Count;

            if (offset > rows.Count)
            {
                throw new
                       ArgumentException(
                           "Offset cannot be greater than the number of rows
available"
                                                 );
            }

            if (origin == System.IO.SeekOrigin.Begin)
            {
                // starting from Beginning with an index 0, the current
offset
                // has to be advanced to offset - 1
                currentOffset = offset - 1;
            }
            else if (origin == System.IO.SeekOrigin.End)
            {
                // starting from the end which is numRows - 1, the current
```

```
                // offset is so much less than numRows - 1
                currentOffset = numRows - 1 - offset;
            }
            else
            {
                // calculate from the previous value of current offset
                // advancing forward always
                currentOffset += offset;
            }

        } // Seek

        /// <summary>
        /// Closes the content reader, so all members are reset
        /// </summary>
        public void Close()
        {
            Dispose();
        } // Close

        /// <summary>
        /// Dispose any resources being used
        /// </summary>
        public void Dispose()
        {
            Seek(0, System.IO.SeekOrigin.Begin);

            GC.SuppressFinalize(this);
        } // Dispose
    } // AccessDBContentWriter

    #endregion AccessDBContentWriter

    #endregion Helper Classes
} // namespace Microsoft.Samples.PowerShell.Providers
```

See Also

System.Management.Automation.Provider.Itemcmdletprovider

System.Management.Automation.Provider.Containercmdletprovider

System.Management.Automation.Provider.Navigationcmdletprovider

Designing Your Windows PowerShell Provider

Windows PowerShell Host Quickstart

Article • 10/04/2022

To host Windows PowerShell in your application, you use the System.Management.Automation.PowerShell class. This class provides methods that create a pipeline of commands and then execute those commands in a runspace. The simplest way to create a host application is to use the default runspace. The default runspace contains all of the core Windows PowerShell commands. If you want your application to expose only a subset of the Windows PowerShell commands, you must create a custom runspace.

Using the default runspace

To start, we'll use the default runspace, and use the methods of the System.Management.Automation.PowerShell class to add commands, parameters, statements, and scripts to a pipeline.

AddCommand

You use the System.Management.Automation.PowerShell.AddCommand method to add commands to the pipeline. For example, suppose you want to get the list of running processes on the machine. The way to run this command is as follows.

1. Create a System.Management.Automation.PowerShell object.

```
C#

PowerShell ps = PowerShell.Create();
```

2. Add the command that you want to execute.

```
C#

ps.AddCommand("Get-Process");
```

3. Invoke the command.

```
C#

ps.Invoke();
```

If you call the AddCommand method more than once before you call the System.Management.Automation.PowerShell.Invoke method, the result of the first command is piped to the second, and so on. If you do not want to pipe the result of a previous command to a command, add it by calling the System.Management.Automation.PowerShell.AddStatement instead.

AddParameter

The previous example executes a single command without any parameters. You can add parameters to the command by using the System.Management.Automation.PSCommand.AddParameter method. For example, the following code gets a list of all of the processes that are named `PowerShell` running on the machine.

C#

```
PowerShell.Create().AddCommand("Get-Process")
                   .AddParameter("Name", "PowerShell")
                   .Invoke();
```

You can add additional parameters by calling the AddParameter method repeatedly.

C#

```
PowerShell.Create().AddCommand("Get-ChildItem")
                   .AddParameter("Path", @"c:\Windows")
                   .AddParameter("Filter", "*.exe")
                   .Invoke();
```

You can also add a dictionary of parameter names and values by calling the System.Management.Automation.PowerShell.AddParameters method.

C#

```
IDictionary parameters = new Dictionary<String, String>();
parameters.Add("Path", @"c:\Windows");
parameters.Add("Filter", "*.exe");

PowerShell.Create().AddCommand("Get-Process")
   .AddParameters(parameters)
      .Invoke()
```

AddStatement

You can simulate batching by using the System.Management.Automation.PowerShell.AddStatement method, which adds an additional statement to the end of the pipeline. The following code gets a list of running processes with the name `PowerShell`, and then gets the list of running services.

```
C#

PowerShell ps = PowerShell.Create();
ps.AddCommand("Get-Process").AddParameter("Name", "PowerShell");
ps.AddStatement().AddCommand("Get-Service");
ps.Invoke();
```

AddScript

You can run an existing script by calling the System.Management.Automation.PowerShell.AddScript method. The following example adds a script to the pipeline and runs it. This example assumes there is already a script named `MyScript.ps1` in a folder named `D:\PSScripts`.

```
C#

PowerShell ps = PowerShell.Create();
ps.AddScript("D:\PSScripts\MyScript.ps1").Invoke();
```

There is also a version of the AddScript method that takes a boolean parameter named `useLocalScope`. If this parameter is set to `true`, then the script is run in the local scope. The following code will run the script in the local scope.

```
C#

PowerShell ps = PowerShell.Create();
ps.AddScript(@"D:\PSScripts\MyScript.ps1", true).Invoke();
```

Creating a custom runspace

While the default runspace used in the previous examples loads all of the core Windows PowerShell commands, you can create a custom runspace that loads only a specified subset of all commands. You might want to do this to improve performance (loading a larger number of commands is a performance hit), or to restrict the capability of the user to perform operations. A runspace that exposes only a limited number of commands is called a constrained runspace. To create a constrained runspace, you use

the System.Management.Automation.Runspaces.Runspace and System.Management.Automation.Runspaces.InitialSessionState classes.

Creating an InitialSessionState object

To create a custom runspace, you must first create an System.Management.Automation.Runspaces.InitialSessionState object. In the following example, we use the System.Management.Automation.Runspaces.RunspaceFactory to create a runspace after creating a default InitialSessionState object.

C#

```
InitialSessionState iss = InitialSessionState.CreateDefault();
Runspace rs = RunspaceFactory.CreateRunspace(iss);
rs.Open();
PowerShell ps = PowerShell.Create();
ps.Runspace = rs;
ps.AddCommand("Get-Command");
ps.Invoke();
rs.Close();
```

Constraining the runspace

In the previous example, we created a default System.Management.Automation.Runspaces.InitialSessionState object that loads all of the built-in core Windows PowerShell. We could also have called the System.Management.Automation.Runspaces.InitialSessionState.CreateDefault2 method to create an InitialSessionState object that would load only the commands in the Microsoft.PowerShell.Core snapin. To create a more constrained runspace, you must create an empty InitialSessionState object by calling the System.Management.Automation.Runspaces.InitialSessionState.Create method, and then add commands to the InitialSessionState.

Using a runspace that loads only the commands that you specify provides significantly improved performance.

You use the methods of the System.Management.Automation.Runspaces.SessionStateCmdletEntry class to define cmdlets for the initial session state. The following example creates an empty initial session state, then defines and adds the `Get-Command` and `Import-Module` commands to the initial session state. We then create a runspace constrained by that initial session state, and execute the commands in that runspace.

Create the initial session state.

```
C#

InitialSessionState iss = InitialSessionState.Create();
```

Define and add commands to the initial session state.

```
C#

SessionStateCmdletEntry getCommand = new SessionStateCmdletEntry(
    "Get-Command", typeof(Microsoft.PowerShell.Commands.GetCommandCommand),
"");
SessionStateCmdletEntry importModule = new SessionStateCmdletEntry(
    "Import-Module",
typeof(Microsoft.PowerShell.Commands.ImportModuleCommand), "");
iss.Commands.Add(getCommand);
iss.Commands.Add(importModule);
```

Create and open the runspace.

```
C#

Runspace rs = RunspaceFactory.CreateRunspace(iss);
rs.Open();
```

Execute a command and show the result.

```
C#

PowerShell ps = PowerShell.Create();
ps.Runspace = rs;
ps.AddCommand("Get-Command");
Collection<CommandInfo> result = ps.Invoke<CommandInfo>();
foreach (var entry in result)
{
    Console.WriteLine(entry.Name);
}
```

Close the runspace.

```
C#

rs.Close();
```

When run, the output of this code will look as follows.

PowerShell

```
Get-Command
Import-Module
```

Creating Runspaces

Article • 09/17/2021

A runspace is the operating environment for the commands that are invoked by a host application. This environment includes the commands and data that are currently present, and any language restrictions that currently apply.

Host applications can use the default runspace that is provided by Windows PowerShell, which includes all available core commands, or create a custom runspace that includes only a subset of the available commands. To create a customized runspace, you create an System.Management.Automation.Runspaces.Initialsessionstate object and assign it to your runspace.

Runspace tasks

1. Creating an InitialSessionState
2. Creating a constrained runspace
3. Creating multiple runspaces

See Also

Creating an InitialSessionState

Article • 10/04/2022

PowerShell commands run in a runspace. To host PowerShell in your application, you must create a System.Management.Automation.Runspaces.Runspace object. Every runspace has an System.Management.Automation.Runspaces.InitialSessionState object associated with it. The InitialSessionState specifies characteristics of the runspace, such as which commands, variables, and modules are available for that runspace.

Create a default InitialSessionState

The CreateDefault and CreateDefault2 methods of the **InitialSessionState** class can be used to create an **InitialSessionState** object. The **CreateDefault** method creates an **InitialSessionState** with all of the built-in commands loaded, while the **CreateDefault2** method loads only the commands required to host PowerShell (the commands from the Microsoft.PowerShell.Core module).

If you want to further limit the commands available in your host application you need to create a constrained runspace. For information, see Creating a constrained runspace.

The following code shows how to create an **InitialSessionState**, assign it to a runspace, add commands to the pipeline in that runspace, and invoke the commands. For more information about adding and invoking commands, see Adding and invoking commands.

C#

```
namespace SampleHost
{
  using System;
  using System.Management.Automation;
  using System.Management.Automation.Runspaces;

  class HostP4b
  {
    static void Main(string[] args)
    {
      // Call InitialSessionState.CreateDefault() to create an empty
      // InitialSessionState object, then add the variables that will be
      // available when the runspace is opened.
      InitialSessionState iss = InitialSessionState.CreateDefault();
      SessionStateVariableEntry var1 =
        new SessionStateVariableEntry("test1",
                                      "MyVar1",
                                      "Initial session state MyVar1 test");
```

```
      iss.Variables.Add(var1);

      SessionStateVariableEntry var2 =
        new SessionStateVariableEntry("test2",
                                      "MyVar2",
                                      "Initial session state MyVar2 test");
      iss.Variables.Add(var2);

      // Call RunspaceFactory.CreateRunspace(InitialSessionState) to
      // create the runspace where the pipeline is run.
      Runspace rs = RunspaceFactory.CreateRunspace(iss);
      rs.Open();

      // Call PowerShell.Create() to create the PowerShell object, then
      // specify the runspace and pipeline commands.
      PowerShell ps = PowerShell.Create();
      ps.Runspace = rs;
      ps.AddCommand("Get-Variable");
      ps.AddArgument("test*");

      Console.WriteLine("Variable            Value");
      Console.WriteLine("--------------------------");

      // Call ps.Invoke() to run the pipeline synchronously.
      foreach (PSObject result in ps.Invoke())
      {
        Console.WriteLine("{0,-20}{1}",
            result.Members["Name"].Value,
            result.Members["Value"].Value);
      } // End foreach.

      // Close the runspace to free resources.
      rs.Close();

    } // End Main.
  } // End SampleHost.
}
```

See Also

Creating a constrained runspace

Adding and invoking commands

Creating a constrained runspace

Article • 09/17/2021

For performance or security reasons, you might want to restrict the Windows PowerShell commands available to your host application. To do this you create an empty System.Management.Automation.Runspaces.Initialsessionstate by calling the System.Management.Automation.Runspaces.Initialsessionstate.Create* method, and then add only the commands you want available.

Using a runspace that loads only the commands that you specify provides significantly improved performance.

You use the methods of the System.Management.Automation.Runspaces.Sessionstatecmdletentry class to define cmdlets for the initial session state.

You can also make commands private. Private commands can be used by the host application, but not by users of the application.

Adding commands to an empty runspace

The following example demonstrates how to create an empty InitialSessionState and add commands to it.

C#

```
namespace Microsoft.Samples.PowerShell.Runspaces
{
  using System;
  using System.Collections.ObjectModel;
  using System.Management.Automation;
  using System.Management.Automation.Runspaces;
  using Microsoft.PowerShell.Commands;
  using PowerShell = System.Management.Automation.PowerShell;

  /// <summary>
  /// This class contains the Main entry point for the application.
  /// </summary>
  internal class Runspace10b
  {
    /// <summary>
    /// This sample shows how to create an empty initial session state,
    /// how to add commands to the session state, and then how to create a
    /// runspace that has only those two commands. A PowerShell object
    /// is used to run the Get-Command cmdlet to show that only two commands
    /// are available.
```

```
    /// </summary>
    /// <param name="args">Parameter not used.</param>
    private static void Main(string[] args)
    {
      // Create an empty InitialSessionState and then add two commands.
      InitialSessionState iss = InitialSessionState.Create();

      // Add the Get-Process and Get-Command cmdlets to the session state.
      SessionStateCmdletEntry ssce1 = new SessionStateCmdletEntry(
                                                              "get-process",
typeof(GetProcessCommand),
                                                              null);
      iss.Commands.Add(ssce1);

      SessionStateCmdletEntry ssce2 = new SessionStateCmdletEntry(
                                                              "get-command",
typeof(GetCommandCommand),
                                                              null);
      iss.Commands.Add(ssce2);

      // Create a runspace.
      using (Runspace myRunSpace = RunspaceFactory.CreateRunspace(iss))
      {
        myRunSpace.Open();
        using (PowerShell powershell = PowerShell.Create())
        {
          powershell.Runspace = myRunSpace;

          // Create a pipeline with the Get-Command command.
          powershell.AddCommand("get-command");

          Collection<PSObject> results = powershell.Invoke();

          Console.WriteLine("Verb                 Noun");
          Console.WriteLine("---------------------------");

          // Display each result object.
          foreach (PSObject result in results)
          {
            Console.WriteLine(
                          "{0,-20} {1}",
                          result.Members["verb"].Value,
                          result.Members["Noun"].Value);
          }
        }

        // Close the runspace and release any resources.
        myRunSpace.Close();
      }

      System.Console.WriteLine("Hit any key to exit...");
      System.Console.ReadKey();
    }
```

```
  }
}
```

Making commands private

You can also make a command private, by setting it's System.Management.Automation.Commandinfo.Visibility property to System.Management.Automation.SessionStateEntryVisibility **Private**. The host application and other commands can call that command, but the user of the application cannot. In the following example, the Get-ChildItem command is private.

C#

```
defaultSessionState = InitialSessionState.CreateDefault();
commandIndex = GetIndexOfEntry(defaultSessionState.Commands, "get-
childitem");
defaultSessionState.Commands[commandIndex].Visibility =
SessionStateEntryVisibility.Private;

this.runspace = RunspaceFactory.CreateRunspace(defaultSessionState);
this.runspace.Open();
```

See Also

Creating an InitialSessionState

Creating multiple runspaces

Article • 09/17/2021

If you create a large number of runspaces, you might consider creating a runspace pool. Using a System.Management.Automation.Runspaces.Runspacepool object, rather than creating a large number of individual runspaces with the same characteristics, can improve performance.

Creating and using a runspace pool.

The following example shows how to create a runspace pool and how to run a command asynchronously in a runspace of the pool.

C#

```
namespace HostRunspacePool
{
  using System;
  using System.Collections.ObjectModel;
  using System.Management.Automation;
  using System.Management.Automation.Runspaces;

  /// <summary>
  /// This class provides the Main entry point for the Host application.
  /// </summary>
  internal class HostRunspacePool
  {
    /// <summary>
    /// This sample demonstrates the following.
    /// 1. Creating and opening a runspace pool.
    /// 2. Creating a PowerShell object.
    /// 3. Adding commands and arguments to the PowerShell object.
    /// 4. Running the commands asynchronously using the runspace
    ///    of the runspace pool.
    /// </summary>
    /// <param name="args">Parameter is not used.</param>
    private static void Main(string[] args)
    {
      // Create a pool of runspaces.
      using (RunspacePool rsp = RunspaceFactory.CreateRunspacePool())
      {
        rsp.Open();

        // Create a PowerShell object to run the following command.
        //  get-process wmi*
        PowerShell gpc = PowerShell.Create();
        // Specify the runspace to use and add commands.
        gpc.RunspacePool = rsp;
```

```
        gpc.AddCommand("Get-Process").AddArgument("wmi*");

        // Invoke the command asynchronously.
        IAsyncResult gpcAsyncResult = gpc.BeginInvoke();
        // Get the results of running the command.
        PSDataCollection<PSObject> gpcOutput =
gpc.EndInvoke(gpcAsyncResult);

        // Process the output.
        Console.WriteLine("The output from running the command: get-process
wmi*");
        for (int i= 0; i < gpcOutput.Count; i++)
        {
         Console.WriteLine(
                           "Process Name: {0} Process Id: {1}",
                           gpcOutput[i].Properties["ProcessName"].Value,
                           gpcOutput[i].Properties["Id"].Value);
        }
      } // End using.
    } // End Main entry point.
  } // End HostPs5 class.
}
```

See Also

Creating an InitialSessionState

Adding and invoking commands

Article • 10/03/2022

After creating a runspace, you can add Windows PowerShell commands and scripts to a pipeline, and then invoke the pipeline synchronously or asynchronously.

Creating a pipeline

The System.Management.Automation.Powershell class provides several methods to add commands, parameters, and scripts to the pipeline. You can invoke the pipeline synchronously by calling an overload of the System.Management.Automation.Powershell.Invoke* method, or asynchronously by calling an overload of the System.Management.Automation.Powershell.Begininvoke* and then the System.Management.Automation.Powershell.Endinvoke* method.

AddCommand

1. Create a System.Management.Automation.Powershell object.

```
C#

PowerShell ps = PowerShell.Create();
```

2. Add the command that you want to execute.

```
C#

ps.AddCommand("Get-Process");
```

3. Invoke the command.

```
C#

ps.Invoke();
```

If you call the System.Management.Automation.Powershell.Addcommand* method more than once before you call the System.Management.Automation.Powershell.Invoke* method, the result of the first command is piped to the second, and so on. If you do not want to pipe the result of a previous command to a command, add it by calling the System.Management.Automation.Powershell.Addstatement* instead.

AddParameter

The previous example executes a single command without any parameters. You can add parameters to the command by using the System.Management.Automation.Pscommand.Addparameter* method For example, the following code gets a list of all of the processes that are named `PowerShell` running on the machine.

C#

```
PowerShell.Create().AddCommand("Get-Process")
                   .AddParameter("Name", "PowerShell")
                   .Invoke();
```

You can add additional parameters by calling System.Management.Automation.Pscommand.Addparameter* repeatedly.

C#

```
PowerShell.Create().AddCommand("Get-Command")
                   .AddParameter("Name", "Get-VM")
                   .AddParameter("Module", "Hyper-V")
                   .Invoke();
```

You can also add a dictionary of parameter names and values by calling the System.Management.Automation.Powershell.Addparameters* method.

C#

```
IDictionary parameters = new Dictionary<String, String>();
parameters.Add("Name", "Get-VM");

parameters.Add("Module", "Hyper-V");
PowerShell.Create().AddCommand("Get-Command")
   .AddParameters(parameters)
      .Invoke()
```

AddStatement

You can simulate batching by using the System.Management.Automation.Powershell.Addstatement* method, which adds an additional statement to the end of the pipeline The following code gets a list of running processes with the name `PowerShell`, and then gets the list of running services.

C#

```
PowerShell ps = PowerShell.Create();
ps.AddCommand("Get-Process").AddParameter("Name", "PowerShell");
ps.AddStatement().AddCommand("Get-Service");
ps.Invoke();
```

AddScript

You can run an existing script by calling the System.Management.Automation.Powershell.Addscript* method. The following example adds a script to the pipeline and runs it. This example assumes there is already a script named `MyScript.ps1` in a folder named `D:\PSScripts`.

C#

```
PowerShell ps = PowerShell.Create();
ps.AddScript(File.ReadAllText(@"D:\PSScripts\MyScript.ps1")).Invoke();
```

There is also a version of the System.Management.Automation.Powershell.Addscript* method that takes a boolean parameter named `useLocalScope`. If this parameter is set to `true`, then the script is run in the local scope. The following code will run the script in the local scope.

C#

```
PowerShell ps = PowerShell.Create();
ps.AddScript(File.ReadAllText(@"D:\PSScripts\MyScript.ps1"), true).Invoke();
```

Invoking a pipeline synchronously

After you add elements to the pipeline, you invoke it. To invoke the pipeline synchronously, you call an overload of the System.Management.Automation.Powershell.Invoke* method. The following example shows how to synchronously invoke a pipeline.

C#

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Management.Automation;
```

```
namespace HostPS1e
{
  class HostPS1e
  {
    static void Main(string[] args)
    {
      // Using the PowerShell.Create and AddCommand
      // methods, create a command pipeline.
      PowerShell ps = PowerShell.Create().AddCommand ("Sort-Object");

      // Using the PowerShell.Invoke method, run the command
      // pipeline using the supplied input.
      foreach (PSObject result in ps.Invoke(new int[] { 3, 1, 6, 2, 5, 4 }))
      {
          Console.WriteLine("{0}", result);
      } // End foreach.
    } // End Main.
  } // End HostPS1e.
}
```

Invoking a pipeline asynchronously

You invoke a pipeline asynchronously by calling an overload of the System.Management.Automation.Powershell.Begininvoke* to create an IAsyncResult object, and then calling the System.Management.Automation.Powershell.Endinvoke* method.

The following example shows how to invoke a pipeline asynchronously.

C#

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Management.Automation;

namespace HostPS3
{
  class HostPS3
  {
    static void Main(string[] args)
    {
      // Use the PowerShell.Create and PowerShell.AddCommand
      // methods to create a command pipeline that includes
      // Get-Process cmdlet. Do not include spaces immediately
      // before or after the cmdlet name as that will cause
      // the command to fail.
      PowerShell ps = PowerShell.Create().AddCommand("Get-Process");

      // Create an IAsyncResult object and call the
```

```
      // BeginInvoke method to start running the
      // command pipeline asynchronously.
      IAsyncResult asyncpl = ps.BeginInvoke();

      // Using the PowerShell.Invoke method, run the command
      // pipeline using the default runspace.
      foreach (PSObject result in ps.EndInvoke(asyncpl))
      {
        Console.WriteLine("{0,-20}{1}",
                result.Members["ProcessName"].Value,
                result.Members["Id"].Value);
      } // End foreach.
      System.Console.WriteLine("Hit any key to exit.");
      System.Console.ReadKey();
    } // End Main.
  } // End HostPS3.
}
```

See Also

Creating an InitialSessionState

Creating a constrained runspace

Creating remote runspaces

Article • 09/17/2021

PowerShell commands that take a **ComputerName** parameter can be run on any computer that runs PowerShell. To run commands that don't take a **ComputerName** parameter, you can use WS-Management to configure a runspace that connects to a specified computer, and run commands on that computer.

Using a WSManConnection to create a remote runspace

To create a runspace that connects to a remote computer, you create a System.Management.Automation.Runspaces.WSManConnectionInfo object. You specify the target endpoint for the connection by setting the System.Management.Automation.Runspaces.WSManConnectionInfo.ConnectionUri property of the object. You then create a runspace by calling the System.Management.Automation.Runspaces.RunspaceFactory.CreateRunspace method, specifying the System.Management.Automation.Runspaces.WSManConnectionInfo object as the `connectionInfo` parameter.

The following example shows how to create a runspace that connects to a remote computer. In the example, `RemoteComputerUri` is used as a placeholder for the actual URI of a remote computer.

C#

```
namespace Samples
{
  using System;
  using System.Collections.ObjectModel;
  using System.Management.Automation;            // PowerShell namespace.
  using System.Management.Automation.Runspaces;  // PowerShell namespace.

  /// <summary>
  /// This class contains the Main entry point for this host application.
  /// </summary>
  internal class RemoteRunspace02
  {
    /// <summary>
    /// This sample shows how to create a remote runspace that
    /// runs commands on the local computer.
    /// </summary>
    /// <param name="args">Parameter not used.</param>
    private static void Main(string[] args)
```

```
    {
      // Create a WSManConnectionInfo object using the default constructor
      // to connect to the "localHost". The WSManConnectionInfo object can
      // also be used to specify connections to remote computers.
      Uri RemoteComputerUri = new Uri("http://Server01:5985/WSMAN");
      WSManConnectionInfo connectionInfo = new
WSManConnectionInfo(RemoteComputerUri);

      // Set the OperationTimeout property and OpenTimeout properties.
      // The OperationTimeout property is used to tell PowerShell
      // how long to wait (in milliseconds) before timing out for an
      // operation. The OpenTimeout property is used to tell Windows
      // PowerShell how long to wait (in milliseconds) before timing out
      // while establishing a remote connection.
      connectionInfo.OperationTimeout = 4 * 60 * 1000; // 4 minutes.
      connectionInfo.OpenTimeout = 1 * 60 * 1000; // 1 minute.

      // Create a remote runspace using the connection information.
      //using (Runspace remoteRunspace = RunspaceFactory.CreateRunspace())
      using (Runspace remoteRunspace =
RunspaceFactory.CreateRunspace(connectionInfo))
      {
        // Establish the connection by calling the Open() method to open the
runspace.
        // The OpenTimeout value set previously will be applied while
establishing
        // the connection. Establishing a remote connection involves sending
and
        // receiving some data, so the OperationTimeout will also play a
role in this process.
          remoteRunspace.Open();

        // Create a PowerShell object to run commands in the remote
runspace.
        using (PowerShell powershell = PowerShell.Create())
        {
          powershell.Runspace = remoteRunspace;
          powershell.AddCommand("get-process");
          powershell.Invoke();

          Collection<PSObject> results = powershell.Invoke();

          Console.WriteLine("Process             HandleCount");
          Console.WriteLine("-------------------------------");

          // Display the results.
          foreach (PSObject result in results)
          {
            Console.WriteLine(
                            "{0,-20} {1}",
                            result.Members["ProcessName"].Value,
                            result.Members["HandleCount"].Value);
          }
        }
```

```
        // Close the connection. Call the Close() method to close the remote
        // runspace. The Dispose() method (called by using primitive) will
call
        // the Close() method if it is not already called.
        remoteRunspace.Close();
      }
    }
  }
}
```

Creating a custom user interface

Article • 10/06/2021

Windows PowerShell provides abstract classes and interfaces that allow you to create a custom interactive UI that hosts the Windows PowerShell engine. To create a custom UI, you must implement the System.Management.Automation.Host.PSHost class. Optionally, you can also implement the System.Management.Automation.Host.Pshostrawuserinterface and System.Management.Automation.Host.Pshostuserinterface classes, and the System.Management.Automation.Host.Ihostsupportsinteractivesession and System.Management.Automation.Host.Ihostuisupportsmultiplechoiceselection interfaces.

Host Application Samples

Article • 09/17/2021

This section includes sample code that is provided in the Windows PowerShell 2.0 SDK.

In This Section

PowerShell API Samples This section includes sample code that shows how to create runspaces that restrict functionality, and how to asynchronously run commands using a runspace pool to supply the runspaces.

Custom Host Samples Includes sample code for writing a custom host. The host is the component of Windows PowerShell that provides communications between the user and the Windows PowerShell engine. For more information about custom hosts, see Custom Host.

Runspace Samples Includes sample code for creating runspaces. For more information about how runspaces are used, see Host Application Runspaces.

Remote Runspace Samples This section includes sample code that shows how to create runspaces that can be used to connect to a computer by using WS-Management-based Windows PowerShell remoting.

See Also

Windows PowerShell API Samples

Article • 09/17/2021

This section includes sample code that shows how to create runspaces that restrict functionality, and how to asynchronously run commands by using a runspace pool to supply the runspaces. You can use Microsoft Visual Studio to create a console application and then copy the code from the topics in this section into your host application.

In This Section

PowerShell01 Sample This sample shows how to use an System.Management.Automation.Runspaces.Initialsessionstate object to limit the functionality of a runspace. The output of this sample demonstrates how to restrict the language mode of the runspace, how to mark a cmdlet as private, how to add and remove cmdlets and providers, how to add a proxy command, and more.

PowerShell02 Sample This sample shows how to run commands asynchronously by using the runspaces of a runspace pool. The sample generates a list of commands, and then runs those commands while the Windows PowerShell engine opens a runspace from the pool when it is needed.

Windows PowerShell01 Sample

Article • 09/17/2021

This sample shows how to use an System.Management.Automation.Runspaces.Initialsessionstate object to limit the functionality of a runspace. The output of this sample demonstrates how to restrict the language mode of the runspace, how to mark a cmdlet as private, how to add and remove cmdlets and providers, how to add a proxy command, and more. This sample concentrates on how to restrict the runspace programmatically. Scripting alternatives to restricting the runspace include the $ExecutionContext.SessionState.LanguageMode and PSSessionConfiguration commands.

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

This sample demonstrates the following:

- Restricting the language by setting the System.Management.Automation.Runspaces.Initialsessionstate.Languagemode property.
- Adding aliases to the initial session state by using a System.Management.Automation.Runspaces.Sessionstatealiasentry?Displayproperty=Fullname object.
- Marking commands as private.
- Removing providers from the initial session state by using the System.Management.Automation.Runspaces.Initialsessionstate.Providers property.
- Removing commands from the initial session state by using the System.Management.Automation.Runspaces.Initialsessionstate.Commands property.
- Adding commands and providers to the System.Management.Automation.Runspaces.Initialsessionstate object.

Example

This sample shows several ways to limit the functionality of a runspace.

C#

```
namespace Sample
{
  using System;
  using System.Collections.ObjectModel;
  using System.Management.Automation;
  using System.Management.Automation.Runspaces;

  /// <summary>
  /// This class contains the Main entry point for the application.
  /// </summary>
  internal class PowerShell01
  {
    /// <summary>
    /// The runspace used to run commands.
    /// </summary>
    private Runspace runspace;

    /// <summary>
    /// Return the first index of the entry in <paramref name="entries"/>
    /// with the name <paramref name="name"/>. Return -1 if it is not found.
    /// </summary>
    /// <typeparam name="T">Type of ConstrainedSessionStateEntry</typeparam>
    /// <param name="entries">Collection of entries to search for <paramref
name="name"/> in.</param>
    /// <param name="name">Named of the entry we are looking for</param>
    /// <returns>
    /// The first index of the entry in <paramref name="entries"/> with the
    /// name <paramref name="name"/>, or return -1 if it is not found.
    /// </returns>
    private static int GetIndexOfEntry<T>(
            InitialSessionStateEntryCollection<T> entries,
            string name) where T : ConstrainedSessionStateEntry
    {
      int foundIndex = 0;
      foreach (T entry in entries)
      {
        if (entry.Name.Equals(name, StringComparison.OrdinalIgnoreCase))
        {
          return foundIndex;
        }

        foundIndex++;
      }

      return -1;
    }
```

```
    /// <summary>
    /// Run commands to demonstrate the ways to constrain the runspace.
    /// </summary>
    /// <param name="args">This parameter is unused.</param>
    private static void Main(string[] args)
    {
      new PowerShell01().RunCommands();
    }

    /// <summary>
    /// Run a script to display the results and errors.
    /// </summary>
    /// <param name="script">Script to be run.</param>
    /// <param name="scriptComment">Comment to be printed about
    /// the script.</param>
    private void RunScript(string script, string scriptComment)
    {
      Console.WriteLine("Running '{0}'\n{1}.\n\nPowerShell Output:", script,
scriptComment);

      // Using a PowerShell object, create a pipeline, add the script to the
      //  pipeline, and specify the runspace where the pipeline is invoked.
      PowerShell powerShellCommand = PowerShell.Create();
      powerShellCommand.AddScript(script);
      powerShellCommand.Runspace = this.runspace;

      try
      {
        Collection<PSObject> results = powerShellCommand.Invoke();

        // Display the results.
        foreach (PSObject result in results)
        {
          Console.WriteLine(result);
        }

        // Display any non-terminating errors.
        foreach (ErrorRecord error in powerShellCommand.Streams.Error)
        {
          Console.WriteLine("PowerShell Error: {0}", error);
        }
      }
      catch (RuntimeException ex)
      {
        Console.WriteLine("PowerShell Error: {0}", ex.Message);
        Console.WriteLine();
      }

      Console.WriteLine("\n----------------------------\n");
    }

    /// <summary>
    /// Run some commands to demonstrate the script capabilities.
    /// </summary>
    private void RunCommands()
```

```
    {
      this.runspace =
RunspaceFactory.CreateRunspace(InitialSessionState.CreateDefault());
      this.runspace.Open();
      this.RunScript("$a=0;$a", "Assigning to a variable will work for a
default InitialSessionState");
      this.runspace.Close();

      this.runspace =
RunspaceFactory.CreateRunspace(InitialSessionState.CreateDefault());
      this.runspace.InitialSessionState.LanguageMode =
PSLanguageMode.RestrictedLanguage;
      this.runspace.Open();
      this.RunScript("$a=0;$a", "Assigning to a variable will not work in
RestrictedLanguage LanguageMode");
      this.runspace.Close();

      this.runspace =
RunspaceFactory.CreateRunspace(InitialSessionState.CreateDefault());
      this.runspace.InitialSessionState.LanguageMode =
PSLanguageMode.NoLanguage;
      this.runspace.Open();
      this.RunScript("10/2", "A script will not work in NoLanguage
LanguageMode.");
      this.runspace.Close();

      this.runspace =
RunspaceFactory.CreateRunspace(InitialSessionState.CreateDefault());
      this.runspace.Open();
      string scriptComment = "get-childitem with a default
InitialSessionState will work since the standard \n" +
           "PowerShell cmdlets are included in the default
InitialSessionState";
      this.RunScript("get-childitem", scriptComment);
      this.runspace.Close();

      InitialSessionState defaultSessionState =
InitialSessionState.CreateDefault();
      defaultSessionState.Commands.Add(new SessionStateAliasEntry("dir2",
"get-childitem"));
      this.runspace = RunspaceFactory.CreateRunspace(defaultSessionState);
      this.runspace.Open();
      this.RunScript("dir2", "An alias, like dir2, can be added to
InitialSessionState");
      this.runspace.Close();

      defaultSessionState = InitialSessionState.CreateDefault();
      int commandIndex = GetIndexOfEntry(defaultSessionState.Commands, "get-
childitem");
      defaultSessionState.Commands.RemoveItem(commandIndex);
      this.runspace = RunspaceFactory.CreateRunspace(defaultSessionState);
      this.runspace.Open();
      scriptComment = "get-childitem was removed from the list of commands
so it\nwill no longer be found";
      this.RunScript("get-childitem", scriptComment);
```

```
      this.runspace.Close();

      defaultSessionState = InitialSessionState.CreateDefault();
      defaultSessionState.Providers.Clear();
      this.runspace = RunspaceFactory.CreateRunspace(defaultSessionState);
      this.runspace.Open();
      this.RunScript("get-childitem", "There are no providers so get-
childitem will not work");
      this.runspace.Close();

      // Marks a command as private, and then defines a proxy command
      // that uses the private command.  One reason to define a proxy for
      // a command is to remove a parameter of the original command.
      // For a more complete sample of a proxy command, see the Runspace11
      // sample.
      defaultSessionState = InitialSessionState.CreateDefault();
      commandIndex = GetIndexOfEntry(defaultSessionState.Commands, "get-
childitem");
      defaultSessionState.Commands[commandIndex].Visibility =
SessionStateEntryVisibility.Private;
      CommandMetadata getChildItemMetadata = new CommandMetadata(
           typeof(Microsoft.PowerShell.Commands.GetChildItemCommand));
      getChildItemMetadata.Parameters.Remove("Recurse");
      string getChildItemBody = ProxyCommand.Create(getChildItemMetadata);
      defaultSessionState.Commands.Add(new SessionStateFunctionEntry("get-
childitem2", getChildItemBody));
      this.runspace = RunspaceFactory.CreateRunspace(defaultSessionState);
      this.runspace.Open();
      this.RunScript("get-childitem", "get-childitem is private so it will
not be available");
      scriptComment = "get-childitem2 is a proxy to get-childitem. \n" +
                      "It works even when get-childitem is private.";
      this.RunScript("get-childitem2", scriptComment);
      scriptComment = "This will fail. Unlike get-childitem, get-childitem2
does not have -Recurse";
      this.RunScript("get-childitem2 -Recurse", scriptComment);

      InitialSessionState cleanSessionState = InitialSessionState.Create();
      this.runspace = RunspaceFactory.CreateRunspace(cleanSessionState);
      this.runspace.Open();
      scriptComment = "A script will not work because \n" +
                    "InitialSessionState.Create() will have the default
LanguageMode of NoLanguage";
      this.RunScript("10/2", scriptComment);
      this.runspace.Close();

      cleanSessionState = InitialSessionState.Create();
      cleanSessionState.LanguageMode = PSLanguageMode.FullLanguage;
      this.runspace = RunspaceFactory.CreateRunspace(cleanSessionState);
      this.runspace.Open();
      scriptComment = "get-childitem, standard cmdlets and providers are not
present \n" +
                      "in an InitialSessionState returned from
InitialSessionState.Create()";
      this.RunScript("get-childitem", scriptComment);
```

```
      this.runspace.Close();

      cleanSessionState = InitialSessionState.Create();
      cleanSessionState.Commands.Add(
                new SessionStateCmdletEntry(
                    "Get-ChildItem",

typeof(Microsoft.PowerShell.Commands.GetChildItemCommand),
                    null));
      cleanSessionState.Providers.Add(
                new SessionStateProviderEntry(
                    "FileSystem",

typeof(Microsoft.PowerShell.Commands.FileSystemProvider),
                    null));
      cleanSessionState.LanguageMode = PSLanguageMode.FullLanguage;
      this.runspace = RunspaceFactory.CreateRunspace(cleanSessionState);
      this.runspace.Open();
      scriptComment = "get-childitem and the FileSystem provider were
explicitly added\n" +
                "so get-childitem will work";
      this.RunScript("get-childitem", scriptComment);
      this.runspace.Close();

      Console.Write("Done...");
      Console.ReadLine();
    }
  }
}
```

See Also

Writing a Windows PowerShell Host Application

Windows PowerShell02 Sample

Article • 09/17/2021

This sample shows how to run commands asynchronously using the runspaces of a runspace pool. The sample generates a list of commands, and then runs those commands while the Windows PowerShell engine opens a runspace from the pool when it is needed.

Requirements

- This sample requires Windows PowerShell 2.0.

Demonstrates

This sample demonstrates the following:

- Creating a RunspacePool object with a minimum and maximum number of runspaces allowed to be open at the same time.
- Creating a list of commands.
- Running the commands asynchronously.
- Calling the System.Management.Automation.Runspaces.Runspacepool.Getavailablerunspaces* method to see how many runspaces are free.
- Capturing the command output with the System.Management.Automation.Powershell.Endinvoke* method.

Example

This sample shows how to open the runspaces of a runspace pool, and how to asynchronously run commands in those runspaces.

C#

```
namespace Sample
{
  using System;
  using System.Collections;
  using System.Collections.Generic;
  using System.Management.Automation;
  using System.Management.Automation.Runspaces;

  /// <summary>
```

```
  /// This class contains the Main entry point for the application.
  /// </summary>
  internal class PowerShell02
  {
    /// <summary>
    /// Runs many commands with the help of a RunspacePool.
    /// </summary>
    /// <param name="args">This parameter is unused.</param>
    private static void Main(string[] args)
    {
      // Creating and opening runspace pool. Use a minimum of 1 runspace and
a maximum of
      // 5 runspaces can be opened at the same time.
      RunspacePool runspacePool = RunspaceFactory.CreateRunspacePool(1, 5);
      runspacePool.Open();

      using (runspacePool)
      {
        // Define the commands to be run.
        List<PowerShell> powerShellCommands = new List<PowerShell>();

        // The command results.
        List<IAsyncResult> powerShellCommandResults = new List<IAsyncResult>
();

        // The maximum number of runspaces that can be opened at one time is
        // 5, but we can queue up many more commands that will use the
        // runspace pool.
        for (int i = 0; i < 100; i++)
        {
          // Using a PowerShell object, run the commands.
          PowerShell powershell = PowerShell.Create();

          // Instead of setting the Runspace property of powershell,
          // the RunspacePool property is used. That is the only difference
          // between running commands with a runspace and running commands
          // with a runspace pool.
          powershell.RunspacePool = runspacePool;

          // The script to be run outputs a sequence number and the number
of available runspaces
          // in the pool.
          string script = String.Format(
                          "write-output ' Command: {0}, Available Runspaces:
{1}'",
                          i,
                          runspacePool.GetAvailableRunspaces());

          // The three lines below look the same running with a runspace or
          // with a runspace pool.
          powershell.AddScript(script);
          powerShellCommands.Add(powershell);
          powerShellCommandResults.Add(powershell.BeginInvoke());
        }
```

```
        // Collect the results.
        for (int i = 0; i < 100; i++)
        {
          // EndInvoke will wait for each command to finish, so we will be
getting the commands
          // in the same 0 to 99 order that they have been invoked withy
BeginInvoke.
          PSDataCollection<PSObject> results =
powerShellCommands[i].EndInvoke(powerShellCommandResults[i]);

          // Print all the results. One PSObject with a plain string is the
expected result.
          PowerShell02.PrintCollection(results);
        }
      }
    }

    /// <summary>
    /// Iterates through a collection printing all items.
    /// </summary>
    /// <param name="collection">collection to be printed</param>
    private static void PrintCollection(IList collection)
    {
      foreach (object obj in collection)
      {
        Console.WriteLine("PowerShell Result: {0}", obj);
      }
    }
  }
}
```

See Also

Writing a Windows PowerShell Host Application

Custom Host Samples

Article • 09/17/2021

This section includes sample code for writing a custom host. You can use Microsoft Visual Studio to create a console application and then copy the code from the topics in this section into your host application.

In This Section

Host01 Sample This sample shows how to implement a host application that uses a basic custom host.

Host02 Sample This sample shows how to write a host application that uses the Windows PowerShell runtime along with a custom host implementation. The host application sets the host culture to German, runs the Get-Process cmdlet and displays the results as you would see them using pwrsh.exe, and then prints out the current data and time in German.

Host03 Sample This sample shows how to build an interactive console-based host application that reads commands from the command line, executes the commands, and then displays the results to the console.

Host04 Sample This sample shows how to build an interactive console-based host application that reads commands from the command line, executes the commands, and then displays the results to the console. This host application also supports displaying prompts that allow the user to specify multiple choices.

Host05 Sample This sample shows how to build an interactive console-based host application that reads commands from the command line, executes the commands, and then displays the results to the console. This host application also supports calls to remote computers by using the Enter-PsSession and Exit-PsSession cmdlets

Host06 Sample This sample shows how to build an interactive console-based host application that reads commands from the command line, executes the commands, and then displays the results to the console. In addition, this sample uses the Tokenizer APIs to specify the color of the text that is entered by the user.

See Also

Host01 Sample

Article • 09/17/2021

This sample shows how to implement a host application that uses a custom host. In this sample a runspace is created that uses the custom host, and then the System.Management.Automation.Powershell API is used to run a script that calls "exit." The host application then looks at the output of the script and prints out the results.

This sample uses the default UI features provided by Windows PowerShell. For more information about implementing the UI features of a custom host, see Host02 Sample.

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

- Creating a custom host class that derives from the System.Management.Automation.Host.PSHost class.
- Creating a runspace that uses the custom host class.
- Creating a System.Management.Automation.Powershell object that runs a script that calls exit.
- Verifying that the correct exit code was used in the exit process.

Example 1

The following code shows an implementation of a host application that uses a simple custom host interface.

C#

```
namespace Microsoft.Samples.PowerShell.Host
{

    using System;
    using System.Management.Automation;
    using System.Management.Automation.Runspaces;
    using PowerShell = System.Management.Automation.PowerShell;

    /// <summary>
```

```
    /// This class contains the Main entry point for this host application.
    /// </summary>
    internal class Host01
    {

        /// <summary>
        /// Indicator to tell the host application that it should exit.
        /// </summary>
        private bool shouldExit;

        /// <summary>
        /// The exit code that the host application will use to exit.
        /// </summary>
        private int exitCode;

        /// <summary>
        /// Gets or sets a value indicating whether the
        /// host application should exit.
        /// </summary>
        public bool ShouldExit
        {
            get { return this.shouldExit; }
            set { this.shouldExit = value; }
        }

        /// <summary>
        /// Gets or sets the PSHost implementation that is
        /// used to tell the host application what code to use
        /// when exiting.
        /// </summary>
        public int ExitCode
        {
            get { return this.exitCode; }
            set { this.exitCode = value; }
        }

        /// <summary>
        /// This sample uses a PowerShell object to run
        /// a script that calls exit. The host application looks at
        /// this and prints out the result.
        /// </summary>
        /// <param name="args">Parameter not used.</param>
        private static void Main(string[] args)
        {
            // Create an instance of this host application class so that
            // the Windows PowerShell engine will have access to the
            // ShouldExit and ExitCode parameters.
            Host01 me = new Host01();

            // Create the host instance to use.
            MyHost myHost = new MyHost(me);

            // Create a runspace that uses the host object and run the
            // script using a PowerShell object.
            using (Runspace myRunSpace =
```

```
RunspaceFactory.CreateRunspace(myHost))
            {
                // Open the runspace.
                myRunSpace.Open();

                // Create a PowerShell object to run the script.
                using (PowerShell powershell = PowerShell.Create())
                {
                    powershell.Runspace = myRunSpace;

                    // Create the pipeline and run the script
                    // "exit (2+2)".
                    string script = "exit (2+2)";
                    powershell.AddScript(script);
                    powershell.Invoke(script);
                }

                // Check the flags and see if they were set propertly.
                Console.WriteLine(
                    "ShouldExit={0} (should be True); ExitCode={1} (should
be 4)",
                    me.ShouldExit,
                    me.ExitCode);

                // close the runspace to free resources.
                myRunSpace.Close();
            }

            Console.WriteLine("Hit any key to exit...");
            Console.ReadKey();
        }
    }
}
```

Example 2

The following code is the implementation of the System.Management.Automation.Host.PSHost class that is used by this host application. Those elements that are not implemented throw an exception or return nothing.

C#

```
namespace Microsoft.Samples.PowerShell.Host
{
    using System;
    using System.Globalization;
    using System.Management.Automation.Host;

    /// <summary>
    /// This is a sample implementation of the PSHost abstract class for
    /// console applications. Not all members are implemented. Those that
```

```
    /// are not implemented throw a NotImplementedException exception or
    /// return nothing.
    /// </summary>
    internal class MyHost : PSHost
    {
        /// <summary>
        /// A reference to the PSHost implementation.
        /// </summary>
        private Host01 program;

        /// <summary>
        /// The culture information of the thread that created
        /// this object.
        /// </summary>
        private CultureInfo originalCultureInfo =
            System.Threading.Thread.CurrentThread.CurrentCulture;

        /// <summary>
        /// The UI culture information of the thread that created
        /// this object.
        /// </summary>
        private CultureInfo originalUICultureInfo =
            System.Threading.Thread.CurrentThread.CurrentUICulture;

        /// <summary>
        /// The identifier of this PSHost implementation.
        /// </summary>
        private Guid myId = Guid.NewGuid();

        /// <summary>
        /// Initializes a new instance of the MyHost class. Keep
        /// a reference to the host application object so that it
        /// can be informed of when to exit.
        /// </summary>
        /// <param name="program">
        /// A reference to the host application object.
        /// </param>
        public MyHost(Host01 program)
        {
            this.program = program;
        }

        /// <summary>
        /// Return the culture information to use. This implementation
        /// returns a snapshot of the culture information of the thread
        /// that created this object.
        /// </summary>
        public override System.Globalization.CultureInfo CurrentCulture
        {
            get { return this.originalCultureInfo; }
        }

        /// <summary>
        /// Return the UI culture information to use. This implementation
        /// returns a snapshot of the UI culture information of the thread
```

```
        /// that created this object.
        /// </summary>
        public override System.Globalization.CultureInfo CurrentUICulture
        {
            get { return this.originalUICultureInfo; }
        }

        /// <summary>
        /// This implementation always returns the GUID allocated at
        /// instantiation time.
        /// </summary>
        public override Guid InstanceId
        {
            get { return this.myId; }
        }

        /// <summary>
        /// Return a string that contains the name of the host
implementation.
        /// Keep in mind that this string may be used by script writers to
        /// identify when your host is being used.
        /// </summary>
        public override string Name
        {
            get { return "MySampleConsoleHostImplementation"; }
        }

        /// <summary>
        /// This sample does not implement a PSHostUserInterface component
so
        /// this property simply returns null.
        /// </summary>
        public override PSHostUserInterface UI
        {
            get { return null; }
        }

        /// <summary>
        /// Return the version object for this application. Typically this
        /// should match the version resource in the application.
        /// </summary>
        public override Version Version
        {
            get { return new Version(1, 0, 0, 0); }
        }

        /// <summary>
        /// Not implemented by this example class. The call fails with
        /// a NotImplementedException exception.
        /// </summary>
        public override void EnterNestedPrompt()
        {
            throw new NotImplementedException(
                "The method or operation is not implemented.");
        }
```

```
        /// <summary>
        /// Not implemented by this example class. The call fails
        /// with a NotImplementedException exception.
        /// </summary>
        public override void ExitNestedPrompt()
        {
            throw new NotImplementedException(
                "The method or operation is not implemented.");
        }

        /// <summary>
        /// This API is called before an external application process is
        /// started. Typically it is used to save state so the parent can
        /// restore state that has been modified by a child process (after
        /// the child exits). In this example, this functionality is not
        /// needed so the method returns nothing.
        /// </summary>
        public override void NotifyBeginApplication()
        {
            return;
        }

        /// <summary>
        /// This API is called after an external application process
finishes.
        /// Typically it is used to restore state that a child process may
        /// have altered. In this example, this functionality is not
        /// needed so the method returns nothing.
        /// </summary>
        public override void NotifyEndApplication()
        {
           return;
        }

        /// <summary>
        /// Indicate to the host application that exit has
        /// been requested. Pass the exit code that the host
        /// application should use when exiting the process.
        /// </summary>
        /// <param name="exitCode">The exit code to use.</param>
        public override void SetShouldExit(int exitCode)
        {
            this.program.ShouldExit = true;
            this.program.ExitCode = exitCode;
        }
    }
}
```

See Also

Host02 Sample

Article • 09/17/2021

This sample shows how to write a host application that uses the Windows PowerShell runtime along with a custom host implementation. The host application sets the host culture to German, runs the Get-Process cmdlet and displays the results as you would see them by using pwrsh.exe, and then prints out the current data and time in German.

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

- Creating a custom host whose classes derive from the System.Management.Automation.Host.PSHost class, the System.Management.Automation.Host.PSHostUserInterface class, and the System.Management.Automation.Host.PSHostRawUserInterface class.
- Creating a runspace that uses the custom host.
- Setting the host culture to German.
- Creating a System.Management.Automation.Powershell object that runs a script to retrieve and sort the processes, then retrieves the current date which is displayed in German.

Example 1

The following code shows an implementation of a host application that uses the custom host.

C#

```
// Copyright (c) 2006 Microsoft Corporation. All rights reserved.
//
// THIS CODE AND INFORMATION IS PROVIDED "AS IS" WITHOUT WARRANTY OF
// ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO
// THE IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR A
// PARTICULAR PURPOSE.
//
using System;
```

```
using System.Collections.Generic;
using System.Text;
using System.Management.Automation;
using System.Management.Automation.Host;
using System.Management.Automation.Runspaces;
using System.Globalization;

namespace Microsoft.Samples.PowerShell.Host
{
  class Host02
  {
    /// <summary>
    /// Define the property that the PSHost implementation will
    /// use to tell the host application that it should exit.
    /// </summary>
    public bool ShouldExit
    {
      get { return shouldExit; }
      set { shouldExit = value; }
    }
    private bool shouldExit;

    /// <summary>
    /// Define the property that the PSHost implementation will
    /// use to tell the host application what exit code to use
    /// when exiting.
    /// </summary>
    public int ExitCode
    {
      get { return exitCode; }
      set { exitCode = value; }
    }
    private int exitCode;

    /// <summary>
    /// This sample uses the PowerShell runtime along with a host
    /// implementation to call get-process and display the results
    /// as you would see them in powershell.exe.
    /// </summary>
    /// <param name="args">Ignored</param>
    static void Main(string[] args)
    {
      // Set the current culture to German. We want this to be picked up
when the MyHost
      // instance is created...
      System.Threading.Thread.CurrentThread.CurrentCulture =
CultureInfo.GetCultureInfo("de-de");

      // Create the runspace so that you can access the pipeline.
      MyHost myHost = new MyHost(new Host02());

      Runspace myRunSpace = RunspaceFactory.CreateRunspace(myHost);
      myRunSpace.Open();

      // Create the pipeline.
```

```
      Pipeline pipe = myRunSpace.CreatePipeline();

      // Add the script we want to run. This script does two things.
      // First, it runs the Get-Process cmdlet with the cmdlet output
      // sorted by handle count. Second, the GetDate cmdlet is piped
      // to the Out-String cmdlet so that we can see the
      // date displayed in German.

      pipe.Commands.AddScript(@"
                    get-process | sort handlecount
                    # This should display the date in German...
                    get-date | out-string
                    ");

      // Add the default outputter to the end of the pipe and indicate
      // that it should handle both output and errors from the previous
      // commands. This will result in the output being written using the
PSHost
      // and PSHostUserInterface classes instead of returning objects to the
hosting
      // application.
      pipe.Commands.Add("out-default");

pipe.Commands[0].MergeMyResults(PipelineResultTypes.Error,PipelineResultType
s.Output);

      // Invoke the pipeline. There will not be any objects
      // returned. The Out-Default cmdlet consumes the objects.
      pipe.Invoke();

      System.Console.WriteLine("Hit any key to exit...");
      System.Console.ReadKey();
    }
  }
}
```

Example 2

The following code is the implementation of the System.Management.Automation.Host.PSHost class that is used by this host application. Those elements that are not implemented throw an exception or return nothing.

C#

```
namespace Microsoft.Samples.PowerShell.Host
{
  using System;
  using System.Globalization;
  using System.Management.Automation.Host;

  /// <summary>
```

```
  /// This is a sample implementation of the PSHost abstract class for
  /// console applications. Not all members are implemented. Those that
  /// are not implemented throw a NotImplementedException exception or
  /// return nothing.
  /// </summary>
  internal class MyHost : PSHost
  {
    /// <summary>
    /// A reference to the PSHost implementation.
    /// </summary>
    private Host02 program;

    /// <summary>
    /// The culture information of the thread that created
    /// this object.
    /// </summary>
    private CultureInfo originalCultureInfo =
        System.Threading.Thread.CurrentThread.CurrentCulture;

    /// <summary>
    /// The UI culture information of the thread that created
    /// this object.
    /// </summary>
    private CultureInfo originalUICultureInfo =
        System.Threading.Thread.CurrentThread.CurrentUICulture;

    /// <summary>
    /// The identifier of this PSHost implementation.
    /// </summary>
    private Guid myId = Guid.NewGuid();

    /// <summary>
    /// Initializes a new instance of the MyHost class. Keep
    /// a reference to the host application object so that it
    /// can be informed of when to exit.
    /// </summary>
    /// <param name="program">
    /// A reference to the host application object.
    /// </param>
    public MyHost(Host02 program)
    {
      this.program = program;
    }

    /// <summary>
    /// A reference to the implementation of the PSHostUserInterface
    /// class for this application.
    /// </summary>
    private MyHostUserInterface myHostUserInterface = new
MyHostUserInterface();

    /// <summary>
    /// Gets the culture information to use. This implementation
    /// returns a snapshot of the culture information of the thread
    /// that created this object.
```

```
    /// </summary>
    public override System.Globalization.CultureInfo CurrentCulture
    {
      get { return this.originalCultureInfo; }
    }

    /// <summary>
    /// Gets the UI culture information to use. This implementation
    /// returns a snapshot of the UI culture information of the thread
    /// that created this object.
    /// </summary>
    public override System.Globalization.CultureInfo CurrentUICulture
    {
      get { return this.originalUICultureInfo; }
    }

    /// <summary>
    /// Gets an identifier for this host. This implementation always
    /// returns the GUID allocated at instantiation time.
    /// </summary>
    public override Guid InstanceId
    {
      get { return this.myId; }
    }

    /// <summary>
    /// Gets a string that contains the name of this host implementation.
    /// Keep in mind that this string may be used by script writers to
    /// identify when your host is being used.
    /// </summary>
    public override string Name
    {
      get { return "MySampleConsoleHostImplementation"; }
    }

    /// <summary>
    /// Gets an instance of the implementation of the PSHostUserInterface
    /// class for this application. This instance is allocated once at
startup time
    /// and returned every time thereafter.
    /// </summary>
    public override PSHostUserInterface UI
    {
      get { return this.myHostUserInterface; }
    }

    /// <summary>
    /// Gets the version object for this application. Typically this
    /// should match the version resource in the application.
    /// </summary>
    public override Version Version
    {
      get { return new Version(1, 0, 0, 0); }
    }
```

```
    /// <summary>
    /// This API Instructs the host to interrupt the currently running
    /// pipeline and start a new nested input loop. In this example this
    /// functionality is not needed so the method throws a
    /// NotImplementedException exception.
    /// </summary>
    public override void EnterNestedPrompt()
    {
      throw new NotImplementedException(
            "The method or operation is not implemented.");
    }

    /// <summary>
    /// This API instructs the host to exit the currently running input
loop.
    /// In this example this functionality is not needed so the method
    /// throws a NotImplementedException exception.
    /// </summary>
    public override void ExitNestedPrompt()
    {
      throw new NotImplementedException(
            "The method or operation is not implemented.");
    }

    /// <summary>
    /// This API is called before an external application process is
    /// started. Typically it is used to save state so that the parent
    /// can restore state that has been modified by a child process (after
    /// the child exits). In this example this functionality is not
    /// needed so the method returns nothing.
    /// </summary>
    public override void NotifyBeginApplication()
    {
      return;
    }

    /// <summary>
    /// This API is called after an external application process finishes.
    /// Typically it is used to restore state that a child process has
    /// altered. In this example, this functionality is not needed so
    /// the method returns nothing.
    /// </summary>
    public override void NotifyEndApplication()
    {
      return;
    }

    /// <summary>
    /// Indicate to the host application that exit has
    /// been requested. Pass the exit code that the host
    /// application should use when exiting the process.
    /// </summary>
    /// <param name="exitCode">The exit code that the
    /// host application should use.</param>
    public override void SetShouldExit(int exitCode)
```

```
    {
      this.program.ShouldExit = true;
      this.program.ExitCode = exitCode;
    }
  }
}
```

Example 3

The following code is the implementation of the System.Management.Automation.Host.PSHostUserInterface class that is used by this host application.

C#

```
namespace Microsoft.Samples.PowerShell.Host
{
  using System;
  using System.Collections.Generic;
  using System.Globalization;
  using System.Management.Automation;
  using System.Management.Automation.Host;

  /// <summary>
  /// A sample implementation of the PSHostUserInterface abstract class for
  /// console applications. Not all members are implemented. Those that are
  /// not implemented throw a NotImplementedException exception. Members
that
  /// are implemented include those that map easily to Console APIs.
  /// </summary>
  internal class MyHostUserInterface : PSHostUserInterface
  {
    /// <summary>
    /// An instance of the PSRawUserInterface class.
    /// </summary>
    private MyRawUserInterface myRawUi = new MyRawUserInterface();

    /// <summary>
    /// Gets an instance of the PSRawUserInterface class for this host
    /// application.
    /// </summary>
    public override PSHostRawUserInterface RawUI
    {
      get { return this.myRawUi; }
    }

    /// <summary>
    /// Prompts the user for input. In this example this functionality is
not
    /// needed so the method throws a NotImplementException exception.
    /// </summary>
```

```
    /// <param name="caption">The caption or title of the prompt.</param>
    /// <param name="message">The text of the prompt.</param>
    /// <param name="descriptions">A collection of FieldDescription objects
that
    /// describe each field of the prompt.</param>
    /// <returns>Throws a NotImplementedException exception.</returns>
    public override Dictionary<string, PSObject> Prompt(
                                                        string caption,
                                                        string message,

System.Collections.ObjectModel.Collection<FieldDescription> descriptions)
    {
       throw new NotImplementedException(
           "The method or operation is not implemented.");
    }

    /// <summary>
    /// Provides a set of choices that enable the user to choose a
    /// single option from a set of options. In this example this
    /// functionality is not needed so the method throws a
    /// NotImplementException exception.
    /// </summary>
    /// <param name="caption">Text that proceeds (a title) the choices.
</param>
    /// <param name="message">A message that describes the choice.</param>
    /// <param name="choices">A collection of ChoiceDescription objects that
describes
    /// each choice.</param>
    /// <param name="defaultChoice">The index of the label in the Choices
parameter
    /// collection. To indicate no default choice, set to -1.</param>
    /// <returns>Throws a NotImplementedException exception.</returns>
    public override int PromptForChoice(string caption, string message,
System.Collections.ObjectModel.Collection<ChoiceDescription> choices, int
defaultChoice)
    {
      throw new NotImplementedException("The method or operation is not
implemented.");
    }

    /// <summary>
    /// Prompts the user for credentials with a specified prompt window
caption,
    /// prompt message, user name, and target name. In this example this
    /// functionality is not needed so the method throws a
    /// NotImplementException exception.
    /// </summary>
    /// <param name="caption">The caption for the message window.</param>
    /// <param name="message">The text of the message.</param>
    /// <param name="userName">The user name whose credential is to be
prompted for.</param>
    /// <param name="targetName">The name of the target for which the
credential is collected.</param>
    /// <returns>Throws a NotImplementedException exception.</returns>
    public override PSCredential PromptForCredential(
```

```
                                                    string caption,
                                                    string message,
                                                    string userName,
                                                    string targetName)
    {
      throw new NotImplementedException("The method or operation is not
implemented.");
    }

    /// <summary>
    /// Prompts the user for credentials by using a specified prompt window
caption,
    /// prompt message, user name and target name, credential types allowed
to be
    /// returned, and UI behavior options. In this example this
functionality
    /// is not needed so the method throws a NotImplementException
exception.
    /// </summary>
    /// <param name="caption">The caption for the message window.</param>
    /// <param name="message">The text of the message.</param>
    /// <param name="userName">The user name whose credential is to be
prompted for.</param>
    /// <param name="targetName">The name of the target for which the
credential is collected.</param>
    /// <param name="allowedCredentialTypes">A PSCredentialTypes constant
that
    /// identifies the type of credentials that can be returned.</param>
    /// <param name="options">A PSCredentialUIOptions constant that
identifies the UI
    /// behavior when it gathers the credentials.</param>
    /// <returns>Throws a NotImplementedException exception.</returns>
    public override PSCredential PromptForCredential(
                                                    string caption,
                                                    string message,
                                                    string userName,
                                                    string targetName,
                                                    PSCredentialTypes
allowedCredentialTypes,
                                                    PSCredentialUIOptions
options)
    {
      throw new NotImplementedException("The method or operation is not
implemented.");
    }

    /// <summary>
    /// Reads characters that are entered by the user until a newline
    /// (carriage return) is encountered.
    /// </summary>
    /// <returns>The characters that are entered by the user.</returns>
    public override string ReadLine()
    {
      return Console.ReadLine();
    }
```

```
    /// <summary>
    /// Reads characters entered by the user until a newline (carriage
return)
    /// is encountered and returns the characters as a secure string. In
this
    /// example this functionality is not needed so the method throws a
    /// NotImplementException exception.
    /// </summary>
    /// <returns>Throws a NotImplemented exception.</returns>
    public override System.Security.SecureString ReadLineAsSecureString()
    {
      throw new NotImplementedException("The method or operation is not
implemented.");
    }

    /// <summary>
    /// Writes characters to the output display of the host.
    /// </summary>
    /// <param name="value">The characters to be written.</param>
    public override void Write(string value)
    {
      System.Console.Write(value);
    }

    /// <summary>
    /// Writes characters to the output display of the host and specifies
the
    /// foreground and background colors of the characters. This
implementation
    /// ignores the colors.
    /// </summary>
    /// <param name="foregroundColor">The color of the characters.</param>
    /// <param name="backgroundColor">The background color to use.</param>
    /// <param name="value">The characters to be written.</param>
    public override void Write(
                               ConsoleColor foregroundColor,
                               ConsoleColor backgroundColor,
                               string value)
    {
       // Colors are ignored.
       System.Console.Write(value);
    }

    /// <summary>
    /// Writes a debug message to the output display of the host.
    /// </summary>
    /// <param name="message">The debug message that is displayed.</param>
    public override void WriteDebugLine(string message)
    {
      Console.WriteLine(String.Format(
                                      CultureInfo.CurrentCulture,
                                      "DEBUG: {0}",
                                      message));
    }
```

```
    /// <summary>
    /// Writes an error message to the output display of the host.
    /// </summary>
    /// <param name="value">The error message that is displayed.</param>
    public override void WriteErrorLine(string value)
    {
      Console.WriteLine(String.Format(
                                    CultureInfo.CurrentCulture,
                                    "ERROR: {0}",
                                    value));
    }

    /// <summary>
    /// Writes a newline character (carriage return)
    /// to the output display of the host.
    /// </summary>
    public override void WriteLine()
    {
      System.Console.WriteLine();
    }

    /// <summary>
    /// Writes a line of characters to the output display of the host
    /// and appends a newline character(carriage return).
    /// </summary>
    /// <param name="value">The line to be written.</param>
    public override void WriteLine(string value)
    {
      System.Console.WriteLine(value);
    }

    /// <summary>
    /// Writes a line of characters to the output display of the host
    /// with foreground and background colors and appends a newline
(carriage return).
    /// </summary>
    /// <param name="foregroundColor">The foreground color of the display.
</param>
    /// <param name="backgroundColor">The background color of the display.
</param>
    /// <param name="value">The line to be written.</param>
    public override void WriteLine(ConsoleColor foregroundColor,
ConsoleColor backgroundColor, string value)
    {
      // Write to the output stream, ignore the colors
      System.Console.WriteLine(value);
    }

    /// <summary>
    /// Writes a progress report to the output display of the host.
    /// </summary>
    /// <param name="sourceId">Unique identifier of the source of the
record. </param>
    /// <param name="record">A ProgressReport object.</param>
```

```
    public override void WriteProgress(long sourceId, ProgressRecord record)
    {
    }

    /// <summary>
    /// Writes a verbose message to the output display of the host.
    /// </summary>
    /// <param name="message">The verbose message that is displayed.</param>
    public override void WriteVerboseLine(string message)
    {
      Console.WriteLine(String.Format(CultureInfo.CurrentCulture, "VERBOSE:
{0}", message));
    }

    /// <summary>
    /// Writes a warning message to the output display of the host.
    /// </summary>
    /// <param name="message">The warning message that is displayed.</param>
    public override void WriteWarningLine(string message)
    {
      Console.WriteLine(String.Format(CultureInfo.CurrentCulture, "WARNING:
{0}", message));
    }
  }
}
```

Example 4

The following code is the implementation of the System.Management.Automation.Host.PSHostRawUserInterface class that is used by this host application. Those elements that are not implemented throw an exception or return nothing.

C#

```
namespace Microsoft.Samples.PowerShell.Host
{
  using System;
  using System.Management.Automation.Host;

  /// <summary>
  /// A sample implementation of the PSHostRawUserInterface for console
  /// applications. Members of this class that easily map to the .NET
  /// console class are implemented. More complex methods are not
  /// implemented and throw a NotImplementedException exception.
  /// </summary>
  internal class MyRawUserInterface : PSHostRawUserInterface
  {
    /// <summary>
    /// Gets or sets the background color of the displayed text.
```

```
    /// This maps to the corresponding Console.Background property.
    /// </summary>
    public override ConsoleColor BackgroundColor
    {
      get { return Console.BackgroundColor; }
      set { Console.BackgroundColor = value; }
    }

    /// <summary>
    /// Gets or sets the size of the host buffer. In this example the
    /// buffer size is adapted from the Console buffer size members.
    /// </summary>
    public override Size BufferSize
    {
      get { return new Size(Console.BufferWidth, Console.BufferHeight); }
      set { Console.SetBufferSize(value.Width, value.Height); }
    }

    /// <summary>
    /// Gets or sets the cursor position. In this example this
    /// functionality is not needed so the property throws a
    /// NotImplementException exception.
    /// </summary>
    public override Coordinates CursorPosition
    {
      get { throw new NotImplementedException(
                  "The method or operation is not implemented."); }
      set { throw new NotImplementedException(
                  "The method or operation is not implemented."); }
    }

    /// <summary>
    /// Gets or sets the size of the displayed cursor. In this example
    /// the cursor size is taken directly from the Console.CursorSize
    /// property.
    /// </summary>
    public override int CursorSize
    {
      get { return Console.CursorSize; }
      set { Console.CursorSize = value; }
    }

    /// <summary>
    /// Gets or sets the foreground color of the displayed text.
    /// This maps to the corresponding Console.ForegroundColor property.
    /// </summary>
    public override ConsoleColor ForegroundColor
    {
      get { return Console.ForegroundColor; }
      set { Console.ForegroundColor = value; }
    }

    /// <summary>
    /// Gets a value indicating whether the user has pressed a key. This
maps
```

```
    /// to the corresponding Console.KeyAvailable property.
    /// </summary>
    public override bool KeyAvailable
    {
      get { return Console.KeyAvailable; }
    }

    /// <summary>
    /// Gets the dimensions of the largest window that could be
    /// rendered in the current display, if the buffer was at the least
    /// that large. This example uses the Console.LargestWindowWidth and
    /// Console.LargestWindowHeight properties to determine the returned
    /// value of this property.
    /// </summary>
    public override Size MaxPhysicalWindowSize
    {
      get { return new Size(Console.LargestWindowWidth,
Console.LargestWindowHeight); }
    }

    /// <summary>
    /// Gets the dimensions of the largest window size that can be
    /// displayed. This example uses the Console.LargestWindowWidth and
    /// console.LargestWindowHeight properties to determine the returned
    /// value of this property.
    /// </summary>
    public override Size MaxWindowSize
    {
      get { return new Size(Console.LargestWindowWidth,
Console.LargestWindowHeight); }
    }

    /// <summary>
    /// Gets or sets the position of the displayed window. This example
    /// uses the Console window position APIs to determine the returned
    /// value of this property.
    /// </summary>
    public override Coordinates WindowPosition
    {
      get { return new Coordinates(Console.WindowLeft, Console.WindowTop); }
      set { Console.SetWindowPosition(value.X, value.Y); }
    }

    /// <summary>
    /// Gets or sets the size of the displayed window. This example
    /// uses the corresponding Console window size APIs to determine the
    /// returned value of this property.
    /// </summary>
    public override Size WindowSize
    {
      get { return new Size(Console.WindowWidth, Console.WindowHeight); }
      set { Console.SetWindowSize(value.Width, value.Height); }
    }

    /// <summary>
```

```
    /// Gets or sets the title of the displayed window. The example
    /// maps the Console.Title property to the value of this property.
    /// </summary>
    public override string WindowTitle
    {
      get { return Console.Title; }
      set { Console.Title = value; }
    }

    /// <summary>
    /// This API resets the input buffer. In this example this
    /// functionality is not needed so the method returns nothing.
    /// </summary>
    public override void FlushInputBuffer()
    {
    }

    /// <summary>
    /// This API returns a rectangular region of the screen buffer. In
    /// this example this functionality is not needed so the method throws
    /// a NotImplementException exception.
    /// </summary>
    /// <param name="rectangle">Defines the size of the rectangle.</param>
    /// <returns>Throws a NotImplementedException exception.</returns>
    public override BufferCell[,] GetBufferContents(Rectangle rectangle)
    {
      throw new NotImplementedException(
                "The method or operation is not implemented.");
    }

    /// <summary>
    /// This API reads a pressed, released, or pressed and released
keystroke
    /// from the keyboard device, blocking processing until a keystroke is
    /// typed that matches the specified keystroke options. In this example
    /// this functionality is not needed so the method throws a
    /// NotImplementException exception.
    /// </summary>
    /// <param name="options">Options, such as IncludeKeyDown,  used when
    /// reading the keyboard.</param>
    /// <returns>Throws a NotImplementedException exception.</returns>
    public override KeyInfo ReadKey(ReadKeyOptions options)
    {
      throw new NotImplementedException(
                 "The method or operation is not implemented.");
    }

    /// <summary>
    /// This API crops a region of the screen buffer. In this example
    /// this functionality is not needed so the method throws a
    /// NotImplementException exception.
    /// </summary>
    /// <param name="source">The region of the screen to be scrolled.
</param>
    /// <param name="destination">The region of the screen to receive the
```

```
    /// source region contents.</param>
    /// <param name="clip">The region of the screen to include in the
operation.</param>
    /// <param name="fill">The character and attributes to be used to fill
all cell.</param>
    public override void ScrollBufferContents(Rectangle source, Coordinates
destination, Rectangle clip, BufferCell fill)
    {
      throw new NotImplementedException(
                "The method or operation is not implemented.");
    }

    /// <summary>
    /// This method copies an array of buffer cells into the screen buffer
    /// at a specified location. In this example this functionality is
    /// not needed so the method throws a NotImplementedException exception.
    /// </summary>
    /// <param name="origin">The parameter is not used.</param>
    /// <param name="contents">The parameter is not used.</param>
    public override void SetBufferContents(Coordinates origin,
                                           BufferCell[,] contents)
    {
      throw new NotImplementedException(
                "The method or operation is not implemented.");
    }

    /// <summary>
    /// This method copies a given character, foreground color, and
background
    /// color to a region of the screen buffer. In this example this
    /// functionality is not needed so the method throws a
    /// NotImplementException exception./// </summary>
    /// <param name="rectangle">Defines the area to be filled. </param>
    /// <param name="fill">Defines the fill character.</param>
    public override void SetBufferContents(Rectangle rectangle, BufferCell
fill)
    {
      throw new NotImplementedException(
                "The method or operation is not implemented.");
    }
  }
}
```

See Also

System.Management.Automation.Powershell

System.Management.Automation.Host.PSHost

System.Management.Automation.Host.Pshostuserinterface

System.Management.Automation.Host.Pshostrawuserinterface

Host03 Sample

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This sample shows how to build an interactive console-based host application that reads commands from the command line, executes the commands, and then displays the results to the console.

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

- Creating a custom host whose classes derive from the System.Management.Automation.Host.PSHost class, the System.Management.Automation.Host.PSHostUserInterface class, and the System.Management.Automation.Host.PSHostRawUserInterface class.
- Building a console application that uses these host classes to build an interactive Windows PowerShell shell.

Example 1

This example allows the user to enter commands at a command line, processes those commands, and then prints out the results.

C#

```
// Copyright (c) 2006 Microsoft Corporation. All rights reserved.
//
// THIS CODE AND INFORMATION IS PROVIDED "AS IS" WITHOUT WARRANTY OF
// ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO
// THE IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR A
// PARTICULAR PURPOSE.
//

namespace Microsoft.Samples.PowerShell.Host
{
  using System;
  using System.Collections.ObjectModel;
  using System.Management.Automation;
  using System.Management.Automation.Runspaces;
  using PowerShell = System.Management.Automation.PowerShell;
```

```
  /// This class contains the Main entry point for this host application.
  internal class PSListenerConsoleSample
  {
    /// Indicator to tell the host application that it should exit.
    private bool shouldExit;

    /// The exit code that the host application will use to exit.
    private int exitCode;

    /// Holds the instance of the PSHost implementation for this
interpreter.
    private MyHost myHost;

    /// Holds the runspace for this interpreter.
    private Runspace myRunSpace;

    /// Holds a reference to the currently executing pipeline so it can be
    /// stopped by the control-C handler.
    private PowerShell currentPowerShell;

    /// Used to serialize access to instance data.
    private object instanceLock = new object();

    /// Create this instance of the console listener.
    private PSListenerConsoleSample()
    {
      // Create the host and runspace instances for this interpreter.
      // Note that this application does not support console files so
      // only the default snapins will be available.
      this.myHost = new MyHost(this);
      this.myRunSpace = RunspaceFactory.CreateRunspace(this.myHost);
      this.myRunSpace.Open();
    }

    /// Gets or sets a value indicating whether the host application
    /// should exit.
    public bool ShouldExit
    {
      get { return this.shouldExit; }
      set { this.shouldExit = value; }
    }

    /// Gets or sets the exit code that the host application will use
    /// when exiting.
    public int ExitCode
    {
      get { return this.exitCode; }
      set { this.exitCode = value; }
    }

    /// Creates and initiates the listener instance.
    /// param name="args";This parameter is not used.
    private static void Main(string[] args)
    {
```

```
      // Display the welcome message...
      Console.Title = "PowerShell Console Host Sample Application";
      ConsoleColor oldFg = Console.ForegroundColor;
      Console.ForegroundColor = ConsoleColor.Cyan;
      Console.WriteLine("    PowerShell Console Host Interactive Sample");
      Console.WriteLine("    ====================================");
      Console.WriteLine(string.Empty);
      Console.WriteLine("This is an example of a simple interactive console
host that uses the ");
      Console.WriteLine("Windows PowerShell engine to interpret commands.
Type 'exit' to exit.");
      Console.WriteLine(string.Empty);
      Console.ForegroundColor = oldFg;

      // Create the listener and run it - this never returns...
      PSListenerConsoleSample listener = new PSListenerConsoleSample();
      listener.Run();
    }

    /// A helper class that builds and executes a pipeline that writes to
the
    /// default output path. Any exceptions that are thrown are just passed
to
    /// the caller. Since all output goes to the default outputter, this
method()
    /// won't return anything.
    /// param name="cmd"; The script to run.
    /// param name="input";Any input arguments to pass to the script. If
null
    /// then nothing is passed in.
    private void executeHelper(string cmd, object input)
    {
      // Ignore empty command lines.
      if (String.IsNullOrEmpty(cmd))
      {
        return;
      }

      // Create the pipeline object and make it available
      // to the ctrl-C handle through the currentPowerShell instance
      // variable
      lock (this.instanceLock)
      {
        this.currentPowerShell = PowerShell.Create();
      }

      this.currentPowerShell.Runspace = this.myRunSpace;

      // Create a pipeline for this execution. Place the result in the
      // currentPowerShell instance variable so that it is available
      // to be stopped.
      try
      {
        this.currentPowerShell.AddScript(cmd);
```

```
        // Now add the default outputter to the end of the pipe and indicate
        // that it should handle both output and errors from the previous
        // commands. This will result in the output being written using the
PSHost
        // and PSHostUserInterface classes instead of returning objects to
the hosting
        // application.
        this.currentPowerShell.AddCommand("out-default");

this.currentPowerShell.Commands.Commands[0].MergeMyResults(PipelineResultTyp
es.Error, PipelineResultTypes.Output);

        // If there was any input specified, pass it in, otherwise just
        // execute the pipeline.
        if (input != null)
        {
          this.currentPowerShell.Invoke(new object[] { input });
        }
        else
        {
          this.currentPowerShell.Invoke();
        }
      }
      finally
      {
        // Dispose of the pipeline line and set it to null, locked because
        // currentPowerShell may be accessed by the ctrl-C handler.
        lock (this.instanceLock)
        {
          this.currentPowerShell.Dispose();
          this.currentPowerShell = null;
        }
      }
    }

    /// An exception occurred that we want to display
    /// using the display formatter. To do this we run
    /// a second pipeline passing in the error record.
    /// The runtime will bind this to the $input variable
    /// which is why $input is being piped to out-string.
    /// We then call WriteErrorLine to make sure the error
    /// gets displayed in the correct error color.

    /// param name="e"; The exception to display.
    private void ReportException(Exception e)
    {
      if (e != null)
      {
        object error;
        IContainsErrorRecord icer = e as IContainsErrorRecord;
        if (icer != null)
        {
          error = icer.ErrorRecord;
        }
        else
```

```
        {
          error = (object)new ErrorRecord(e, "Host.ReportException",
ErrorCategory.NotSpecified, null);
        }

        lock (this.instanceLock)
        {
          this.currentPowerShell = PowerShell.Create();
        }

        this.currentPowerShell.Runspace = this.myRunSpace;

        try
        {
          this.currentPowerShell.AddScript("$input").AddCommand("out-
string");

          // Do not merge errors, this function will swallow errors.
          Collection<PSObject> result;
          PSDataCollection<object> inputCollection = new
PSDataCollection<object>();
          inputCollection.Add(error);
          inputCollection.Complete();
          result = this.currentPowerShell.Invoke(inputCollection);

          if (result.Count > 0)
          {
            string str = result[0].BaseObject as string;
            if (!string.IsNullOrEmpty(str))
            {
              // Remove \r\n that is added by Out-string.
              this.myHost.UI.WriteErrorLine(str.Substring(0, str.Length -
2));
            }
          }
        }
        finally
        {
          // Dispose of the pipeline line and set it to null, locked because
currentPowerShell
          // may be accessed by the ctrl-C handler.
          lock (this.instanceLock)
          {
            this.currentPowerShell.Dispose();
            this.currentPowerShell = null;
          }
        }
      }
    }

    /// Basic script execution routine - any runtime exceptions are
    /// caught and passed back into the engine to display.

    /// param name="cmd"; The parameter is not used.
    private void Execute(string cmd)
```

```
    {
      try
      {
        // Execute the command with no input.
        this.executeHelper(cmd, null);
      }
      catch (RuntimeException rte)
      {
        this.ReportException(rte);
      }
    }

    /// Method used to handle control-C's from the user. It calls the
    /// pipeline Stop() method to stop execution. If any exceptions occur
    /// they are printed to the console but otherwise ignored.

    /// param name="sender"; See sender property of
ConsoleCancelEventHandler documentation.
    /// param name="e"; See e property of ConsoleCancelEventHandler
documentation.
    private void HandleControlC(object sender, ConsoleCancelEventArgs e)
    {
      try
      {
        lock (this.instanceLock)
        {
          if (this.currentPowerShell != null &&
this.currentPowerShell.InvocationStateInfo.State ==
PSInvocationState.Running)
          {
            this.currentPowerShell.Stop();
          }
        }

        e.Cancel = true;
      }
      catch (Exception exception)
      {
        this.myHost.UI.WriteErrorLine(exception.ToString());
      }
    }

    /// Implements the basic listener loop. It sets up the ctrl-C handler,
then
    /// reads a command from the user, executes it and repeats until the
ShouldExit
    /// flag is set.
    private void Run()
    {
      // Set up the control-C handler.
      Console.CancelKeyPress += new
ConsoleCancelEventHandler(this.HandleControlC);
      Console.TreatControlCAsInput = false;

      // Read commands to execute until ShouldExit is set by
```

```
      // the user calling "exit".
      while (!this.ShouldExit)
      {
        this.myHost.UI.Write(ConsoleColor.Cyan, ConsoleColor.Black,
"\nPSConsoleSample: ");
        string cmd = Console.ReadLine();
        this.Execute(cmd);
      }

      // Exit with the desired exit code that was set by exit command.
      // This is set in the host by the MyHost.SetShouldExit()
implementation.
      Environment.Exit(this.ExitCode);
    }
  }
}
```

Example 2

The following code is the implementation of the System.Management.Automation.Host.PSHost class that is used by this host application. Those elements that are not implemented throw an exception or return nothing.

C#

```
// Copyright (c) 2006 Microsoft Corporation. All rights reserved.
//
// THIS CODE AND INFORMATION IS PROVIDED "AS IS" WITHOUT WARRANTY OF
// ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO
// THE IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR A
// PARTICULAR PURPOSE.
//
using System;
using System.Collections.Generic;
using System.Text;
using System.Management.Automation;
using System.Management.Automation.Host;
using System.Management.Automation.Runspaces;

namespace Microsoft.Samples.PowerShell.Host
{
  /// <summary>
  /// Simple PowerShell interactive console host listener implementation.
This class
  /// implements a basic read-evaluate-print loop or 'listener' allowing you
to
  /// interactively work with the PowerShell runtime.
  /// </summary>
  class PSListenerConsoleSample
  {
    /// <summary>
```

```
    /// Define the property that the PSHost implementation will use to tell
the host
    /// application that it should exit.
    /// </summary>
    public bool ShouldExit
    {
      get { return shouldExit; }
      set { shouldExit = value; }
    }
    private bool shouldExit;

    /// <summary>
    /// Define the property that the PSHost implementation will use to tell
the host
    /// application what code to use when exiting.
    /// </summary>
    public int ExitCode
    {
      get { return exitCode; }
      set { exitCode = value; }
    }
    private int exitCode;
    /// <summary>
    /// Holds the instance of the PSHost implementation for this
interpreter.
    /// </summary>
    private MyHost myHost;

    /// <summary>
    /// Holds the runspace for this interpreter.
    /// </summary>
    private Runspace myRunSpace;

    /// <summary>
    /// Holds a reference to the currently executing pipeline so it can be
    /// stopped by the control-C handler.
    /// </summary>
    private Pipeline currentPipeline;

    /// <summary>
    /// Used to serialize access to instance data...
    /// </summary>
    private object instanceLock = new object();

    /// <summary>
    /// Create this instance of the console listener.
    /// </summary>
    PSListenerConsoleSample()
    {
      // Create the host and runspace instances for this interpreter. Note
that
      // this application doesn't support console files so only the default
snapins
      // will be available.
      myHost = new MyHost(this);
```

```
      myRunSpace = RunspaceFactory.CreateRunspace(myHost);
      myRunSpace.Open();
    }

    /// <summary>
    /// A helper class that builds and executes a pipeline that writes to
the
    /// default output path. Any exceptions that are thrown are just passed
to
    /// the caller. Since all output goes to the default outputter, this
method()
    /// won't return anything.
    /// </summary>
    /// <param name="cmd">The script to run</param>
    /// <param name="input">Any input arguments to pass to the script. If
null
    /// then nothing is passed in.</param>
    void executeHelper(string cmd, object input)
    {
      // Ignore empty command lines.
      if (String.IsNullOrEmpty(cmd))
        return;

      // Create the pipeline object and make it available
      // to the ctrl-C handle through the currentPipeline instance
      // variable.
      lock (instanceLock)
      {
        currentPipeline = myRunSpace.CreatePipeline();
      }

      // Create a pipeline for this execution. Place the result in the
currentPipeline
      // instance variable so that it is available to be stopped.
      try
      {
        currentPipeline.Commands.AddScript(cmd);

        // Now add the default outputter to the end of the pipe and indicate
        // that it should handle both output and errors from the previous
        // commands. This will result in the output being written using the
PSHost
        // and PSHostUserInterface classes instead of returning objects to
the hosting
        // application.
        currentPipeline.Commands.Add("out-default");

currentPipeline.Commands[0].MergeMyResults(PipelineResultTypes.Error,
PipelineResultTypes.Output);

        // If there was any input specified, pass it in, otherwise just
        // execute the pipeline.
        if (input != null)
        {
          currentPipeline.Invoke(new object[] { input });
```

```
        }
        else
        {
          currentPipeline.Invoke();
        }
      }
      finally
      {
        // Dispose of the pipeline line and set it to null, locked because
currentPipeline
        // may be accessed by the ctrl-C handler.
        lock (instanceLock)
        {
          currentPipeline.Dispose();
          currentPipeline = null;
        }
      }
    }

    /// <summary>
    /// Basic script execution routine - any runtime exceptions are
    /// caught and passed back into the runtime to display.
    /// </summary>
    /// <param name="cmd"></param>
    void Execute(string cmd)
    {
      try
      {
        // execute the command with no input...
        executeHelper(cmd, null);
      }
      catch (RuntimeException rte)
      {
        // An exception occurred that we want to display
        // using the display formatter. To do this we run
        // a second pipeline passing in the error record.
        // The runtime will bind this to the $input variable
        // which is why $input is being piped to out-default
        executeHelper("$input | out-default", rte.ErrorRecord);
      }
    }

    /// <summary>
    /// Method used to handle control-C's from the user. It calls the
    /// pipeline Stop() method to stop execution. If any exceptions occur,
    /// they are printed to the console; otherwise they are ignored.
    /// </summary>
    /// <param name="sender">See ConsoleCancelEventHandler
documentation</param>
    /// <param name="e">See ConsoleCancelEventHandler documentation</param>
    void HandleControlC(object sender, ConsoleCancelEventArgs e)
    {
      try
      {
        lock (instanceLock)
```

```
        {
          if (currentPipeline != null &&
currentPipeline.PipelineStateInfo.State == PipelineState.Running)
                    currentPipeline.Stop();
        }
        e.Cancel = true;
      }
      catch (Exception exception)
      {
        this.myHost.UI.WriteErrorLine(exception.ToString());
      }
    }

    /// <summary>
    /// Implements the basic listener loop. It sets up the ctrl-C handler,
then
    /// reads a command from the user, executes it and repeats until the
ShouldExit
    /// flag is set.
    /// </summary>
    private void Run()
    {
      // Set up the control-C handler.
      Console.CancelKeyPress += new
ConsoleCancelEventHandler(HandleControlC);
      Console.TreatControlCAsInput = false;

      // Loop reading commands to execute until ShouldExit is set by
      // the user calling "exit".
      while (!ShouldExit)
      {
        myHost.UI.Write(ConsoleColor.Cyan, ConsoleColor.Black,
"\nPSConsoleSample: ");
        string cmd = Console.ReadLine();
        Execute(cmd);
      }

      // Exit with the desired exit code that was set by exit command.
      // This is set in the host by the MyHost.SetShouldExit()
implementation.
      Environment.Exit(ExitCode);
    }

    /// <summary>
    /// Creates and initiates the listener instance.
    /// </summary>
    /// <param name="args">Ignored for now.</param>
    static void Main(string[] args)
    {
      // Display the welcome message.
      Console.Title = "PowerShell Console Host Sample Application";
      ConsoleColor oldFg = Console.ForegroundColor;
      Console.ForegroundColor = ConsoleColor.Cyan;
      Console.WriteLine("    PowerShell Console Host Interactive Sample");
      Console.WriteLine("    ==========================================");
```

```
      Console.WriteLine("");
      Console.WriteLine("This is an example of a simple interactive console
host using the PowerShell");
      Console.WriteLine("engine to interpret commands. Type 'exit' to
exit.");
      Console.WriteLine("");
      Console.ForegroundColor = oldFg;

      // Create the listener and run it - this never returns.
      PSListenerConsoleSample listener = new PSListenerConsoleSample();
      listener.Run();
    }
  }
}
```

Example 3

The following code is the implementation of the System.Management.Automation.Host.PSHostUserInterface class that is used by this host application.

C#

```
namespace Microsoft.Samples.PowerShell.Host
{
  using System;
  using System.Collections.Generic;
  using System.Collections.ObjectModel;
  using System.Globalization;
  using System.Management.Automation;
  using System.Management.Automation.Host;
  using System.Text;

  /// <summary>
  /// A sample implementation of the PSHostUserInterface abstract class for
  /// console applications. Not all members are implemented. Those that are
  /// not implemented throw a NotImplementedException exception or return
  /// nothing. Members that are implemented include those that map easily to
  /// Console APIs and a basic implementation of the prompt API provided.
  /// </summary>
  internal class MyHostUserInterface : PSHostUserInterface
  {
    /// <summary>
    /// An instance of the PSRawUserInterface object.
    /// </summary>
    private MyRawUserInterface myRawUi = new MyRawUserInterface();

    /// <summary>
    /// Gets an instance of the PSRawUserInterface object for this host
    /// application.
    /// </summary>
```

```
    public override PSHostRawUserInterface RawUI
    {
      get { return this.myRawUi; }
    }

    /// <summary>
    /// Prompts the user for input.
    /// <param name="caption">The caption or title of the prompt.</param>
    /// <param name="message">The text of the prompt.</param>
    /// <param name="descriptions">A collection of FieldDescription objects
that
    /// describe each field of the prompt.</param>
    /// <returns>A dictionary object that contains the results of the user
    /// prompts.</returns>
    public override Dictionary<string, PSObject> Prompt(
                                        string caption,
                                        string message,
                                        Collection<FieldDescription>
descriptions)
    {
      this.Write(
                 ConsoleColor.Blue,
                 ConsoleColor.Black,
                 caption + "\n" + message + " ");
      Dictionary<string, PSObject> results =
               new Dictionary<string, PSObject>();
      foreach (FieldDescription fd in descriptions)
      {
        string[] label = GetHotkeyAndLabel(fd.Label);
        this.WriteLine(label[1]);
        string userData = Console.ReadLine();
        if (userData == null)
        {
          return null;
        }

        results[fd.Name] = PSObject.AsPSObject(userData);
      }

      return results;
    }

    /// <summary>

/// Provides a set of choices that enable the user to choose a
    /// single option from a set of options.
    /// </summary>
    /// <param name="caption">Text that proceeds (a title) the choices.
</param>
    /// <param name="message">A message that describes the choice.</param>
    /// <param name="choices">A collection of ChoiceDescription objects that
describe
    /// each choice.</param>
    /// <param name="defaultChoice">The index of the label in the Choices
parameter
```

```
    /// collection. To indicate no default choice, set to -1.</param>
    /// <returns>The index of the Choices parameter collection element that
corresponds
    /// to the option that is selected by the user.</returns>
    public override int PromptForChoice(
                                        string caption,
                                        string message,
                                        Collection<ChoiceDescription>
choices,
                                        int defaultChoice)
    {
      // Write the caption and message strings in Blue.
      this.WriteLine(
                      ConsoleColor.Blue,
                      ConsoleColor.Black,
                      caption + "\n" + message + "\n");

      // Convert the choice collection into something that is easier to
      // work with. See the BuildHotkeysAndPlainLabels method for details.
      Dictionary<string, PSObject> results =
          new Dictionary<string, PSObject>();
      string[,] promptData = BuildHotkeysAndPlainLabels(choices);

      // Format the overall choice prompt string to display...
      StringBuilder sb = new StringBuilder();
      for (int element = 0; element < choices.Count; element++)
      {
        sb.Append(String.Format(
                                CultureInfo.CurrentCulture,
                                "|{0}> {1} ",
                                promptData[0, element],
                                promptData[1, element]));
      }

      sb.Append(String.Format(
                              CultureInfo.CurrentCulture,
                              "[Default is ({0})]",
                              promptData[0, defaultChoice]));

      // Read prompts until a match is made, the default is
      // chosen, or the loop is interrupted with ctrl-C.
      while (true)
      {
        this.WriteLine(ConsoleColor.Cyan, ConsoleColor.Black,
sb.ToString());
        string data =
Console.ReadLine().Trim().ToUpper(CultureInfo.CurrentCulture);

        // If the choice string was empty, use the default selection.
        if (data.Length == 0)
        {
          return defaultChoice;
        }

        // See if the selection matched and return the
```

```
        // corresponding index if it did.
        for (int i = 0; i < choices.Count; i++)
        {
          if (promptData[0, i] == data)
          {
            return i;
          }
        }

        this.WriteErrorLine("Invalid choice: " + data);
      }
    }

    /// <summary>
    /// Prompts the user for credentials with a specified prompt window
caption,
    /// prompt message, user name, and target name. In this example this
    /// functionality is not needed so the method throws a
    /// NotImplementExecption exception.
    /// </summary>
    /// <param name="caption">The caption for the message window.</param>
    /// <param name="message">The text of the message.</param>
    /// <param name="userName">The user name whose credential is to be
prompted for.</param>
    /// <param name="targetName">The name of the target for which the
credential is collected.</param>
    /// <returns>Throws a NotImplementedException exception.</returns>
    public override PSCredential PromptForCredential(
                                                    string caption,
                                                    string message,
                                                    string userName,
                                                    string targetName)
    {
      throw new NotImplementedException("The method or operation is not
implemented.");
    }

    /// <summary>
    /// Prompts the user for credentials by using a specified prompt window
caption,
    /// prompt message, user name and target name, credential types allowed
to be
    /// returned, and UI behavior options. In this example this
functionality
    /// is not needed so the method throws a NotImplementException
exception.
    /// </summary>
    /// <param name="caption">The caption for the message window.</param>
    /// <param name="message">The text of the message.</param>
    /// <param name="userName">The user name whose credential is to be
prompted for.</param>
    /// <param name="targetName">The name of the target for which the
credential is collected.</param>
    /// <param name="allowedCredentialTypes">A PSCredentialTypes constant
that
```

```
    /// identifies the type of credentials that can be returned.</param>
    /// <param name="options">A PSCredentialUIOptions constant that
identifies the UI
    /// behavior when it gathers the credentials.</param>
    /// <returns>Throws a NotImplementedException exception.</returns>
    public override PSCredential PromptForCredential(
                                                    string caption,
                                                    string message,
                                                    string userName,
                                                    string targetName,
                                                    PSCredentialTypes
allowedCredentialTypes,
                                                    PSCredentialUIOptions
options)
    {
      throw new NotImplementedException("The method or operation is not
implemented.");
    }

    /// <summary>
    /// Reads characters that are entered by the user until a newline
    /// (carriage return) is encountered.
    /// </summary>
    /// <returns>The characters that are entered by the user.</returns>
    public override string ReadLine()
    {
      return Console.ReadLine();
    }

    /// <summary>
    /// Reads characters entered by the user until a newline (carriage
return)
    /// is encountered and returns the characters as a secure string. In
this
    /// example this functionality is not needed so the method throws a
    /// NotImplementException exception.
    /// </summary>
    /// <returns>Throws a NotImplemented exception.</returns>
    public override System.Security.SecureString ReadLineAsSecureString()
    {
      throw new NotImplementedException("The method or operation is not
implemented.");
    }

    /// <summary>
    /// Writes characters to the output display of the host.
    /// </summary>
    /// <param name="value">The characters to be written.</param>
    public override void Write(string value)
    {
      Console.Write(value);
    }

    /// <summary>
    /// Writes characters to the output display of the host with possible
```

```
    /// foreground and background colors.
    /// </summary>
    /// <param name="foregroundColor">The color of the characters.</param>
    /// <param name="backgroundColor">The background color to use.</param>
    /// <param name="value">The characters to be written.</param>
    public override void Write(
                               ConsoleColor foregroundColor,
                               ConsoleColor backgroundColor,
                               string value)
    {
      ConsoleColor oldFg = Console.ForegroundColor;
      ConsoleColor oldBg = Console.BackgroundColor;
      Console.ForegroundColor = foregroundColor;
      Console.BackgroundColor = backgroundColor;
      Console.Write(value);
      Console.ForegroundColor = oldFg;
      Console.BackgroundColor = oldBg;
    }

    /// <summary>
    /// Writes a line of characters to the output display of the host
    /// with foreground and background colors and appends a newline
(carriage return).
    /// </summary>
    /// <param name="foregroundColor">The foreground color of the display.
</param>
    /// <param name="backgroundColor">The background color of the display.
</param>
    /// <param name="value">The line to be written.</param>
    public override void WriteLine(
                                   ConsoleColor foregroundColor,
                                   ConsoleColor backgroundColor,
                                   string value)
    {
      ConsoleColor oldFg = Console.ForegroundColor;
      ConsoleColor oldBg = Console.BackgroundColor;
      Console.ForegroundColor = foregroundColor;
      Console.BackgroundColor = backgroundColor;
      Console.WriteLine(value);
      Console.ForegroundColor = oldFg;
      Console.BackgroundColor = oldBg;
    }

    /// <summary>
    /// Writes a debug message to the output display of the host.
    /// </summary>
    /// <param name="message">The debug message that is displayed.</param>
    public override void WriteDebugLine(string message)
    {
      this.WriteLine(
                     ConsoleColor.DarkYellow,
                     ConsoleColor.Black,
                     String.Format(CultureInfo.CurrentCulture, "DEBUG: {0}",
message));
    }
```

```
    /// <summary>
    /// Writes an error message to the output display of the host.
    /// </summary>
    /// <param name="value">The error message that is displayed.</param>
    public override void WriteErrorLine(string value)
    {
      this.WriteLine(
                    ConsoleColor.Red,
                    ConsoleColor.Black,
                    value);
    }

    /// <summary>
    /// Writes a newline character (carriage return)
    /// to the output display of the host.
    /// </summary>
    public override void WriteLine()
    {
      Console.WriteLine();
    }

    /// <summary>
    /// Writes a line of characters to the output display of the host
    /// and appends a newline character(carriage return).
    /// </summary>
    /// <param name="value">The line to be written.</param>
    public override void WriteLine(string value)
    {
      Console.WriteLine(value);
    }

    /// <summary>
    /// Writes a progress report to the output display of the host.
    /// </summary>
    /// <param name="sourceId">Unique identifier of the source of the
record. </param>
    /// <param name="record">A ProgressReport object.</param>
    public override void WriteProgress(long sourceId, ProgressRecord record)
    {

    }

    /// <summary>
    /// Writes a verbose message to the output display of the host.
    /// </summary>
    /// <param name="message">The verbose message that is displayed.</param>
    public override void WriteVerboseLine(string message)
    {
      this.WriteLine(
                    ConsoleColor.Green,
                    ConsoleColor.Black,
                    String.Format(CultureInfo.CurrentCulture, "VERBOSE:
{0}", message));
    }
```

```
    /// <summary>
    /// Writes a warning message to the output display of the host.
    /// </summary>
    /// <param name="message">The warning message that is displayed.</param>
    public override void WriteWarningLine(string message)
    {
      this.WriteLine(
                    ConsoleColor.Yellow,
                    ConsoleColor.Black,
                    String.Format(CultureInfo.CurrentCulture, "WARNING:
{0}", message));
    }

    /// <summary>
    /// This is a private worker function splits out the
    /// accelerator keys from the menu and builds a two
    /// dimensional array with the first access containing the
    /// accelerator and the second containing the label string
    /// with the & removed.
    /// </summary>
    /// <param name="choices">The choice collection to process</param>
    /// <returns>
    /// A two dimensional array containing the accelerator characters
    /// and the cleaned-up labels</returns>
    private static string[,] BuildHotkeysAndPlainLabels(
        Collection<ChoiceDescription> choices)
    {
      // Allocate the result array.
      string[,] hotkeysAndPlainLabels = new string[2, choices.Count];
      for (int i = 0; i < choices.Count; ++i)
      {
        string[] hotkeyAndLabel = GetHotkeyAndLabel(choices[i].Label);
        hotkeysAndPlainLabels[0, i] = hotkeyAndLabel[0];
        hotkeysAndPlainLabels[1, i] = hotkeyAndLabel[1];
      }

      return hotkeysAndPlainLabels;
    }

    /// <summary>
    /// Parse a string containing a hotkey character.
    /// Take a string of the form
    ///    Yes to &all
    /// and returns a two-dimensional array split out as
    ///    "A", "Yes to all".
    /// </summary>
    /// <param name="input">The string to process</param>
    /// <returns>
    /// A two dimensional array containing the parsed components.
    /// </returns>
    private static string[] GetHotkeyAndLabel(string input)
    {
      string[] result = new string[] { String.Empty, String.Empty };
      string[] fragments = input.Split('&');
```

```
      if (fragments.Length == 2)
      {
        if (fragments[1].Length > 0)
        {
          result[0] = fragments[1][0].ToString().
          ToUpper(CultureInfo.CurrentCulture);
        }

        result[1] = (fragments[0] + fragments[1]).Trim();
      }
      else
      {
        result[1] = input;
      }

      return result;
    }
  }
}
```

Example 4

The following code is the implementation of the System.Management.Automation.Host.PSHostRawUserInterface class that is used by this host application. Those elements that are not implemented throw an exception or return nothing.

C#

```
namespace Microsoft.Samples.PowerShell.Host
{
  using System;
  using System.Management.Automation.Host;

  /// <summary>
  /// A sample implementation of the PSHostRawUserInterface for console
  /// applications. Members of this class that easily map to the .NET
  /// console class are implemented. More complex methods are not
  /// implemented and throw a NotImplementedException exception.
  /// </summary>
  internal class MyRawUserInterface : PSHostRawUserInterface
  {
    /// <summary>
    /// Gets or sets the background color of text to be written.
    /// This maps to the corresponding Console.Background property.
    /// </summary>
    public override ConsoleColor BackgroundColor
    {
      get { return Console.BackgroundColor; }
      set { Console.BackgroundColor = value; }
```

```
    }

    /// <summary>
    /// Gets or sets the host buffer size adapted from the Console buffer
    /// size members.
    /// </summary>
    public override Size BufferSize
    {
      get { return new Size(Console.BufferWidth, Console.BufferHeight); }
      set { Console.SetBufferSize(value.Width, value.Height); }
    }

    /// <summary>
    /// Gets or sets the cursor position. In this example this
    /// functionality is not needed so the property throws a
    /// NotImplementException exception.
    /// </summary>
    public override Coordinates CursorPosition
    {
      get { throw new NotImplementedException(
                  "The method or operation is not implemented."); }
      set { throw new NotImplementedException(
                  "The method or operation is not implemented."); }
    }

    /// <summary>
    /// Gets or sets the cursor size taken directly from the
    /// Console.CursorSize property.
    /// </summary>
    public override int CursorSize
    {
      get { return Console.CursorSize; }
      set { Console.CursorSize = value; }
    }

    /// <summary>
    /// Gets or sets the foreground color of the text to be written.
    /// This maps to the corresponding Console.ForegroundColor property.
    /// </summary>
    public override ConsoleColor ForegroundColor
    {
      get { return Console.ForegroundColor; }
      set { Console.ForegroundColor = value; }
    }

    /// <summary>
    /// Gets a value indicating whether a key is available. This maps to
    /// the corresponding Console.KeyAvailable property.
    /// </summary>
    public override bool KeyAvailable
    {
      get { return Console.KeyAvailable; }
    }

    /// <summary>
```

```
    /// Gets the maximum physical size of the window adapted from the
    ///  Console.LargestWindowWidth and Console.LargestWindowHeight
    ///  properties.
    /// </summary>
    public override Size MaxPhysicalWindowSize
    {
      get { return new Size(Console.LargestWindowWidth,
Console.LargestWindowHeight); }
    }

    /// <summary>
    /// Gets the maximum window size adapted from the
    /// Console.LargestWindowWidth and console.LargestWindowHeight
    /// properties.
    /// </summary>
    public override Size MaxWindowSize
    {
      get { return new Size(Console.LargestWindowWidth,
Console.LargestWindowHeight); }
    }

    /// <summary>
    /// Gets or sets the window position adapted from the Console window
position
    /// members.
    /// </summary>
    public override Coordinates WindowPosition
    {
      get { return new Coordinates(Console.WindowLeft, Console.WindowTop); }
      set { Console.SetWindowPosition(value.X, value.Y); }
    }

    /// <summary>
    /// Gets or sets the window size adapted from the corresponding Console
    /// calls.
    /// </summary>
    public override Size WindowSize
    {
      get { return new Size(Console.WindowWidth, Console.WindowHeight); }
      set { Console.SetWindowSize(value.Width, value.Height); }
    }

    /// <summary>
    /// Gets or sets the title of the window mapped to the Console.Title
    /// property.
    /// </summary>
    public override string WindowTitle
    {
      get { return Console.Title; }
      set { Console.Title = value; }
    }

    /// <summary>
    /// This API resets the input buffer. In this example this
    /// functionality is not needed so the method returns nothing.
```

```
    /// </summary>
    public override void FlushInputBuffer()
    {
    }

    /// <summary>
    /// This API returns a rectangular region of the screen buffer. In
    /// this example this functionality is not needed so the method throws
    /// a NotImplementException exception.
    /// </summary>
    /// <param name="rectangle">Defines the size of the rectangle.</param>
    /// <returns>Throws a NotImplementedException exception.</returns>
    public override BufferCell[,] GetBufferContents(Rectangle rectangle)
    {
      throw new NotImplementedException(
               "The method or operation is not implemented.");
    }

    /// <summary>
    /// This API Reads a pressed, released, or pressed and released
keystroke
    /// from the keyboard device, blocking processing until a keystroke is
    /// typed that matches the specified keystroke options. In this example
    /// this functionality is not needed so the method throws a
    /// NotImplementException exception.
    /// </summary>
    /// <param name="options">Options, such as IncludeKeyDown,  used when
    /// reading the keyboard.</param>
    /// <returns>Throws a NotImplementedException exception.</returns>
    public override KeyInfo ReadKey(ReadKeyOptions options)
    {
      throw new NotImplementedException(
                "The method or operation is not implemented.");
    }

    /// <summary>
    /// This API crops a region of the screen buffer. In this example
    /// this functionality is not needed so the method throws a
    /// NotImplementException exception.
    /// </summary>
    /// <param name="source">The region of the screen to be scrolled.
</param>
    /// <param name="destination">The region of the screen to receive the
    /// source region contents.</param>
    /// <param name="clip">The region of the screen to include in the
operation.</param>
    /// <param name="fill">The character and attributes to be used to fill
all cell.</param>
    public override void ScrollBufferContents(Rectangle source, Coordinates
destination, Rectangle clip, BufferCell fill)
    {
      throw new NotImplementedException(
                "The method or operation is not implemented.");
    }
```

```
     /// <summary>
    /// This API copies an array of buffer cells into the screen buffer
    /// at a specified location. In this example this  functionality is
    /// not needed si the method  throws a NotImplementedException
exception.
    /// </summary>
    /// <param name="origin">The parameter is not used.</param>
    /// <param name="contents">The parameter is not used.</param>
    public override void SetBufferContents(Coordinates origin, BufferCell[,]
contents)
    {
      throw new NotImplementedException(
                "The method or operation is not implemented.");
    }

    /// <summary>
    /// This API Copies a given character, foreground color, and background
    /// color to a region of the screen buffer. In this example this
    /// functionality is not needed so the method throws a
    /// NotImplementException exception./// </summary>
    /// <param name="rectangle">Defines the area to be filled. </param>
    /// <param name="fill">Defines the fill character.</param>
    public override void SetBufferContents(Rectangle rectangle, BufferCell
fill)
    {
      throw new NotImplementedException(
                "The method or operation is not implemented.");
    }
  }
}
```

See Also

System.Management.Automation.Host.PSHost

System.Management.Automation.Host.Pshostuserinterface

System.Management.Automation.Host.Pshostrawuserinterface

Host04 Sample

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This sample shows how to build an interactive console-based host application that reads commands from the command line, executes the commands, and then displays the results to the console. This host application also supports displaying prompts that allow the user to specify multiple choices.

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

- Creating a custom host whose classes derive from the System.Management.Automation.Host.PSHost class, the System.Management.Automation.Host.PSHostUserInterface class, and the System.Management.Automation.Host.PSHostRawUserInterface class.
- Building a console application that uses these host classes to build an interactive Windows PowerShell shell.
- Creating a `$profile` variable and loading the following profiles.
  - current user, current host
  - current user, all hosts
  - all users, current host
  - all users, all hosts
- Implement the System.Management.Automation.Host.IHostUISupportsMultipleChoiceSelection interface.

Example 1

This example allows the user to enter commands at a command line, processes those commands, and then prints out the results.

C#

```
namespace Microsoft.Samples.PowerShell.Host
{
```

```
using System;
using System.Collections.ObjectModel;
using System.Management.Automation;
using System.Management.Automation.Runspaces;
using PowerShell = System.Management.Automation.PowerShell;

/// <summary>
/// This class contains the Main entry point for this host application.
/// </summary>
internal class PSListenerConsoleSample
{
  /// <summary>
  /// Indicator to tell the host application that it should exit.
  /// </summary>
  private bool shouldExit;

  /// <summary>
  /// The exit code that the host application will use to exit.
  /// </summary>
  private int exitCode;

  /// <summary>
  /// Holds a reference to  the PSHost object for this interpreter.
  /// </summary>
  private MyHost myHost;

  /// <summary>
  /// Holds a reference to the runspace for this interpreter.
  /// </summary>
  private Runspace myRunSpace;

  /// <summary>
  /// Holds a reference to the currently executing pipeline so that
  /// it can be stopped by the control-C handler.
  /// </summary>
  private PowerShell currentPowerShell;

  /// <summary>
  /// Used to serialize access to instance data.
  /// </summary>
  private object instanceLock = new object();

  /// <summary>
  /// Gets or sets a value indicating whether the host application
  /// should exit.
  /// </summary>
  public bool ShouldExit
  {
    get { return this.shouldExit; }
    set { this.shouldExit = value; }
  }

  /// <summary>
  /// Gets or sets the exit code that the host application will use
  /// when exiting.
```

```
    /// </summary>
    public int ExitCode
    {
      get { return this.exitCode; }
      set { this.exitCode = value; }
    }

    /// <summary>
    /// Creates and initiates the listener.
    /// </summary>
    /// <param name="args">The parameter is not used</param>
    private static void Main(string[] args)
    {
      // Display the welcome message.
      Console.Title = "Windows PowerShell Console Host Application Sample";
      ConsoleColor oldFg = Console.ForegroundColor;
      Console.ForegroundColor = ConsoleColor.Cyan;
      Console.WriteLine("    Windows PowerShell Console Host Interactive
Sample");
      Console.WriteLine("
================================================");
      Console.WriteLine(string.Empty);
      Console.WriteLine("This is an example of a simple interactive console
host that uses ");
      Console.WriteLine("the Windows PowerShell engine to interpret
commands.");
      Console.WriteLine("Type 'exit' to exit.");
      Console.WriteLine(string.Empty);
      Console.ForegroundColor = oldFg;

      // Create the listener and run it. This never returns.
      PSListenerConsoleSample listener = new PSListenerConsoleSample();
      listener.Run();
    }

    /// <summary>
    /// Create this instance of the console listener.
    /// </summary>
    private PSListenerConsoleSample()
    {
      // Create the host and runspace instances for this interpreter. Note
that
      // this application doesn't support console files so only the default
snapins
      // will be available.
      this.myHost = new MyHost(this);
      this.myRunSpace = RunspaceFactory.CreateRunspace(this.myHost);
      this.myRunSpace.Open();

      // Create a PowerShell object that will be used to execute the
commands
      // to create $profile and load the profiles.
      lock (this.instanceLock)
      {
        this.currentPowerShell = PowerShell.Create();
```

```
      }

      try
      {
        this.currentPowerShell.Runspace = this.myRunSpace;

        PSCommand[] profileCommands =
Microsoft.Samples.PowerShell.Host.HostUtilities.GetProfileCommands("SampleHo
st04");
        foreach (PSCommand command in profileCommands)
        {
          this.currentPowerShell.Commands = command;
          this.currentPowerShell.Invoke();
        }
      }
      finally
      {
        // Dispose of the pipeline line and set it to null, locked because
currentPowerShell
        // may be accessed by the ctrl-C handler...
        lock (this.instanceLock)
        {
          this.currentPowerShell.Dispose();
          this.currentPowerShell = null;
        }
      }
    }

    /// <summary>
    /// A helper class that builds and executes a pipeline that writes to
the
    /// default output path. Any exceptions that are thrown are just passed
to
    /// the caller. Since all output goes to the default outputter, this
method
    /// returns nothing.
    /// </summary>
    /// <param name="cmd">The script to run</param>
    /// <param name="input">Any input arguments to pass to the script. If
null
    /// then nothing is passed in.</param>
    private void executeHelper(string cmd, object input)
    {
      // Ignore empty command lines.
      if (String.IsNullOrEmpty(cmd))
      {
        return;
      }

      // Create the pipeline object and make it available
      // to the ctrl-C handle through the currentPowerShell instance
      // variable.
      lock (this.instanceLock)
      {
        this.currentPowerShell = PowerShell.Create();
```

```
      }

      this.currentPowerShell.Runspace = this.myRunSpace;

      // Create a pipeline for this execution. Place the result in the
      // currentPowerShell instance variable so that it is available to
      // be stopped.
      try
      {
        this.currentPowerShell.AddScript(cmd);

        // Now add the default outputter to the end of the pipe and indicate
        // that it should handle both output and errors from the previous
        // commands. This will result in the output being written using the
PSHost
        // and PSHostUserInterface classes instead of returning objects to
the hosting
        // application.
        this.currentPowerShell.AddCommand("out-default");

this.currentPowerShell.Commands.Commands[0].MergeMyResults(PipelineResultTyp
es.Error, PipelineResultTypes.Output);

        // If there was any input specified, pass it in, otherwise just
        // execute the pipeline.
        if (input != null)
        {
          this.currentPowerShell.Invoke(new object[] { input });
        }
        else
        {
          this.currentPowerShell.Invoke();
        }
      }
      finally
      {
        // Dispose of the pipeline line and set it to null, locked because
currentPowerShell
        // may be accessed by the ctrl-C handler.
        lock (this.instanceLock)
        {
          this.currentPowerShell.Dispose();
          this.currentPowerShell = null;
        }
      }
    }

    /// <summary>
    /// An exception occurred that we want to display
    /// using the display formatter. To do this we run
    /// a second pipeline passing in the error record.
    /// The runtime will bind this to the $input variable
    /// which is why $input is being piped to out-string.
    /// We then call WriteErrorLine to make sure the error
    /// gets displayed in the correct error color.
```

```
    /// </summary>
    /// <param name="e">The exception to display</param>
    private void ReportException(Exception e)
    {
      if (e != null)
      {
        object error;
        IContainsErrorRecord icer = e as IContainsErrorRecord;
        if (icer != null)
        {
          error = icer.ErrorRecord;
        }
        else
        {
          error = (object)new ErrorRecord(e, "Host.ReportException",
ErrorCategory.NotSpecified, null);
        }

        lock (this.instanceLock)
        {
          this.currentPowerShell = PowerShell.Create();
        }

        this.currentPowerShell.Runspace = this.myRunSpace;

        try
        {
          this.currentPowerShell.AddScript("$input").AddCommand("out-
string");

          // Do not merge errors, this function will swallow errors.
          Collection<PSObject> result;
          PSDataCollection<object> inputCollection = new
PSDataCollection<object>();
          inputCollection.Add(error);
          inputCollection.Complete();
          result = this.currentPowerShell.Invoke(inputCollection);

          if (result.Count > 0)
          {
            string str = result[0].BaseObject as string;
            if (!string.IsNullOrEmpty(str))
            {
              // Remove \r\n that is added by out-string.
              this.myHost.UI.WriteErrorLine(str.Substring(0, str.Length -
2));
            }
          }
        }
        finally
        {
          // Dispose of the pipeline line and set it to null, locked because
currentPowerShell
          // may be accessed by the ctrl-C handler.
          lock (this.instanceLock)
```

```
          {
            this.currentPowerShell.Dispose();
            this.currentPowerShell = null;
          }
        }
      }
    }

    /// <summary>
    /// Basic script execution routine - any runtime exceptions are
    /// caught and passed back into the engine to display.
    /// </summary>
    /// <param name="cmd">The parameter is not used.</param>
    private void Execute(string cmd)
    {
      try
      {
        // Execute the command with no input.
        this.executeHelper(cmd, null);
      }
      catch (RuntimeException rte)
      {
        this.ReportException(rte);
      }
    }

    /// <summary>
    /// Method used to handle control-C's from the user. It calls the
    /// pipeline Stop() method to stop execution. If any exceptions occur
    /// they are printed to the console but otherwise ignored.
    /// </summary>
    /// <param name="sender">See sender property of
ConsoleCancelEventHandler documentation.</param>
    /// <param name="e">See e property of ConsoleCancelEventHandler
documentation</param>
    private void HandleControlC(object sender, ConsoleCancelEventArgs e)
    {
      try
      {
        lock (this.instanceLock)
        {
          if (this.currentPowerShell != null &&
this.currentPowerShell.InvocationStateInfo.State ==
PSInvocationState.Running)
          {
            this.currentPowerShell.Stop();
          }
        }

        e.Cancel = true;
      }
      catch (Exception exception)
      {
        this.myHost.UI.WriteErrorLine(exception.ToString());
      }
```

```
    }

    /// <summary>
    /// Implements the basic listener loop. It sets up the ctrl-C handler,
then
    /// reads a command from the user, executes it and repeats until the
ShouldExit
    /// flag is set.
    /// </summary>
    private void Run()
    {
      // Set up the control-C handler.
      Console.CancelKeyPress += new
ConsoleCancelEventHandler(this.HandleControlC);
      Console.TreatControlCAsInput = false;

      // Read commands to execute until ShouldExit is set by
      // the user calling "exit".
      while (!this.ShouldExit)
      {
        this.myHost.UI.Write(ConsoleColor.Cyan, ConsoleColor.Black,
"\nPSConsoleSample: ");
        string cmd = Console.ReadLine();
        this.Execute(cmd);
      }

      // Exit with the desired exit code that was set by exit command.
      // This is set in the host by the MyHost.SetShouldExit()
implementation.
      Environment.Exit(this.ExitCode);
    }
  }
}
```

Example 2

The following code is the implementation of the System.Management.Automation.Host.PSHost class that is used by this host application. Those elements that are not implemented throw an exception or return nothing.

C#

```
namespace Microsoft.Samples.PowerShell.Host
{
  using System;
  using System.Globalization;
  using System.Management.Automation.Host;

  /// <summary>
  /// This is a sample implementation of the PSHost abstract class for
  /// console applications. Not all members are implemented. Those that
```

```
  /// are not implemented throw a NotImplementedException exception or
  /// return nothing.
  /// </summary>
  internal class MyHost : PSHost
  {
    /// <summary>
    /// A reference to the PSHost implementation.
    /// </summary>
    private PSListenerConsoleSample program;

    /// <summary>
    /// The culture information of the thread that created
    /// this object.
    /// </summary>
    private CultureInfo originalCultureInfo =
        System.Threading.Thread.CurrentThread.CurrentCulture;

    /// <summary>
    /// The UI culture information of the thread that created
    /// this object.
    /// </summary>
    private CultureInfo originalUICultureInfo =
        System.Threading.Thread.CurrentThread.CurrentUICulture;

    /// <summary>
    /// The identifier of this PSHost implementation.
    /// </summary>
    private static Guid instanceId = Guid.NewGuid();

    /// <summary>
    /// Initializes a new instance of the MyHost class. Keep
    /// a reference to the host application object so that it
    /// can be informed of when to exit.
    /// </summary>
    /// <param name="program">
    /// A reference to the host application object.
    /// </param>
    public MyHost(PSListenerConsoleSample program)
    {
      this.program = program;
    }

    /// <summary>
    /// A reference to the implementation of the PSHostUserInterface
    /// class for this application.
    /// </summary>
    private MyHostUserInterface myHostUserInterface = new
MyHostUserInterface();

    /// <summary>
    /// Gets the culture information to use. This implementation
    /// returns a snapshot of the culture information of the thread
    /// that created this object.
    /// </summary>
    public override CultureInfo CurrentCulture
```

```
    {
      get { return this.originalCultureInfo; }
    }

    /// <summary>
    /// Gets the UI culture information to use. This implementation
    /// returns a snapshot of the UI culture information of the thread
    /// that created this object.
    /// </summary>
    public override CultureInfo CurrentUICulture
    {
      get { return this.originalUICultureInfo; }
    }

    /// <summary>
    /// Gets an identifier for this host. This implementation always
    /// returns the GUID allocated at instantiation time.
    /// </summary>
    public override Guid InstanceId
    {
      get { return instanceId; }
    }

    /// <summary>
    /// Gets a string that contains the name of this host implementation.
    /// Keep in mind that this string may be used by script writers to
    /// identify when your host is being used.
    /// </summary>
    public override string Name
    {
      get { return "MySampleConsoleHostImplementation"; }
    }

    /// <summary>
    /// Gets an instance of the implementation of the PSHostUserInterface
    /// class for this application. This instance is allocated once at
startup time
    /// and returned every time thereafter.
    /// </summary>
    public override PSHostUserInterface UI
    {
      get { return this.myHostUserInterface; }
    }

    /// <summary>
    /// Gets the version object for this application. Typically this
    /// should match the version resource in the application.
    /// </summary>
    public override Version Version
    {
      get { return new Version(1, 0, 0, 0); }
    }

    /// <summary>
    /// This API Instructs the host to interrupt the currently running
```

```
    /// pipeline and start a new nested input loop. In this example this
    /// functionality is not needed so the method throws a
    /// NotImplementedException exception.
    /// </summary>
    public override void EnterNestedPrompt()
    {
      throw new NotImplementedException(
            "The method or operation is not implemented.");
    }

    /// <summary>
    /// This API instructs the host to exit the currently running input
loop.
    /// In this example this functionality is not needed so the method
    /// throws a NotImplementedException exception.
    /// </summary>
    public override void ExitNestedPrompt()
    {
      throw new NotImplementedException(
            "The method or operation is not implemented.");
    }

    /// <summary>
    /// This API is called before an external application process is
    /// started. Typically it is used to save state so that the parent
    /// can restore state that has been modified by a child process (after
    /// the child exits). In this example this functionality is not
    /// needed so the method returns nothing.
    /// </summary>
    public override void NotifyBeginApplication()
    {
      return;
    }

    /// <summary>
    /// This API is called after an external application process finishes.
    /// Typically it is used to restore state that a child process has
    /// altered. In this example, this functionality is not needed so
    /// the method returns nothing.
    /// </summary>
    public override void NotifyEndApplication()
    {
      return;
    }

    /// <summary>
    /// Indicate to the host application that exit has
    /// been requested. Pass the exit code that the host
    /// application should use when exiting the process.
    /// </summary>
    /// <param name="exitCode">The exit code that the
    /// host application should use.</param>
    public override void SetShouldExit(int exitCode)
    {
      this.program.ShouldExit = true;
```

```
      this.program.ExitCode = exitCode;
    }
  }
}
```

Example 3

The following code is the implementation of the System.Management.Automation.Host.Pshostuserinterface class that is used by this host application.

C#

```
namespace Microsoft.Samples.PowerShell.Host
{
  using System;
  using System.Collections.Generic;
  using System.Collections.ObjectModel;
  using System.Globalization;
  using System.Management.Automation;
  using System.Management.Automation.Host;
  using System.Text;

  /// <summary>
  /// A sample implementation of the PSHostUserInterface abstract class for
  /// console applications. Not all members are implemented. Those that are
  /// not implemented throw a NotImplementedException exception or return
  /// nothing. Members that are implemented include those that map easily to
  /// Console APIs and a basic implementation of the prompt API provided.
  /// </summary>
  internal class MyHostUserInterface : PSHostUserInterface,
IHostUISupportsMultipleChoiceSelection
  {
    /// <summary>
    /// A reference to the PSRawUserInterface implementation.
    /// </summary>
    private MyRawUserInterface myRawUi = new MyRawUserInterface();

    /// <summary>
    /// Gets an instance of the PSRawUserInterface object for this host
    /// application.
    /// </summary>
    public override PSHostRawUserInterface RawUI
    {
      get { return this.myRawUi; }
    }

    /// <summary>
    /// Prompts the user for input.
    /// <param name="caption">The caption or title of the prompt.</param>
    /// <param name="message">The text of the prompt.</param>
```

```
    /// <param name="descriptions">A collection of FieldDescription objects
    /// that describe each field of the prompt.</param>
    /// <returns>A dictionary object that contains the results of the user
    /// prompts.</returns>
    public override Dictionary<string, PSObject> Prompt(
                            string caption,
                            string message,
                            Collection<FieldDescription> descriptions)
    {
      this.Write(
                ConsoleColor.Blue,
                ConsoleColor.Black,
                caption + "\n" + message + " ");
      Dictionary<string, PSObject> results =
               new Dictionary<string, PSObject>();
      foreach (FieldDescription fd in descriptions)
      {
        string[] label = GetHotkeyAndLabel(fd.Label);
        this.WriteLine(label[1]);
        string userData = Console.ReadLine();
        if (userData == null)
        {
          return null;
        }

        results[fd.Name] = PSObject.AsPSObject(userData);
      }

      return results;
    }

    /// <summary>

/// Provides a set of choices that enable the user to choose a
    /// single option from a set of options.
    /// </summary>
    /// <param name="caption">Text that proceeds (a title) the choices.
</param>
    /// <param name="message">A message that describes the choice.</param>
    /// <param name="choices">A collection of ChoiceDescription objects that
    /// describe each choice.</param>
    /// <param name="defaultChoice">The index of the label in the Choices
    /// parameter collection. To indicate no default choice, set to -1.
</param>
    /// <returns>The index of the Choices parameter collection element that
    /// corresponds to the option that is selected by the user.</returns>
    public override int PromptForChoice(
                                        string caption,
                                        string message,
                                        Collection<ChoiceDescription>
choices,
                                        int defaultChoice)
    {
      // Write the caption and message strings in Blue.
      this.WriteLine(
```

```
                    ConsoleColor.Blue,
                    ConsoleColor.Black,
                    caption + "\n" + message + "\n");

      // Convert the choice collection into something that is
      // easier to work with. See the BuildHotkeysAndPlainLabels
      // method for details.
      string[,] promptData = BuildHotkeysAndPlainLabels(choices);

      // Format the overall choice prompt string to display.
      StringBuilder sb = new StringBuilder();
      for (int element = 0; element < choices.Count; element++)
      {
        sb.Append(String.Format(
                            CultureInfo.CurrentCulture,
                            "|{0}> {1} ",
                            promptData[0, element],
                            promptData[1, element]));
      }

      sb.Append(String.Format(
                          CultureInfo.CurrentCulture,
                          "[Default is ({0})]",
                          promptData[0, defaultChoice]));

      // Read prompts until a match is made, the default is
      // chosen, or the loop is interrupted with ctrl-C.
      while (true)
      {
        this.WriteLine(ConsoleColor.Cyan, ConsoleColor.Black,
sb.ToString());
        string data =
Console.ReadLine().Trim().ToUpper(CultureInfo.CurrentCulture);

        // If the choice string was empty, use the default selection.
        if (data.Length == 0)
        {
          return defaultChoice;
        }

        // See if the selection matched and return the
        // corresponding index if it did.
        for (int i = 0; i < choices.Count; i++)
        {
          if (promptData[0, i] == data)
          {
            return i;
          }
        }

        this.WriteErrorLine("Invalid choice: " + data);
      }
    }

    #region IHostUISupportsMultipleChoiceSelection Members
```

```
    /// <summary>
    /// Provides a set of choices that enable the user to choose a one or
    /// more options from a set of options.
    /// </summary>
    /// <param name="caption">Text that proceeds (a title) the choices.
</param>
    /// <param name="message">A message that describes the choice.</param>
    /// <param name="choices">A collection of ChoiceDescription objects that
    /// describe each choice.</param>
    /// <param name="defaultChoices">The index of the label in the Choices
    /// parameter collection. To indicate no default choice, set to -1.
</param>
    /// <returns>The index of the Choices parameter collection element that
    /// corresponds to the option that is selected by the user.</returns>
    public Collection<int> PromptForChoice(
                                           string caption,
                                           string message,
                                           Collection<ChoiceDescription>
choices,
                                           IEnumerable<int> defaultChoices)
    {
      // Write the caption and message strings in Blue.
      this.WriteLine(
                     ConsoleColor.Blue,
                     ConsoleColor.Black,
                     caption + "\n" + message + "\n");

      // Convert the choice collection into something that is
      // easier to work with. See the BuildHotkeysAndPlainLabels
      // method for details.
      string[,] promptData = BuildHotkeysAndPlainLabels(choices);

      // Format the overall choice prompt string to display.
      StringBuilder sb = new StringBuilder();
      for (int element = 0; element < choices.Count; element++)
      {
        sb.Append(String.Format(
                                CultureInfo.CurrentCulture,
                                "|{0}> {1} ",
                                promptData[0, element],
                                promptData[1, element]));
      }

      Collection<int> defaultResults = new Collection<int>();
      if (defaultChoices != null)
      {
        int countDefaults = 0;
        foreach (int defaultChoice in defaultChoices)
        {
          ++countDefaults;
          defaultResults.Add(defaultChoice);
        }

        if (countDefaults != 0)
```

```
        {
          sb.Append(countDefaults == 1 ? "[Default choice is " : "[Default
choices are ");
          foreach (int defaultChoice in defaultChoices)
          {
            sb.AppendFormat(
                          CultureInfo.CurrentCulture,
                          "\"{0}\",",
                          promptData[0, defaultChoice]);
          }

          sb.Remove(sb.Length - 1, 1);
          sb.Append("]");
        }
      }

      this.WriteLine(
                    ConsoleColor.Cyan,
                    ConsoleColor.Black,
                    sb.ToString());
      // Read prompts until a match is made, the default is
      // chosen, or the loop is interrupted with ctrl-C.
      Collection<int> results = new Collection<int>();
      while (true)
      {
        ReadNext:
        string prompt = string.Format(CultureInfo.CurrentCulture,
"Choice[{0}]:", results.Count);
        this.Write(ConsoleColor.Cyan, ConsoleColor.Black, prompt);
        string data =
Console.ReadLine().Trim().ToUpper(CultureInfo.CurrentCulture);

        // If the choice string was empty, no more choices have been made.
        // If there were no choices made, return the defaults
        if (data.Length == 0)
        {
          return (results.Count == 0) ? defaultResults : results;
        }

        // See if the selection matched and return the
        // corresponding index if it did.
        for (int i = 0; i < choices.Count; i++)
        {
          if (promptData[0, i] == data)
          {
            results.Add(i);
            goto ReadNext;
          }
        }

        this.WriteErrorLine("Invalid choice: " + data);
      }
    }

    #endregion
```

```
    /// <summary>
    /// Prompts the user for credentials with a specified prompt window
    /// caption, prompt message, user name, and target name. In this
    /// example this functionality is not needed so the method throws a
    /// NotImplementException exception.
    /// </summary>
    /// <param name="caption">The caption for the message window.</param>
    /// <param name="message">The text of the message.</param>
    /// <param name="userName">The user name whose credential is to be
    /// prompted for.</param>
    /// <param name="targetName">The name of the target for which the
    /// credential is collected.</param>
    /// <returns>Throws a NotImplementedException exception.</returns>
    public override PSCredential PromptForCredential(
                                                    string caption,
                                                    string message,
                                                    string userName,
                                                    string targetName)
    {
      throw new NotImplementedException(
                          "The method or operation is not implemented.");
    }

    /// <summary>
    /// Prompts the user for credentials by using a specified prompt window
    /// caption, prompt message, user name and target name, credential
    /// types allowed to be returned, and UI behavior options. In this
    /// example this functionality is not needed so the method throws a
    /// NotImplementException exception.
    /// </summary>
    /// <param name="caption">The caption for the message window.</param>
    /// <param name="message">The text of the message.</param>
    /// <param name="userName">The user name whose credential is to be
    /// prompted for.</param>
    /// <param name="targetName">The name of the target for which the
    /// credential is collected.</param>
    /// <param name="allowedCredentialTypes">A PSCredentialTypes constant
    /// that identifies the type of credentials that can be returned.
</param>
    /// <param name="options">A PSCredentialUIOptions constant that
    /// identifies the UI behavior when it gathers the credentials.</param>
    /// <returns>Throws a NotImplementedException exception.</returns>
    public override PSCredential PromptForCredential(
                                       string caption,
                                       string message,
                                       string userName,
                                       string targetName,
                                       PSCredentialTypes
allowedCredentialTypes,
                                       PSCredentialUIOptions options)
    {
      throw new NotImplementedException(
                               "The method or operation is not
implemented.");
```

```
    }

    /// <summary>
    /// Reads characters that are entered by the user until a newline
    /// (carriage return) is encountered.
    /// </summary>
    /// <returns>The characters that are entered by the user.</returns>
    public override string ReadLine()
    {
      return Console.ReadLine();
    }

    /// <summary>
    /// Reads characters entered by the user until a newline (carriage
return)
    /// is encountered and returns the characters as a secure string. In
this
    /// example this functionality is not needed so the method throws a
    /// NotImplementExceptionexception.
    /// </summary>
    /// <returns>Throws a NotImplemented exception.</returns>
    public override System.Security.SecureString ReadLineAsSecureString()
    {
      throw new NotImplementedException("The method or operation is not
implemented.");
    }

    /// <summary>
    /// Writes characters to the output display of the host.
    /// </summary>
    /// <param name="value">The characters to be written.</param>
    public override void Write(string value)
    {
      Console.Write(value);
    }

    /// <summary>
    /// Writes characters to the output display of the host with possible
    /// foreground and background colors.
    /// </summary>
    /// <param name="foregroundColor">The color of the characters.</param>
    /// <param name="backgroundColor">The background color to use.</param>
    /// <param name="value">The characters to be written.</param>
    public override void Write(
                              ConsoleColor foregroundColor,
                              ConsoleColor backgroundColor,
                              string value)
    {
      ConsoleColor oldFg = Console.ForegroundColor;
      ConsoleColor oldBg = Console.BackgroundColor;
      Console.ForegroundColor = foregroundColor;
      Console.BackgroundColor = backgroundColor;
      Console.Write(value);
      Console.ForegroundColor = oldFg;
      Console.BackgroundColor = oldBg;
```

```
    }

    /// <summary>
    /// Writes a line of characters to the output display of the host
    /// with foreground and background colors and appends a newline
(carriage return).
    /// </summary>
    /// <param name="foregroundColor">The foreground color of the display.
</param>
    /// <param name="backgroundColor">The background color of the display.
</param>
    /// <param name="value">The line to be written.</param>
    public override void WriteLine(
                                   ConsoleColor foregroundColor,
                                   ConsoleColor backgroundColor,
                                   string value)
    {
      ConsoleColor oldFg = Console.ForegroundColor;
      ConsoleColor oldBg = Console.BackgroundColor;
      Console.ForegroundColor = foregroundColor;
      Console.BackgroundColor = backgroundColor;
      Console.WriteLine(value);
      Console.ForegroundColor = oldFg;
      Console.BackgroundColor = oldBg;
    }

    /// <summary>
    /// Writes a debug message to the output display of the host.
    /// </summary>
    /// <param name="message">The debug message that is displayed.</param>
    public override void WriteDebugLine(string message)
    {
      this.WriteLine(
                     ConsoleColor.DarkYellow,
                     ConsoleColor.Black,
                     String.Format(CultureInfo.CurrentCulture, "DEBUG: {0}",
message));
    }

    /// <summary>
    /// Writes an error message to the output display of the host.
    /// </summary>
    /// <param name="value">The error message that is displayed.</param>
    public override void WriteErrorLine(string value)
    {
      this.WriteLine(
                     ConsoleColor.Red,
                     ConsoleColor.Black,
                     value);
    }

    /// <summary>
    /// Writes a newline character (carriage return)
    /// to the output display of the host.
    /// </summary>
```

```
    public override void WriteLine()
    {
      Console.WriteLine();
    }

       /// <summary>
    /// Writes a line of characters to the output display of the host
    /// and appends a newline character(carriage return).
    /// </summary>
    /// <param name="value">The line to be written.</param>
    public override void WriteLine(string value)
    {
      Console.WriteLine(value);
    }

    /// <summary>
    /// Writes a progress report to the output display of the host.
    /// </summary>
    /// <param name="sourceId">Unique identifier of the source of the
record. </param>
    /// <param name="record">A ProgressReport object.</param>
    public override void WriteProgress(long sourceId, ProgressRecord record)
    {

    }

    /// <summary>
    /// Writes a verbose message to the output display of the host.
    /// </summary>
    /// <param name="message">The verbose message that is displayed.</param>
    public override void WriteVerboseLine(string message)
    {
      this.WriteLine(
                    ConsoleColor.Green,
                    ConsoleColor.Black,
                    String.Format(CultureInfo.CurrentCulture, "VERBOSE:
{0}", message));
    }

    /// <summary>
    /// Writes a warning message to the output display of the host.
    /// </summary>
    /// <param name="message">The warning message that is displayed.</param>
    public override void WriteWarningLine(string message)
    {
      this.WriteLine(
                    ConsoleColor.Yellow,
                    ConsoleColor.Black,
                    String.Format(CultureInfo.CurrentCulture, "WARNING:
{0}", message));
    }

    /// <summary>
    /// Parse a string containing a hotkey character.
    /// Take a string of the form
```

```
    ///    Yes to &all
    /// and returns a two-dimensional array split out as
    ///    "A", "Yes to all".
    /// </summary>
    /// <param name="input">The string to process</param>
    /// <returns>
    /// A two dimensional array containing the parsed components.
    /// </returns>
    private static string[] GetHotkeyAndLabel(string input)
    {
      string[] result = new string[] { String.Empty, String.Empty };
      string[] fragments = input.Split('&');
      if (fragments.Length == 2)
      {
        if (fragments[1].Length > 0)
        {
          result[0] = fragments[1][0].ToString().
          ToUpper(CultureInfo.CurrentCulture);
        }

        result[1] = (fragments[0] + fragments[1]).Trim();
      }
      else
      {
        result[1] = input;
      }

      return result;
    }

    /// <summary>
    /// This is a private worker function splits out the
    /// accelerator keys from the menu and builds a two
    /// dimensional array with the first access containing the
    /// accelerator and the second containing the label string
    /// with the & removed.
    /// </summary>
    /// <param name="choices">The choice collection to process</param>
    /// <returns>
    /// A two dimensional array containing the accelerator characters
    /// and the cleaned-up labels</returns>
    private static string[,] BuildHotkeysAndPlainLabels(
         Collection<ChoiceDescription> choices)
    {
      // Allocate the result array
      string[,] hotkeysAndPlainLabels = new string[2, choices.Count];

      for (int i = 0; i < choices.Count; ++i)
      {
        string[] hotkeyAndLabel = GetHotkeyAndLabel(choices[i].Label);
        hotkeysAndPlainLabels[0, i] = hotkeyAndLabel[0];
        hotkeysAndPlainLabels[1, i] = hotkeyAndLabel[1];
      }

      return hotkeysAndPlainLabels;
```

```
    }
  }
}
```

Example 4

The following code is the implementation of the System.Management.Automation.Host.Pshostrawuserinterface class that is used by this host application. Those elements that are not implemented throw an exception or return nothing.

C#

```
namespace Microsoft.Samples.PowerShell.Host
{
  using System;
  using System.Management.Automation.Host;

  /// <summary>
  /// A sample implementation of the PSHostRawUserInterface for console
  /// applications. Members of this class that easily map to the .NET
  /// console class are implemented. More complex methods are not
  /// implemented and throw a NotImplementedException exception.
  /// </summary>
  internal class MyRawUserInterface : PSHostRawUserInterface
  {
    /// <summary>
    /// Gets or sets the background color of text to be written.
    /// This maps to the corresponding Console.Background property.
    /// </summary>
    public override ConsoleColor BackgroundColor
    {
      get { return Console.BackgroundColor; }
      set { Console.BackgroundColor = value; }
    }

    /// <summary>
    /// Gets or sets the host buffer size adapted from the Console buffer
    /// size members.
    /// </summary>
    public override Size BufferSize
    {
      get { return new Size(Console.BufferWidth, Console.BufferHeight); }
      set { Console.SetBufferSize(value.Width, value.Height); }
    }

     /// <summary>
    /// Gets or sets the cursor position. In this example this
    /// functionality is not needed so the property throws a
    /// NotImplementException exception.
```

```
    /// </summary>
    public override Coordinates CursorPosition
    {
      get { throw new NotImplementedException(
                  "The method or operation is not implemented."); }
      set { throw new NotImplementedException(
                  "The method or operation is not implemented."); }
    }

    /// <summary>
    /// Gets or sets the cursor size taken directly from the
    /// Console.CursorSize property.
    /// </summary>
    public override int CursorSize
    {
      get { return Console.CursorSize; }
      set { Console.CursorSize = value; }
    }

    /// <summary>
    /// Gets or sets the foreground color of the text to be written.
    /// This maps to the corresponding Console.ForegroundColor property.
    /// </summary>
    public override ConsoleColor ForegroundColor
    {
      get { return Console.ForegroundColor; }
      set { Console.ForegroundColor = value; }
    }

    /// <summary>
    /// Gets a value indicating whether a key is available. This maps to
    /// the corresponding Console.KeyAvailable property.
    /// </summary>
    public override bool KeyAvailable
    {
      get { return Console.KeyAvailable; }
    }

    /// <summary>
    /// Gets the maximum physical size of the window adapted from the
    /// Console.LargestWindowWidth and Console.LargestWindowHeight
    /// properties.
    /// </summary>
    public override Size MaxPhysicalWindowSize
    {
      get { return new Size(Console.LargestWindowWidth,
Console.LargestWindowHeight); }
    }

    /// <summary>
    /// Gets the maximum window size adapted from the
    /// Console.LargestWindowWidth and console.LargestWindowHeight
    /// properties.
    /// </summary>
    public override Size MaxWindowSize
```

```
    {
      get { return new Size(Console.LargestWindowWidth,
Console.LargestWindowHeight); }
    }

    /// <summary>
    /// Gets or sets the window position adapted from the Console window
position
    /// members.
    /// </summary>
    public override Coordinates WindowPosition
    {
      get { return new Coordinates(Console.WindowLeft, Console.WindowTop); }
      set { Console.SetWindowPosition(value.X, value.Y); }
    }

    /// <summary>
    /// Gets or sets the window size adapted from the corresponding Console
    /// calls.
    /// </summary>
    public override Size WindowSize
    {
      get { return new Size(Console.WindowWidth, Console.WindowHeight); }
      set { Console.SetWindowSize(value.Width, value.Height); }
    }

    /// <summary>
    /// Gets or sets the title of the window mapped to the Console.Title
    /// property.
    /// </summary>
    public override string WindowTitle
    {
      get { return Console.Title; }
      set { Console.Title = value; }
    }

    /// <summary>
    /// This API resets the input buffer. In this example this
    /// functionality is not needed so the method returns nothing.
    /// </summary>
    public override void FlushInputBuffer()
    {
    }

    /// <summary>
    /// This API returns a rectangular region of the screen buffer. In
    /// this example this functionality is not needed so the method throws
    /// a NotImplementException exception.
    /// </summary>
    /// <param name="rectangle">Defines the size of the rectangle.</param>
    /// <returns>Throws a NotImplementedException exception.</returns>
    public override BufferCell[,] GetBufferContents(Rectangle rectangle)
    {
      throw new NotImplementedException(
                "The method or operation is not implemented.");
```

```
    }

    /// <summary>
    /// This API Reads a pressed, released, or pressed and released
keystroke
    /// from the keyboard device, blocking processing until a keystroke is
    /// typed that matches the specified keystroke options. In this example
    /// this functionality is not needed so the method throws a
    /// NotImplementException exception.
    /// </summary>
    /// <param name="options">Options, such as IncludeKeyDown,  used when
    /// reading the keyboard.</param>
    /// <returns>Throws a NotImplementedException exception.</returns>
    public override KeyInfo ReadKey(ReadKeyOptions options)
    {
      throw new NotImplementedException(
                "The method or operation is not implemented.");
    }

    /// <summary>
    /// This API crops a region of the screen buffer. In this example
    /// this functionality is not needed so the method throws a
    /// NotImplementException exception.
    /// </summary>
    /// <param name="source">The region of the screen to be scrolled.
</param>
    /// <param name="destination">The region of the screen to receive the
    /// source region contents.</param>
    /// <param name="clip">The region of the screen to include in the
operation.</param>
    /// <param name="fill">The character and attributes to be used to fill
all cell.</param>
    public override void ScrollBufferContents(Rectangle source, Coordinates
destination, Rectangle clip, BufferCell fill)
    {
      throw new NotImplementedException(
                "The method or operation is not implemented.");
    }

    /// <summary>
    /// This API copies an array of buffer cells into the screen buffer
    /// at a specified location. In this example this  functionality is
    /// not needed si the method  throws a NotImplementedException
exception.
    /// </summary>
    /// <param name="origin">The parameter is not used.</param>
    /// <param name="contents">The parameter is not used.</param>
    public override void SetBufferContents(Coordinates origin, BufferCell[,]
contents)
    {
      throw new NotImplementedException(
                "The method or operation is not implemented.");
    }

    /// <summary>
```

```
    /// This API Copies a given character, foreground color, and background
    /// color to a region of the screen buffer. In this example this
    /// functionality is not needed so the method throws a
    /// NotImplementException exception./// </summary>
    /// <param name="rectangle">Defines the area to be filled. </param>
    /// <param name="fill">Defines the fill character.</param>
    public override void SetBufferContents(Rectangle rectangle, BufferCell
fill)
    {
      throw new NotImplementedException(
                "The method or operation is not implemented.");
    }
  }
}
```

See Also

System.Management.Automation.Host.PSHost

System.Management.Automation.Host.Pshostuserinterface

System.Management.Automation.Host.Pshostrawuserinterface

Host05 Sample

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This sample shows how to build an interactive console-based host application that reads commands from the command line, executes the commands, and then displays the results to the console. This host application also supports calls to remote computers by using the Enter-PsSession and Exit-PsSession cmdlets.

Requirements

- This sample requires Windows PowerShell 2.0.
- This application must be run in elevated mode (Run as administrator).

Demonstrates

- Creating a custom host whose classes derive from the System.Management.Automation.Host.PSHost class, the System.Management.Automation.Host.Pshostuserinterface class, and the System.Management.Automation.Host.Pshostrawuserinterface class.
- Building a console application that uses these host classes to build an interactive Windows PowerShell shell.
- Creating a `$profile` variable and loading the following profiles.
  - current user, current host
  - current user, all hosts
  - all users, current host
  - all users, all hosts
- Implement the System.Management.Automation.Host.IHostUISupportsMultipleChoiceSelection interface.
- Implement the System.Management.Automation.Host.IHostSupportsInteractiveSession interface to support interactive remoting by using the Enter-PsSession and Exit-PsSession cmdlets.

Example 1

This example allows the user to enter commands at a command line, processes those commands, and then prints out the results.

C#

```
namespace Microsoft.Samples.PowerShell.Host
{
  using System;
  using System.Collections.Generic;
  using System.Collections.ObjectModel;
  using System.Management.Automation;
  using System.Management.Automation.Host;
  using System.Management.Automation.Runspaces;
  using System.Text;
  using PowerShell = System.Management.Automation.PowerShell;

  /// <summary>
  /// Simple PowerShell interactive console host listener implementation.
This class
  /// implements a basic read-evaluate-print loop or 'listener' allowing you
to
  /// interactively work with the PowerShell engine.
  /// </summary>
  internal class PSListenerConsoleSample
  {
    /// <summary>
    /// Holds a reference to the runspace for this interpreter.
    /// </summary>
    internal Runspace myRunSpace;

    /// <summary>
    /// Indicator to tell the host application that it should exit.
    /// </summary>
    private bool shouldExit;

    /// <summary>
    /// The exit code that the host application will use to exit.
    /// </summary>
    private int exitCode;

    /// <summary>
    /// Holds a reference to  the PSHost object for this interpreter.
    /// </summary>
    private MyHost myHost;

    /// <summary>
    /// Holds a reference to the currently executing pipeline so that
    /// it can be stopped by the control-C handler.
    /// </summary>
    private PowerShell currentPowerShell;

    /// <summary>
    /// Used to serialize access to instance data.
    /// </summary>
```

```
    private object instanceLock = new object();

    /// <summary>
    /// Gets or sets a value indicating whether the host application
    /// should exit.
    /// </summary>
    public bool ShouldExit
    {
      get { return this.shouldExit; }
      set { this.shouldExit = value; }
    }

    /// <summary>
    /// Gets or sets the exit code that the host application will use
    /// when exiting.
    /// </summary>
    public int ExitCode
    {
      get { return this.exitCode; }
      set { this.exitCode = value; }
    }

    /// <summary>
    /// Creates and initiates the listener.
    /// </summary>
    /// <param name="args">The parameter is not used.</param>
    private static void Main(string[] args)
    {
      // Display the welcome message.
      Console.Title = "Windows PowerShell Console Host Application Sample";
      ConsoleColor oldFg = Console.ForegroundColor;
      Console.ForegroundColor = ConsoleColor.Cyan;
      Console.WriteLine("    Windows PowerShell Console Host Interactive
Sample");
      Console.WriteLine("
================================================");
      Console.WriteLine(string.Empty);
      Console.WriteLine("This is an example of a simple interactive console
host that uses ");
      Console.WriteLine("the Windows PowerShell engine to interpret
commands.");
      Console.WriteLine("Type 'exit' to exit.");
      Console.WriteLine(string.Empty);
      Console.ForegroundColor = oldFg;

      // Create the listener and runs it. This method never returns.
      PSListenerConsoleSample listener = new PSListenerConsoleSample();
      listener.Run();
    }

    /// <summary>
    /// Create an instance of the console listener.
    /// </summary>
    private PSListenerConsoleSample()
    {
```

```
      // Create the host and runspace instances for this interpreter. Note
      // that this application doesn't support console files so only the
      // default snap-ins will be available.
      this.myHost = new MyHost(this);
      this.myRunSpace = RunspaceFactory.CreateRunspace(this.myHost);
      this.myRunSpace.Open();

      // Create a PowerShell object to run the commands used to create
      // $profile and load the profiles.
      lock (this.instanceLock)
      {
        this.currentPowerShell = PowerShell.Create();
      }

      try
      {
        this.currentPowerShell.Runspace = this.myRunSpace;

        PSCommand[] profileCommands =
Microsoft.Samples.PowerShell.Host.HostUtilities.GetProfileCommands("SampleHo
st05");
        foreach (PSCommand command in profileCommands)
        {
          this.currentPowerShell.Commands = command;
          this.currentPowerShell.Invoke();
        }
      }
      finally
      {
        // Dispose of the pipeline line and set it to null, locked because
currentPowerShell
        // may be accessed by the ctrl-C handler...
        lock (this.instanceLock)
        {
          this.currentPowerShell.Dispose();
          this.currentPowerShell = null;
        }
      }
    }

    /// <summary>
    /// A helper class that builds and executes a pipeline that writes to
the
    /// default output path. Any exceptions that are thrown are just passed
to
    /// the caller. Since all output goes to the default
    /// outputter, this method does not return anything.
    /// </summary>
    /// <param name="cmd">The script to run.</param>
    /// <param name="input">Any input arguments to pass to the script.
    /// If null then nothing is passed in.</param>
    private void executeHelper(string cmd, object input)
    {
      // Ignore empty command lines.
      if (String.IsNullOrEmpty(cmd))
```

```
      {
        return;
      }

      // Create the pipeline object and make it available to the
      // ctrl-C handle through the currentPowerShell instance
      // variable.
      lock (this.instanceLock)
      {
        this.currentPowerShell = PowerShell.Create();
      }

      // Create a pipeline for this execution, and then place the
      // result in the currentPowerShell variable so it is available
      // to be stopped.
      try
      {
        this.currentPowerShell.Runspace = this.myRunSpace;
        this.currentPowerShell.AddScript(cmd);

        // Add the default outputter to the end of the pipe and then
        // call the MergeMyResults method to merge the output and
        // error streams from the pipeline. This will result in the
        // output being written using the PSHost and PSHostUserInterface
        // classes instead of returning objects to the host application.
        this.currentPowerShell.AddCommand("out-default");

this.currentPowerShell.Commands.Commands[0].MergeMyResults(PipelineResultTyp
es.Error, PipelineResultTypes.Output);

        // If there is any input pass it in, otherwise just invoke the
        // the pipeline.
        if (input != null)
        {
          this.currentPowerShell.Invoke(new object[] { input });
        }
        else
        {
          this.currentPowerShell.Invoke();
        }
      }
      finally
      {
        // Dispose the PowerShell object and set currentPowerShell to null.
        // It is locked because currentPowerShell may be accessed by the
        // ctrl-C handler.
        lock (this.instanceLock)
        {
          this.currentPowerShell.Dispose();
          this.currentPowerShell = null;
        }
      }
    }

    /// <summary>
```

```
    /// To display an exception using the display formatter,
    /// run a second pipeline passing in the error record.
    /// The runtime will bind this to the $input variable,
    /// which is why $input is being piped to the Out-String
    /// cmdlet. The WriteErrorLine method is called to make sure
    /// the error gets displayed in the correct error color.
    /// </summary>
    /// <param name="e">The exception to display.</param>
    private void ReportException(Exception e)
    {
      if (e != null)
      {
        object error;
        IContainsErrorRecord icer = e as IContainsErrorRecord;
        if (icer != null)
        {
          error = icer.ErrorRecord;
        }
        else
        {
          error = (object)new ErrorRecord(e, "Host.ReportException",
ErrorCategory.NotSpecified, null);
        }

        lock (this.instanceLock)
        {
          this.currentPowerShell = PowerShell.Create();
        }

        this.currentPowerShell.Runspace = this.myRunSpace;

        try
        {
          this.currentPowerShell.AddScript("$input").AddCommand("out-
string");

          // Do not merge errors, this function will swallow errors.
          Collection<PSObject> result;
          PSDataCollection<object> inputCollection = new
PSDataCollection<object>();
          inputCollection.Add(error);
          inputCollection.Complete();
          result = this.currentPowerShell.Invoke(inputCollection);

          if (result.Count > 0)
          {
            string str = result[0].BaseObject as string;
            if (!string.IsNullOrEmpty(str))
            {
              // Remove \r\n, which is added by the Out-String cmdlet.
              this.myHost.UI.WriteErrorLine(str.Substring(0, str.Length -
2));
            }
          }
        }
```

```
        finally
        {
          // Dispose of the pipeline and set it to null, locking it  because
          // currentPowerShell may be accessed by the ctrl-C handler.
          lock (this.instanceLock)
          {
            this.currentPowerShell.Dispose();
            this.currentPowerShell = null;
          }
        }
      }
    }

    /// <summary>
    /// Basic script execution routine. Any runtime exceptions are
    /// caught and passed back to the Windows PowerShell engine to
    /// display.
    /// </summary>
    /// <param name="cmd">Script to run.</param>
    private void Execute(string cmd)
    {
      try
      {
        // Execute the command with no input.
        this.executeHelper(cmd, null);
      }
      catch (RuntimeException rte)
      {
        this.ReportException(rte);
      }
    }

    /// <summary>
    /// Method used to handle control-C's from the user. It calls the
    /// pipeline Stop() method to stop execution. If any exceptions occur
    /// they are printed to the console but otherwise ignored.
    /// </summary>
    /// <param name="sender">See sender property documentation of
    /// ConsoleCancelEventHandler.</param>
    /// <param name="e">See e property documentation of
    /// ConsoleCancelEventHandler.</param>
    private void HandleControlC(object sender, ConsoleCancelEventArgs e)
    {
      try
      {
        lock (this.instanceLock)
        {
          if (this.currentPowerShell != null &&
this.currentPowerShell.InvocationStateInfo.State ==
PSInvocationState.Running)
          {
            this.currentPowerShell.Stop();
          }
        }
```

```
        e.Cancel = true;
      }
      catch (Exception exception)
      {
        this.myHost.UI.WriteErrorLine(exception.ToString());
      }
    }

    /// <summary>
    /// Implements the basic listener loop. It sets up the ctrl-C handler,
then
    /// reads a command from the user, executes it and repeats until the
ShouldExit
    /// flag is set.
    /// </summary>
    private void Run()
    {
      // Set up the control-C handler.
      Console.CancelKeyPress += new
ConsoleCancelEventHandler(this.HandleControlC);
      Console.TreatControlCAsInput = false;

      // Read commands to execute until ShouldExit is set by
      // the user calling "exit".
      while (!this.ShouldExit)
      {
        string prompt;
        if (this.myHost.IsRunspacePushed)
        {
          prompt = string.Format("\n[{0}] PSConsoleSample: ",
this.myRunSpace.ConnectionInfo.ComputerName);
        }
        else
        {
          prompt = "\nPSConsoleSample: ";
        }

        this.myHost.UI.Write(ConsoleColor.Cyan, ConsoleColor.Black, prompt);
        string cmd = Console.ReadLine();
        this.Execute(cmd);
      }

      // Exit with the desired exit code that was set by exit command.
      // This is set in the host by the MyHost.SetShouldExit()
implementation.
      Environment.Exit(this.ExitCode);
    }
  }
}
```

Example 2

The following code is the implementation of the System.Management.Automation.Host.PSHost class that is used by this host application. Those elements that are not implemented throw an exception or return nothing.

C#

```
namespace Microsoft.Samples.PowerShell.Host
{
  using System;
  using System.Globalization;
  using System.Management.Automation.Host;
  using System.Management.Automation.Runspaces;

  /// <summary>
  /// This is a sample implementation of the PSHost abstract class for
  /// console applications. Not all members are implemented. Those that
  /// are not implemented throw a NotImplementedException exception or
  /// return nothing.
  /// </summary>
  internal class MyHost : PSHost, IHostSupportsInteractiveSession
  {

    /// <summary>
    /// A reference to the PSHost implementation.
    /// </summary>
    private PSListenerConsoleSample program;

    /// <summary>
    /// The culture information of the thread that created
    /// this object.
    /// </summary>
    private CultureInfo originalCultureInfo =
        System.Threading.Thread.CurrentThread.CurrentCulture;

    /// <summary>
    /// The UI culture information of the thread that created
    /// this object.
    /// </summary>
    private CultureInfo originalUICultureInfo =
        System.Threading.Thread.CurrentThread.CurrentUICulture;

    /// <summary>
    /// The identifier of this PSHost implementation.
    /// </summary>
    private static Guid instanceId = Guid.NewGuid();

    /// <summary>
    /// Initializes a new instance of the MyHost class. Keep
    /// a reference to the host application object so that it
    /// can be informed of when to exit.
    /// </summary>
    /// <param name="program">
    /// A reference to the host application object.
```

```
    /// </param>
    public MyHost(PSListenerConsoleSample program)
    {
      this.program = program;
    }

    /// <summary>
    /// A reference to the implementation of the PSHostUserInterface
    /// class for this application.
    /// </summary>
    private MyHostUserInterface myHostUserInterface = new
MyHostUserInterface();

    /// <summary>
    /// A reference to the runspace used to start an interactive session.
    /// </summary>
    public Runspace pushedRunspace = null;

    /// <summary>
    /// Gets the culture information to use. This implementation
    /// returns a snapshot of the culture information of the thread
    /// that created this object.
    /// </summary>
    public override CultureInfo CurrentCulture
    {
      get { return this.originalCultureInfo; }
    }

    /// <summary>
    /// Gets the UI culture information to use. This implementation
    /// returns a snapshot of the UI culture information of the thread
    /// that created this object.
    /// </summary>
    public override CultureInfo CurrentUICulture
    {
      get { return this.originalUICultureInfo; }
    }

    /// <summary>
    /// Gets an identifier for this host. This implementation always
    /// returns the GUID allocated at instantiation time.
    /// </summary>
    public override Guid InstanceId
    {
      get { return instanceId; }
    }

    /// <summary>
    /// Gets a string that contains the name of this host implementation.
    /// Keep in mind that this string may be used by script writers to
    /// identify when your host is being used.
    /// </summary>
    public override string Name
    {
      get { return "MySampleConsoleHostImplementation"; }
```

```
    }

    /// <summary>
    /// Gets an instance of the implementation of the PSHostUserInterface
    /// class for this application. This instance is allocated once at
startup time
    /// and returned every time thereafter.
    /// </summary>
    public override PSHostUserInterface UI
    {
      get { return this.myHostUserInterface; }
    }

    /// <summary>
    /// Gets the version object for this application. Typically this
    /// should match the version resource in the application.
    /// </summary>
    public override Version Version
    {
      get { return new Version(1, 0, 0, 0); }
    }

    #region IHostSupportsInteractiveSession Properties

    /// <summary>
    /// Gets a value indicating whether a request
    /// to open a PSSession has been made.
    /// </summary>
    public bool IsRunspacePushed
    {
      get { return this.pushedRunspace != null; }
    }

    /// <summary>
    /// Gets or sets the runspace used by the PSSession.
    /// </summary>
    public Runspace Runspace
    {
      get { return this.program.myRunSpace; }
      internal set { this.program.myRunSpace = value; }
    }
    #endregion IHostSupportsInteractiveSession Properties

    /// <summary>
    /// This API Instructs the host to interrupt the currently running
    /// pipeline and start a new nested input loop. In this example this
    /// functionality is not needed so the method throws a
    /// NotImplementedException exception.
    /// </summary>
    public override void EnterNestedPrompt()
    {
      throw new NotImplementedException(
            "The method or operation is not implemented.");
    }
```

```
    /// <summary>
    /// This API instructs the host to exit the currently running input
loop.
    /// In this example this functionality is not needed so the method
    /// throws a NotImplementedException exception.
    /// </summary>
    public override void ExitNestedPrompt()
    {
      throw new NotImplementedException(
            "The method or operation is not implemented.");
    }

    /// <summary>
    /// This API is called before an external application process is
    /// started. Typically it is used to save state so that the parent
    /// can restore state that has been modified by a child process (after
    /// the child exits). In this example this functionality is not
    /// needed so the method returns nothing.
    /// </summary>
    public override void NotifyBeginApplication()
    {
      return;
    }

    /// <summary>
    /// This API is called after an external application process finishes.
    /// Typically it is used to restore state that a child process has
    /// altered. In this example, this functionality is not needed so
    /// the method returns nothing.
    /// </summary>
    public override void NotifyEndApplication()
    {
      return;
    }

    /// <summary>
    /// Indicate to the host application that exit has
    /// been requested. Pass the exit code that the host
    /// application should use when exiting the process.
    /// </summary>
    /// <param name="exitCode">The exit code that the
    /// host application should use.</param>
    public override void SetShouldExit(int exitCode)
    {
      this.program.ShouldExit = true;
      this.program.ExitCode = exitCode;
    }

    #region IHostSupportsInteractiveSession Methods

    /// <summary>
    /// Requests to close a PSSession.
    /// </summary>
    public void PopRunspace()
    {
```

```
      Runspace = this.pushedRunspace;
      this.pushedRunspace = null;
    }

    /// <summary>
    /// Requests to open a PSSession.
    /// </summary>
    /// <param name="runspace">Runspace to use.</param>
    public void PushRunspace(Runspace runspace)
    {
      this.pushedRunspace = Runspace;
      Runspace = runspace;
    }

    #endregion IHostSupportsInteractiveSession Methods
  }
}
```

Example 3

The following code is the implementation of the System.Management.Automation.Host.Pshostuserinterface class that is used by this host application.

C#

```
namespace Microsoft.Samples.PowerShell.Host
{
  using System;
  using System.Collections.Generic;
  using System.Collections.ObjectModel;
  using System.Globalization;
  using System.Management.Automation;
  using System.Management.Automation.Host;
  using System.Text;

  /// <summary>
  /// A sample implementation of the PSHostUserInterface abstract class for
  /// console applications. Not all members are implemented. Those that are
  /// not implemented throw a NotImplementedException exception or return
  /// nothing. Members that are implemented include those that map easily to
  /// Console APIs and a basic implementation of the prompt API provided.
  /// </summary>
  internal class MyHostUserInterface : PSHostUserInterface,
IHostUISupportsMultipleChoiceSelection
  {
    /// <summary>
    /// A reference to the PSRawUserInterface implementation.
    /// </summary>
    private MyRawUserInterface myRawUi = new MyRawUserInterface();
```

```
    /// <summary>
    /// Gets an instance of the PSRawUserInterface object for this host
    /// application.
    /// </summary>
    public override PSHostRawUserInterface RawUI
    {
      get { return this.myRawUi; }
    }

    /// <summary>
    /// Prompts the user for input.
    /// <param name="caption">The caption or title of the prompt.</param>
    /// <param name="message">The text of the prompt.</param>
    /// <param name="descriptions">A collection of FieldDescription objects
    /// that describe each field of the prompt.</param>
    /// <returns>A dictionary object that contains the results of the user
    /// prompts.</returns>
    public override Dictionary<string, PSObject> Prompt(
                            string caption,
                            string message,
                            Collection<FieldDescription> descriptions)
    {
      this.Write(
                ConsoleColor.Blue,
                ConsoleColor.Black,
                caption + "\n" + message + " ");
      Dictionary<string, PSObject> results =
                new Dictionary<string, PSObject>();
      foreach (FieldDescription fd in descriptions)
      {
        string[] label = GetHotkeyAndLabel(fd.Label);
        this.WriteLine(label[1]);
        string userData = Console.ReadLine();
        if (userData == null)
        {
          return null;
        }

        results[fd.Name] = PSObject.AsPSObject(userData);
      }

      return results;
    }

    /// <summary>

    /// Provides a set of choices that enable the user to choose a
    /// single option from a set of options.
    /// </summary>
    /// <param name="caption">Text that proceeds (a title) the choices.
</param>
    /// <param name="message">A message that describes the choice.</param>
    /// <param name="choices">A collection of ChoiceDescription objects that
    /// describe each choice.</param>
    /// <param name="defaultChoice">The index of the label in the Choices
```

```
    /// parameter collection. To indicate no default choice, set to -1.
</param>
    /// <returns>The index of the Choices parameter collection element that
    /// corresponds to the option that is selected by the user.</returns>
    public override int PromptForChoice(
                                        string caption,
                                        string message,
                                        Collection<ChoiceDescription>
choices,
                                        int defaultChoice)
    {
      // Write the caption and message strings in Blue.
      this.WriteLine(
                      ConsoleColor.Blue,
                      ConsoleColor.Black,
                      caption + "\n" + message + "\n");

      // Convert the choice collection into something that is
      // easier to work with. See the BuildHotkeysAndPlainLabels
      // method for details.
      string[,] promptData = BuildHotkeysAndPlainLabels(choices);

      // Format the overall choice prompt string to display.
      StringBuilder sb = new StringBuilder();
      for (int element = 0; element < choices.Count; element++)
      {
        sb.Append(String.Format(
                                CultureInfo.CurrentCulture,
                                "|{0}> {1} ",
                                promptData[0, element],
                                promptData[1, element]));
      }

      sb.Append(String.Format(
                              CultureInfo.CurrentCulture,
                              "[Default is ({0})]",
                              promptData[0, defaultChoice]));

      // Read prompts until a match is made, the default is
      // chosen, or the loop is interrupted with ctrl-C.
      while (true)
      {
        this.WriteLine(ConsoleColor.Cyan, ConsoleColor.Black,
sb.ToString());
        string data =
Console.ReadLine().Trim().ToUpper(CultureInfo.CurrentCulture);

        // If the choice string was empty, use the default selection.
        if (data.Length == 0)
        {
          return defaultChoice;
        }

        // See if the selection matched and return the
        // corresponding index if it did.
```

```
        for (int i = 0; i < choices.Count; i++)
        {
          if (promptData[0, i] == data)
          {
            return i;
          }
        }

        this.WriteErrorLine("Invalid choice: " + data);
      }
    }

    #region IHostUISupportsMultipleChoiceSelection Members

    /// <summary>
    /// Provides a set of choices that enable the user to choose a one or
    /// more options from a set of options.
    /// </summary>
    /// <param name="caption">Text that proceeds (a title) the choices.
</param>
    /// <param name="message">A message that describes the choice.</param>
    /// <param name="choices">A collection of ChoiceDescription objects that
    /// describe each choice.</param>
    /// <param name="defaultChoices">The index of the label in the Choices
    /// parameter collection. To indicate no default choice, set to -1.
</param>
    /// <returns>The index of the Choices parameter collection element that
    /// corresponds to the option that is selected by the user.</returns>
    public Collection<int> PromptForChoice(
                                           string caption,
                                           string message,
                                           Collection<ChoiceDescription>
choices,
                                           IEnumerable<int> defaultChoices)
    {
      // Write the caption and message strings in Blue.
      this.WriteLine(
                     ConsoleColor.Blue,
                     ConsoleColor.Black,
                     caption + "\n" + message + "\n");

      // Convert the choice collection into something that is
      // easier to work with. See the BuildHotkeysAndPlainLabels
      // method for details.
      string[,] promptData = BuildHotkeysAndPlainLabels(choices);

      // Format the overall choice prompt string to display.
      StringBuilder sb = new StringBuilder();
      for (int element = 0; element < choices.Count; element++)
      {
        sb.Append(String.Format(
                                CultureInfo.CurrentCulture,
                                "|{0}> {1} ",
                                promptData[0, element],
                                promptData[1, element]));
```

```
      }

      Collection<int> defaultResults = new Collection<int>();
      if (defaultChoices != null)
      {
        int countDefaults = 0;
        foreach (int defaultChoice in defaultChoices)
        {
          ++countDefaults;
          defaultResults.Add(defaultChoice);
        }

        if (countDefaults != 0)
        {
          sb.Append(countDefaults == 1 ? "[Default choice is " : "[Default
choices are ");
          foreach (int defaultChoice in defaultChoices)
          {
            sb.AppendFormat(
                          CultureInfo.CurrentCulture,
                          "\"{0}\",",
                          promptData[0, defaultChoice]);
          }

          sb.Remove(sb.Length - 1, 1);
          sb.Append("]");
        }
      }

      this.WriteLine(
                    ConsoleColor.Cyan,
                    ConsoleColor.Black,
                    sb.ToString());

      // Read prompts until a match is made, the default is
      // chosen, or the loop is interrupted with ctrl-C.
      Collection<int> results = new Collection<int>();
      while (true)
      {
        ReadNext:
        string prompt = string.Format(CultureInfo.CurrentCulture,
"Choice[{0}]:", results.Count);
        this.Write(ConsoleColor.Cyan, ConsoleColor.Black, prompt);
        string data =
Console.ReadLine().Trim().ToUpper(CultureInfo.CurrentCulture);

        // If the choice string was empty, no more choices have been made.
        // If there were no choices made, return the defaults
        if (data.Length == 0)
        {
          return (results.Count == 0) ? defaultResults : results;
        }

        // See if the selection matched and return the
        // corresponding index if it did.
```

```
        for (int i = 0; i < choices.Count; i++)
        {
          if (promptData[0, i] == data)
          {
            results.Add(i);
            goto ReadNext;
          }
        }

        this.WriteErrorLine("Invalid choice: " + data);
      }
    }

    #endregion

    /// <summary>
    /// Prompts the user for credentials with a specified prompt window
    /// caption, prompt message, user name, and target name. In this
    /// example this functionality is not needed so the method throws a
    /// NotImplementException exception.
    /// </summary>
    /// <param name="caption">The caption for the message window.</param>
    /// <param name="message">The text of the message.</param>
    /// <param name="userName">The user name whose credential is to be
    /// prompted for.</param>
    /// <param name="targetName">The name of the target for which the
    /// credential is collected.</param>
    /// <returns>Throws a NotImplementedException exception.</returns>
    public override PSCredential PromptForCredential(
                                                    string caption,
                                                    string message,
                                                    string userName,
                                                    string targetName)
    {
      throw new NotImplementedException(
                          "The method or operation is not implemented.");
    }

    /// <summary>
    /// Prompts the user for credentials by using a specified prompt window
    /// caption, prompt message, user name and target name, credential
    /// types allowed to be returned, and UI behavior options. In this
    /// example this functionality is not needed so the method throws a
    /// NotImplementException exception.
    /// </summary>
    /// <param name="caption">The caption for the message window.</param>
    /// <param name="message">The text of the message.</param>
    /// <param name="userName">The user name whose credential is to be
    /// prompted for.</param>
    /// <param name="targetName">The name of the target for which the
    /// credential is collected.</param>
    /// <param name="allowedCredentialTypes">A PSCredentialTypes constant
    /// that identifies the type of credentials that can be returned.
</param>
    /// <param name="options">A PSCredentialUIOptions constant that
```

```
    /// identifies the UI behavior when it gathers the credentials.</param>
    /// <returns>Throws a NotImplementedException exception.</returns>
    public override PSCredential PromptForCredential(
                                        string caption,
                                        string message,
                                        string userName,
                                        string targetName,
                                        PSCredentialTypes
allowedCredentialTypes,
                                        PSCredentialUIOptions options)
    {
      throw new NotImplementedException(
                                "The method or operation is not
implemented.");
    }

    /// <summary>
    /// Reads characters that are entered by the user until a newline
    /// (carriage return) is encountered.
    /// </summary>
    /// <returns>The characters that are entered by the user.</returns>
    public override string ReadLine()
    {
      return Console.ReadLine();
    }

    /// <summary>
    /// Reads characters entered by the user until a newline (carriage
return)
    /// is encountered and returns the characters as a secure string. In
this
    /// example this functionality is not needed so the method throws a
    /// NotImplementException exception.
    /// </summary>
    /// <returns>Throws a NotImplemented exception.</returns>
    public override System.Security.SecureString ReadLineAsSecureString()
    {
      throw new NotImplementedException("The method or operation is not
implemented.");
    }

    /// <summary>
    /// Writes characters to the output display of the host.
    /// </summary>
    /// <param name="value">The characters to be written.</param>
    public override void Write(string value)
    {
      Console.Write(value);
    }

    /// <summary>
    /// Writes characters to the output display of the host with possible
    /// foreground and background colors.
    /// </summary>
    /// <param name="foregroundColor">The color of the characters.</param>
```

```
    /// <param name="backgroundColor">The background color to use.</param>
    /// <param name="value">The characters to be written.</param>
    public override void Write(
                                ConsoleColor foregroundColor,
                                ConsoleColor backgroundColor,
                                string value)
    {
      ConsoleColor oldFg = Console.ForegroundColor;
      ConsoleColor oldBg = Console.BackgroundColor;
      Console.ForegroundColor = foregroundColor;
      Console.BackgroundColor = backgroundColor;
      Console.Write(value);
      Console.ForegroundColor = oldFg;
      Console.BackgroundColor = oldBg;
    }

    /// <summary>
    /// Writes a line of characters to the output display of the host
    /// with foreground and background colors and appends a newline
(carriage return).
    /// </summary>
    /// <param name="foregroundColor">The foreground color of the display.
</param>
    /// <param name="backgroundColor">The background color of the display.
</param>
    /// <param name="value">The line to be written.</param>
    public override void WriteLine(
                                   ConsoleColor foregroundColor,
                                   ConsoleColor backgroundColor,
                                   string value)
    {
      ConsoleColor oldFg = Console.ForegroundColor;
      ConsoleColor oldBg = Console.BackgroundColor;
      Console.ForegroundColor = foregroundColor;
      Console.BackgroundColor = backgroundColor;
      Console.WriteLine(value);
      Console.ForegroundColor = oldFg;
      Console.BackgroundColor = oldBg;
    }

    /// <summary>
    /// Writes a debug message to the output display of the host.
    /// </summary>
    /// <param name="message">The debug message that is displayed.</param>
    public override void WriteDebugLine(string message)
    {
      this.WriteLine(
                     ConsoleColor.DarkYellow,
                     ConsoleColor.Black,
                     String.Format(CultureInfo.CurrentCulture, "DEBUG: {0}",
message));
    }

    /// <summary>
    /// Writes an error message to the output display of the host.
```

```
    /// </summary>
    /// <param name="value">The error message that is displayed.</param>
    public override void WriteErrorLine(string value)
    {
      this.WriteLine(
                    ConsoleColor.Red,
                    ConsoleColor.Black,
                    value);
    }

    /// <summary>
    /// Writes a newline character (carriage return)
    /// to the output display of the host.
    /// </summary>
    public override void WriteLine()
    {
      Console.WriteLine();
    }

       /// <summary>
    /// Writes a line of characters to the output display of the host
    /// and appends a newline character(carriage return).
    /// </summary>
    /// <param name="value">The line to be written.</param>
    public override void WriteLine(string value)
    {
      Console.WriteLine(value);
    }

    /// <summary>
    /// Writes a progress report to the output display of the host.
    /// </summary>
    /// <param name="sourceId">Unique identifier of the source of the
record. </param>
    /// <param name="record">A ProgressReport object.</param>
    public override void WriteProgress(long sourceId, ProgressRecord record)
    {

    }

    /// <summary>
    /// Writes a verbose message to the output display of the host.
    /// </summary>
    /// <param name="message">The verbose message that is displayed.</param>
    public override void WriteVerboseLine(string message)
    {
      this.WriteLine(
                    ConsoleColor.Green,
                    ConsoleColor.Black,
                    String.Format(CultureInfo.CurrentCulture, "VERBOSE:
{0}", message));
    }

    /// <summary>
    /// Writes a warning message to the output display of the host.
```

```
    /// </summary>
    /// <param name="message">The warning message that is displayed.</param>
    public override void WriteWarningLine(string message)
    {
      this.WriteLine(
                    ConsoleColor.Yellow,
                    ConsoleColor.Black,
                    String.Format(CultureInfo.CurrentCulture, "WARNING:
{0}", message));
    }

    /// <summary>
    /// Parse a string containing a hotkey character.
    /// Take a string of the form
    ///    Yes to &all
    /// and returns a two-dimensional array split out as
    ///    "A", "Yes to all".
    /// </summary>
    /// <param name="input">The string to process</param>
    /// <returns>
    /// A two dimensional array containing the parsed components.
    /// </returns>
    private static string[] GetHotkeyAndLabel(string input)
    {
      string[] result = new string[] { String.Empty, String.Empty };
      string[] fragments = input.Split('&');
      if (fragments.Length == 2)
      {
        if (fragments[1].Length > 0)
        {
          result[0] = fragments[1][0].ToString().
          ToUpper(CultureInfo.CurrentCulture);
        }

        result[1] = (fragments[0] + fragments[1]).Trim();
      }
      else
      {
        result[1] = input;
      }

      return result;
    }

    /// <summary>
    /// This is a private worker function splits out the
    /// accelerator keys from the menu and builds a two
    /// dimensional array with the first access containing the
    /// accelerator and the second containing the label string
    /// with the & removed.
    /// </summary>
    /// <param name="choices">The choice collection to process</param>
    /// <returns>
    /// A two dimensional array containing the accelerator characters
    /// and the cleaned-up labels</returns>
```

```
    private static string[,] BuildHotkeysAndPlainLabels(
         Collection<ChoiceDescription> choices)
    {
      // Allocate the result array
      string[,] hotkeysAndPlainLabels = new string[2, choices.Count];

      for (int i = 0; i < choices.Count; ++i)
      {
        string[] hotkeyAndLabel = GetHotkeyAndLabel(choices[i].Label);
        hotkeysAndPlainLabels[0, i] = hotkeyAndLabel[0];
        hotkeysAndPlainLabels[1, i] = hotkeyAndLabel[1];
      }

      return hotkeysAndPlainLabels;
    }
  }
}
```

Example 4

The following code is the implementation of the System.Management.Automation.Host.Pshostrawuserinterface class that is used by this host application. Those elements that are not implemented throw an exception or return nothing.

C#

```
namespace Microsoft.Samples.PowerShell.Host
{
  using System;
  using System.Management.Automation.Host;

  /// <summary>
  /// A sample implementation of the PSHostRawUserInterface for console
  /// applications. Members of this class that easily map to the .NET
  /// console class are implemented. More complex methods are not
  /// implemented and throw a NotImplementedException exception.
  /// </summary>
  internal class MyRawUserInterface : PSHostRawUserInterface
  {
    /// <summary>
    /// Gets or sets the background color of text to be written.
    /// This maps to the corresponding Console.Background property.
    /// </summary>
    public override ConsoleColor BackgroundColor
    {
      get { return Console.BackgroundColor; }
      set { Console.BackgroundColor = value; }
    }
```

```
    /// <summary>
    /// Gets or sets the host buffer size adapted from the Console buffer
    /// size members.
    /// </summary>
    public override Size BufferSize
    {
      get { return new Size(Console.BufferWidth, Console.BufferHeight); }
      set { Console.SetBufferSize(value.Width, value.Height); }
    }

    /// <summary>
    /// Gets or sets the cursor position. In this example this
    /// functionality is not needed so the property throws a
    /// NotImplementException exception.
    /// </summary>
    public override Coordinates CursorPosition
    {
      get { throw new NotImplementedException(
                  "The method or operation is not implemented."); }
      set { throw new NotImplementedException(
                  "The method or operation is not implemented."); }
    }

    /// <summary>
    /// Gets or sets the cursor size taken directly from the
    /// Console.CursorSize property.
    /// </summary>
    public override int CursorSize
    {
      get { return Console.CursorSize; }
      set { Console.CursorSize = value; }
    }

    /// <summary>
    /// Gets or sets the foreground color of the text to be written.
    /// This maps to the corresponding Console.ForegroundColor property.
    /// </summary>
    public override ConsoleColor ForegroundColor
    {
      get { return Console.ForegroundColor; }
      set { Console.ForegroundColor = value; }
    }

    /// <summary>
    /// Gets a value indicating whether a key is available. This maps to
    /// the corresponding Console.KeyAvailable property.
    /// </summary>
    public override bool KeyAvailable
    {
      get { return Console.KeyAvailable; }
    }

    /// <summary>
    /// Gets the maximum physical size of the window adapted from the
    /// Console.LargestWindowWidth and Console.LargestWindowHeight
```

```
    /// properties.
    /// </summary>
    public override Size MaxPhysicalWindowSize
    {
      get { return new Size(Console.LargestWindowWidth,
Console.LargestWindowHeight); }
    }

    /// <summary>
    /// Gets the maximum window size adapted from the
    /// Console.LargestWindowWidth and console.LargestWindowHeight
    /// properties.
    /// </summary>
    public override Size MaxWindowSize
    {
      get { return new Size(Console.LargestWindowWidth,
Console.LargestWindowHeight); }
    }

    /// <summary>
    /// Gets or sets the window position adapted from the Console window
position
    /// members.
    /// </summary>
    public override Coordinates WindowPosition
    {
      get { return new Coordinates(Console.WindowLeft, Console.WindowTop); }
      set { Console.SetWindowPosition(value.X, value.Y); }
    }

    /// <summary>
    /// Gets or sets the window size adapted from the corresponding Console
    /// calls.
    /// </summary>
    public override Size WindowSize
    {
      get { return new Size(Console.WindowWidth, Console.WindowHeight); }
      set { Console.SetWindowSize(value.Width, value.Height); }
    }

    /// <summary>
    /// Gets or sets the title of the window mapped to the Console.Title
    /// property.
    /// </summary>
    public override string WindowTitle
    {
      get { return Console.Title; }
      set { Console.Title = value; }
    }

    /// <summary>
    /// This API resets the input buffer. In this example this
    /// functionality is not needed so the method returns nothing.
    /// </summary>
    public override void FlushInputBuffer()
```

```
    {
    }

    /// <summary>
    /// This API returns a rectangular region of the screen buffer. In
    /// this example this functionality is not needed so the method throws
    /// a NotImplementException exception.
    /// </summary>
    /// <param name="rectangle">Defines the size of the rectangle.</param>
    /// <returns>Throws a NotImplementedException exception.</returns>
    public override BufferCell[,] GetBufferContents(Rectangle rectangle)
    {
      throw new NotImplementedException(
               "The method or operation is not implemented.");
    }

    /// <summary>
    /// This API Reads a pressed, released, or pressed and released
keystroke
    /// from the keyboard device, blocking processing until a keystroke is
    /// typed that matches the specified keystroke options. In this example
    /// this functionality is not needed so the method throws a
    /// NotImplementException exception.
    /// </summary>
    /// <param name="options">Options, such as IncludeKeyDown,  used when
    /// reading the keyboard.</param>
    /// <returns>Throws a NotImplementedException exception.</returns>
    public override KeyInfo ReadKey(ReadKeyOptions options)
    {
      throw new NotImplementedException(
                "The method or operation is not implemented.");
    }

    /// <summary>
    /// This API crops a region of the screen buffer. In this example
    /// this functionality is not needed so the method throws a
    /// NotImplementException exception.
    /// </summary>
    /// <param name="source">The region of the screen to be scrolled.
</param>
    /// <param name="destination">The region of the screen to receive the
    /// source region contents.</param>
    /// <param name="clip">The region of the screen to include in the
operation.</param>
    /// <param name="fill">The character and attributes to be used to fill
all cell.</param>
    public override void ScrollBufferContents(Rectangle source, Coordinates
destination, Rectangle clip, BufferCell fill)
    {
      throw new NotImplementedException(
                "The method or operation is not implemented.");
    }

    /// <summary>
    /// This API copies an array of buffer cells into the screen buffer
```

```
    /// at a specified location. In this example this  functionality is
    /// not needed si the method  throws a NotImplementedException
exception.
    /// </summary>
    /// <param name="origin">The parameter is not used.</param>
    /// <param name="contents">The parameter is not used.</param>
    public override void SetBufferContents(Coordinates origin, BufferCell[,]
contents)
    {
      throw new NotImplementedException(
                "The method or operation is not implemented.");
    }

    /// <summary>
    /// This API Copies a given character, foreground color, and background
    /// color to a region of the screen buffer. In this example this
    /// functionality is not needed so the method throws a
    /// NotImplementException exception./// </summary>
    /// <param name="rectangle">Defines the area to be filled. </param>
    /// <param name="fill">Defines the fill character.</param>
    public override void SetBufferContents(Rectangle rectangle, BufferCell
fill)
    {
      throw new NotImplementedException(
                "The method or operation is not implemented.");
    }
  }
}
```

See Also

System.Management.Automation.Host.PSHost

System.Management.Automation.Host.Pshostuserinterface

System.Management.Automation.Host.Pshostrawuserinterface

Host06 Sample

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This sample shows how to build an interactive console-based host application that reads commands from the command line, executes the commands, and then displays the results to the console. In addition, this sample uses the Tokenizer APIs to specify the color of the text that is entered by the user.

Requirements

- This sample requires Windows PowerShell 2.0.
- This application must be run in elevated mode (Run as administrator).

Demonstrates

- Creating a custom host whose classes derive from the System.Management.Automation.Host.PSHost class, the System.Management.Automation.Host.Pshostuserinterface class, and the System.Management.Automation.Host.Pshostrawuserinterface class.

- Building a console application that uses these host classes to build an interactive Windows PowerShell shell.

- Creating a `$profile` variable and loading the following profiles.
  - current user, current host
  - current user, all hosts
  - all users, current host
  - all users, all hosts

- Implement the System.Management.Automation.Host.IHostUISupportsMultipleChoiceSelection interface.

- Implement the System.Management.Automation.Host.IHostSupportsInteractiveSession interface to support interactive remoting by using the Enter-PsSession and Exit-PsSession cmdlets.

- Use the Tokenize API to colorize the command line as it is typed.

Example 1

This example allows the user to enter commands at a command line, processes those commands, and then prints out the results.

C#

```
namespace Microsoft.Samples.PowerShell.Host
{
  using System;
  using System.Collections.Generic;
  using System.Collections.ObjectModel;
  using System.Management.Automation;
  using System.Management.Automation.Host;
  using System.Management.Automation.Runspaces;
  using System.Text;
  using PowerShell = System.Management.Automation.PowerShell;

  /// <summary>
  /// This sample shows how to implement a basic read-evaluate-print
  /// loop (or 'listener') that allowing you to interactively work
  /// with the Windows PowerShell engine.
  /// </summary>
  internal class PSListenerConsoleSample
  {
    /// <summary>
    /// Used to read user input.
    /// </summary>
        internal ConsoleReadLine consoleReadLine = new ConsoleReadLine();

    /// <summary>
    /// Holds a reference to the runspace for this interpreter.
    /// </summary>
    internal Runspace myRunSpace;

    /// <summary>
    /// Indicator to tell the host application that it should exit.
    /// </summary>
    private bool shouldExit;

    /// <summary>
    /// The exit code that the host application will use to exit.
    /// </summary>
    private int exitCode;

    /// <summary>
    /// Holds a reference to the PSHost implementation for this interpreter.
    /// </summary>
    private MyHost myHost;

    /// <summary>
    /// Holds a reference to the currently executing pipeline so that it can
be
```

```
    /// stopped by the control-C handler.
    /// </summary>
    private PowerShell currentPowerShell;

    /// <summary>
    /// Used to serialize access to instance data.
    /// </summary>
    private object instanceLock = new object();

    /// <summary>
    /// Gets or sets a value indicating whether the host application
    /// should exit.
    /// </summary>
    public bool ShouldExit
    {
      get { return this.shouldExit; }
      set { this.shouldExit = value; }
    }

    /// <summary>
    /// Gets or sets a value indicating whether the host application
    /// should exit.
    /// </summary>
    public int ExitCode
    {
      get { return this.exitCode; }
      set { this.exitCode = value; }
    }

    /// <summary>
    /// Creates and initiates the listener instance.
    /// </summary>
    /// <param name="args">This parameter is not used.</param>
    private static void Main(string[] args)
    {
      // Display the welcome message.
      Console.Title = "PowerShell Console Host Sample Application";
      ConsoleColor oldFg = Console.ForegroundColor;
      Console.ForegroundColor = ConsoleColor.Cyan;
      Console.WriteLine("    Windows PowerShell Console Host Application
Sample");
      Console.WriteLine("
================================================");
      Console.WriteLine(string.Empty);
      Console.WriteLine("This is an example of a simple interactive console
host uses ");
      Console.WriteLine("the Windows PowerShell engine to interpret
commands.");
      Console.WriteLine("Type 'exit' to exit.");
      Console.WriteLine(string.Empty);
      Console.ForegroundColor = oldFg;

      // Create the listener and run it. This method never returns.
      PSListenerConsoleSample listener = new PSListenerConsoleSample();
      listener.Run();
```

```
    }

    /// <summary>
    /// Initializes a new instance of the PSListenerConsoleSample class.
    /// </summary>
    public PSListenerConsoleSample()
    {
      // Create the host and runspace instances for this interpreter.
      // Note that this application does not support console files so
      // only the default snap-ins will be available.
      this.myHost = new MyHost(this);
      this.myRunSpace = RunspaceFactory.CreateRunspace(this.myHost);
      this.myRunSpace.Open();

      // Create a PowerShell object to run the commands used to create
      // $profile and load the profiles.
      lock (this.instanceLock)
      {
        this.currentPowerShell = PowerShell.Create();
      }

      try
      {
        this.currentPowerShell.Runspace = this.myRunSpace;

        PSCommand[] profileCommands =
Microsoft.Samples.PowerShell.Host.HostUtilities.GetProfileCommands("SampleHo
st06");
        foreach (PSCommand command in profileCommands)
        {
          this.currentPowerShell.Commands = command;
          this.currentPowerShell.Invoke();
        }
      }
      finally
      {
        // Dispose the PowerShell object and set currentPowerShell
        // to null. It is locked because currentPowerShell may be
        // accessed by the ctrl-C handler.
        lock (this.instanceLock)
        {
          this.currentPowerShell.Dispose();
          this.currentPowerShell = null;
        }
      }
    }

    /// <summary>
    /// A helper class that builds and executes a pipeline that writes
    /// to the default output path. Any exceptions that are thrown are
    /// just passed to the caller. Since all output goes to the default
    /// outputter, this method does not return anything.
    /// </summary>
    /// <param name="cmd">The script to run.</param>
    /// <param name="input">Any input arguments to pass to the script.
```

```
    /// If null then nothing is passed in.</param>
    private void executeHelper(string cmd, object input)
    {
      // Ignore empty command lines.
      if (String.IsNullOrEmpty(cmd))
      {
        return;
      }

      // Create the pipeline object and make it available to the
      // ctrl-C handle through the currentPowerShell instance
      // variable.
      lock (this.instanceLock)
      {
        this.currentPowerShell = PowerShell.Create();
      }

      // Add a script and command to the pipeline and then run the pipeline.
Place
      // the results in the currentPowerShell variable so that the pipeline
can be
      // stopped.
      try
      {
        this.currentPowerShell.Runspace = this.myRunSpace;

        this.currentPowerShell.AddScript(cmd);

        // Add the default outputter to the end of the pipe and then call
the
        // MergeMyResults method to merge the output and error streams from
the
        // pipeline. This will result in the output being written using the
PSHost
        // and PSHostUserInterface classes instead of returning objects to
the host
        // application.
        this.currentPowerShell.AddCommand("out-default");

this.currentPowerShell.Commands.Commands[0].MergeMyResults(PipelineResultTyp
es.Error, PipelineResultTypes.Output);

        // If there is any input pass it in, otherwise just invoke the
        // the pipeline.
        if (input != null)
        {
          this.currentPowerShell.Invoke(new object[] { input });
        }
        else
        {
          this.currentPowerShell.Invoke();
        }
      }
      finally
      {
```

```
        // Dispose the PowerShell object and set currentPowerShell to null.
        // It is locked because currentPowerShell may be accessed by the
        // ctrl-C handler.
        lock (this.instanceLock)
        {
          this.currentPowerShell.Dispose();
          this.currentPowerShell = null;
        }
      }
    }

    /// <summary>
    /// To display an exception using the display formatter,
    /// run a second pipeline passing in the error record.
    /// The runtime will bind this to the $input variable,
    /// which is why $input is being piped to the Out-String
    /// cmdlet. The WriteErrorLine method is called to make sure
    /// the error gets displayed in the correct error color.
    /// </summary>
    /// <param name="e">The exception to display.</param>
    private void ReportException(Exception e)
    {
      if (e != null)
      {
        object error;
        IContainsErrorRecord icer = e as IContainsErrorRecord;
        if (icer != null)
        {
          error = icer.ErrorRecord;
        }
        else
        {
          error = (object)new ErrorRecord(e, "Host.ReportException",
ErrorCategory.NotSpecified, null);
        }

        lock (this.instanceLock)
        {
          this.currentPowerShell = PowerShell.Create();
        }

        this.currentPowerShell.Runspace = this.myRunSpace;

        try
        {
          this.currentPowerShell.AddScript("$input").AddCommand("out-
string");

          // Do not merge errors, this function will swallow errors.
          Collection<PSObject> result;
          PSDataCollection<object> inputCollection = new
PSDataCollection<object>();
          inputCollection.Add(error);
          inputCollection.Complete();
          result = this.currentPowerShell.Invoke(inputCollection);
```

```
          if (result.Count > 0)
          {
            string str = result[0].BaseObject as string;
            if (!string.IsNullOrEmpty(str))
            {
              // Remove \r\n, which is added by the Out-String cmdlet.
              this.myHost.UI.WriteErrorLine(str.Substring(0, str.Length -
2));
            }
          }
        }
        finally
        {
          // Dispose of the pipeline and set it to null, locking it  because
          // currentPowerShell may be accessed by the ctrl-C handler.
          lock (this.instanceLock)
          {
            this.currentPowerShell.Dispose();
            this.currentPowerShell = null;
          }
        }
      }
    }

    /// <summary>
    /// Basic script execution routine. Any runtime exceptions are
    /// caught and passed back to the Windows PowerShell engine to
    /// display.
    /// </summary>
    /// <param name="cmd">Script to run.</param>
    private void Execute(string cmd)
    {
      try
      {
        // Run the command with no input.
        this.executeHelper(cmd, null);
      }
      catch (RuntimeException rte)
      {
        this.ReportException(rte);
      }
    }

    /// <summary>
    /// Method used to handle control-C's from the user. It calls the
    /// pipeline Stop() method to stop execution. If any exceptions occur
    /// they are printed to the console but otherwise ignored.
    /// </summary>
    /// <param name="sender">See sender property documentation of
    /// ConsoleCancelEventHandler.</param>
    /// <param name="e">See e property documentation of
    /// ConsoleCancelEventHandler.</param>
    private void HandleControlC(object sender, ConsoleCancelEventArgs e)
    {
```

```
      try
      {
        lock (this.instanceLock)
        {
          if (this.currentPowerShell != null &&
this.currentPowerShell.InvocationStateInfo.State ==
PSInvocationState.Running)
          {
            this.currentPowerShell.Stop();
          }
        }

        e.Cancel = true;
      }
      catch (Exception exception)
      {
        this.myHost.UI.WriteErrorLine(exception.ToString());
      }
    }

    /// <summary>
    /// Implements the basic listener loop. It sets up the ctrl-C handler,
then
    /// reads a command from the user, executes it and repeats until the
ShouldExit
    /// flag is set.
    /// </summary>
    private void Run()
    {
      // Set up the control-C handler.
      Console.CancelKeyPress += new
ConsoleCancelEventHandler(this.HandleControlC);
      Console.TreatControlCAsInput = false;

      // Read commands and run them until the ShouldExit flag is set by
      // the user calling "exit".
      while (!this.ShouldExit)
      {
        string prompt;
        if (this.myHost.IsRunspacePushed)
        {
          prompt = string.Format("\n[{0}] PSConsoleSample: ",
this.myRunSpace.ConnectionInfo.ComputerName);
        }
        else
        {
          prompt = "\nPSConsoleSample: ";
        }

        this.myHost.UI.Write(ConsoleColor.Cyan, ConsoleColor.Black, prompt);
        string cmd = this.consoleReadLine.Read();
        this.Execute(cmd);
      }

      // Exit with the desired exit code that was set by the exit command.
```

```
      // The exit code is set in the host by the MyHost.SetShouldExit()
method.
      Environment.Exit(this.ExitCode);
    }
  }
}
```

Example 2

The following code is the implementation of the System.Management.Automation.Host.PSHost class that is used by this host application. Those elements that are not implemented throw an exception or return nothing.

C#

```
namespace Microsoft.Samples.PowerShell.Host
{
  using System;
  using System.Globalization;
  using System.Management.Automation.Host;
  using System.Management.Automation.Runspaces;

  /// <summary>
  /// This is a sample implementation of the PSHost abstract class for
  /// console applications. Not all members are implemented. Those that
  /// are not implemented throw a NotImplementedException exception or
  /// return nothing.
  /// </summary>
  internal class MyHost : PSHost, IHostSupportsInteractiveSession
  {
        public MyHost(PSListenerConsoleSample program)
        {
            this.program = program;
        }

    /// <summary>
    /// A reference to the PSHost implementation.
    /// </summary>
    private PSListenerConsoleSample program;

    /// <summary>
    /// The culture information of the thread that created
    /// this object.
    /// </summary>
    private CultureInfo originalCultureInfo =
        System.Threading.Thread.CurrentThread.CurrentCulture;

    /// <summary>
    /// The UI culture information of the thread that created
    /// this object.
    /// </summary>
```

```
    private CultureInfo originalUICultureInfo =
        System.Threading.Thread.CurrentThread.CurrentUICulture;

    /// <summary>
    /// The identifier of this PSHost implementation.
    /// </summary>
    private static Guid instanceId = Guid.NewGuid();

    /// <summary>
    /// A reference to the implementation of the PSHostUserInterface
    /// class for this application.
    /// </summary>
    private MyHostUserInterface myHostUserInterface = new
MyHostUserInterface();

    /// <summary>
    /// A reference to the runspace used to start an interactive session.
    /// </summary>
    public Runspace pushedRunspace = null;

    /// <summary>
    /// Gets the culture information to use. This implementation
    /// returns a snapshot of the culture information of the thread
    /// that created this object.
    /// </summary>
    public override CultureInfo CurrentCulture
    {
      get { return this.originalCultureInfo; }
    }

    /// <summary>
    /// Gets the UI culture information to use. This implementation
    /// returns a snapshot of the UI culture information of the thread
    /// that created this object.
    /// </summary>
    public override CultureInfo CurrentUICulture
    {
      get { return this.originalUICultureInfo; }
    }

    /// <summary>
    /// Gets an identifier for this host. This implementation always
    /// returns the GUID allocated at instantiation time.
    /// </summary>
    public override Guid InstanceId
    {
      get { return instanceId; }
    }

    /// <summary>
    /// Gets a string that contains the name of this host implementation.
    /// Keep in mind that this string may be used by script writers to
    /// identify when your host is being used.
    /// </summary>
    public override string Name
```

```
    {
      get { return "MySampleConsoleHostImplementation"; }
    }

    /// <summary>
    /// Gets an instance of the implementation of the PSHostUserInterface
    /// class for this application. This instance is allocated once at
startup time
    /// and returned every time thereafter.
    /// </summary>
    public override PSHostUserInterface UI
    {
      get { return this.myHostUserInterface; }
    }

    /// <summary>
    /// Gets the version object for this application. Typically this
    /// should match the version resource in the application.
    /// </summary>
    public override Version Version
    {
      get { return new Version(1, 0, 0, 0); }
    }

    #region IHostSupportsInteractiveSession Properties

    /// <summary>
    /// Gets a value indicating whether a request
    /// to open a PSSession has been made.
    /// </summary>
    public bool IsRunspacePushed
    {
      get { return this.pushedRunspace != null; }
    }

    /// <summary>
    /// Gets or sets the runspace used by the PSSession.
    /// </summary>
    public Runspace Runspace
    {
      get { return this.program.myRunSpace; }
      internal set { this.program.myRunSpace = value; }
    }
    #endregion IHostSupportsInteractiveSession Properties

    /// <summary>
    /// This API Instructs the host to interrupt the currently running
    /// pipeline and start a new nested input loop. In this example this
    /// functionality is not needed so the method throws a
    /// NotImplementedException exception.
    /// </summary>
    public override void EnterNestedPrompt()
    {
      throw new NotImplementedException(
            "The method or operation is not implemented.");
```

```
    }

    /// <summary>
    /// This API instructs the host to exit the currently running input
loop.
    /// In this example this functionality is not needed so the method
    /// throws a NotImplementedException exception.
    /// </summary>
    public override void ExitNestedPrompt()
    {
      throw new NotImplementedException(
            "The method or operation is not implemented.");
    }

    /// <summary>
    /// This API is called before an external application process is
    /// started. Typically it is used to save state so that the parent
    /// can restore state that has been modified by a child process (after
    /// the child exits). In this example this functionality is not
    /// needed so the method returns nothing.
    /// </summary>
    public override void NotifyBeginApplication()
    {
      return;
    }

    /// <summary>
    /// This API is called after an external application process finishes.
    /// Typically it is used to restore state that a child process has
    /// altered. In this example, this functionality is not needed so
    /// the method returns nothing.
    /// </summary>
    public override void NotifyEndApplication()
    {
      return;
    }

    /// <summary>
    /// Indicate to the host application that exit has
    /// been requested. Pass the exit code that the host
    /// application should use when exiting the process.
    /// </summary>
    /// <param name="exitCode">The exit code that the
    /// host application should use.</param>
    public override void SetShouldExit(int exitCode)
    {
      this.program.ShouldExit = true;
      this.program.ExitCode = exitCode;
    }

    #region IHostSupportsInteractiveSession Methods

    /// <summary>
    /// Requests to close a PSSession.
    /// </summary>
```

```
    public void PopRunspace()
    {
      Runspace = this.pushedRunspace;
      this.pushedRunspace = null;
    }

    /// <summary>
    /// Requests to open a PSSession.
    /// </summary>
    /// <param name="runspace">Runspace to use.</param>
    public void PushRunspace(Runspace runspace)
    {
      this.pushedRunspace = Runspace;
      Runspace = runspace;
    }

    #endregion IHostSupportsInteractiveSession Methods
  }
}
```

Example 3

The following code is the implementation of the System.Management.Automation.Host.Pshostuserinterface class that is used by this host application.

C#

```
namespace Microsoft.Samples.PowerShell.Host
{
  using System;
  using System.Collections.Generic;
  using System.Collections.ObjectModel;
  using System.Globalization;
  using System.Management.Automation;
  using System.Management.Automation.Host;
  using System.Text;

  /// <summary>
  /// A sample implementation of the PSHostUserInterface abstract class for
  /// console applications. Not all members are implemented. Those that are
  /// not implemented throw a NotImplementedException exception or return
  /// nothing. Members that are implemented include those that map easily to
  /// Console APIs and a basic implementation of the prompt API provided.
  /// </summary>
  internal class MyHostUserInterface : PSHostUserInterface,
IHostUISupportsMultipleChoiceSelection
  {
    /// <summary>
    /// A reference to the PSRawUserInterface implementation.
    /// </summary>
```

```
    private MyRawUserInterface myRawUi = new MyRawUserInterface();

    /// <summary>
    /// Gets an instance of the PSRawUserInterface class for this host
    /// application.
    /// </summary>
    public override PSHostRawUserInterface RawUI
    {
      get { return this.myRawUi; }
    }

    /// <summary>
    /// Prompts the user for input.
    /// <param name="caption">The caption or title of the prompt.</param>
    /// <param name="message">The text of the prompt.</param>
    /// <param name="descriptions">A collection of FieldDescription objects
    /// that describe each field of the prompt.</param>
    /// <returns>A dictionary object that contains the results of the user
    /// prompts.</returns>
    public override Dictionary<string, PSObject> Prompt(
                            string caption,
                            string message,
                            Collection<FieldDescription> descriptions)
    {
      this.Write(
                ConsoleColor.DarkCyan,
                ConsoleColor.Black,
                caption + "\n" + message + " ");
      Dictionary<string, PSObject> results =
                new Dictionary<string, PSObject>();
      foreach (FieldDescription fd in descriptions)
      {
        string[] label = GetHotkeyAndLabel(fd.Label);
        this.WriteLine(label[1]);
        string userData = Console.ReadLine();
        if (userData == null)
        {
          return null;
        }

        results[fd.Name] = PSObject.AsPSObject(userData);
      }

      return results;
    }

    /// <summary>

/// Provides a set of choices that enable the user to choose a
    /// single option from a set of options.
    /// </summary>
    /// <param name="caption">Text that proceeds (a title) the choices.
</param>
    /// <param name="message">A message that describes the choice.</param>
    /// <param name="choices">A collection of ChoiceDescription objects that
```

```
    /// describe each choice.</param>
    /// <param name="defaultChoice">The index of the label in the Choices
    /// parameter collection. To indicate no default choice, set to -1.
</param>
    /// <returns>The index of the Choices parameter collection element that
    /// corresponds to the option that is selected by the user.</returns>
    public override int PromptForChoice(
                                        string caption,
                                        string message,
                                        Collection<ChoiceDescription>
choices,
                                        int defaultChoice)
    {
      // Write the caption and message strings in Blue.
      this.WriteLine(
                    ConsoleColor.Blue,
                    ConsoleColor.Black,
                    caption + "\n" + message + "\n");

      // Convert the choice collection into something that is
      // easier to work with. See the BuildHotkeysAndPlainLabels
      // method for details.
      string[,] promptData = BuildHotkeysAndPlainLabels(choices);

      // Format the overall choice prompt string to display.
      StringBuilder sb = new StringBuilder();
      for (int element = 0; element < choices.Count; element++)
      {
        sb.Append(String.Format(
                                CultureInfo.CurrentCulture,
                                "|{0}> {1} ",
                                promptData[0, element],
                                promptData[1, element]));
      }

      sb.Append(String.Format(
                              CultureInfo.CurrentCulture,
                              "[Default is ({0})]",
                              promptData[0, defaultChoice]));

      // Read prompts until a match is made, the default is
      // chosen, or the loop is interrupted with ctrl-C.
      while (true)
      {
        this.WriteLine(ConsoleColor.Cyan, ConsoleColor.Black,
sb.ToString());
        string data =
Console.ReadLine().Trim().ToUpper(CultureInfo.CurrentCulture);

        // If the choice string was empty, use the default selection.
        if (data.Length == 0)
        {
          return defaultChoice;
        }
```

```
        // See if the selection matched and return the
        // corresponding index if it did.
        for (int i = 0; i < choices.Count; i++)
        {
          if (promptData[0, i] == data)
          {
            return i;
          }
        }

        this.WriteErrorLine("Invalid choice: " + data);
      }
    }

    #region IHostUISupportsMultipleChoiceSelection Members

        /// <summary>
    /// Provides a set of choices that enable the user to choose a one or
    /// more options from a set of options.
    /// </summary>
    /// <param name="caption">Text that proceeds (a title) the choices.
</param>
    /// <param name="message">A message that describes the choice.</param>
    /// <param name="choices">A collection of ChoiceDescription objects that
    /// describe each choice.</param>
    /// <param name="defaultChoices">The index of the label in the Choices
    /// parameter collection. To indicate no default choice, set to -1.
</param>
    /// <returns>The index of the Choices parameter collection element that
    /// corresponds to the option that is selected by the user.</returns>
    public Collection<int> PromptForChoice(
                                           string caption,
                                           string message,
                                           Collection<ChoiceDescription>
choices,
                                           IEnumerable<int> defaultChoices)
    {
      // Write the caption and message strings in Blue.
      this.WriteLine(
                    ConsoleColor.Blue,
                    ConsoleColor.Black,
                    caption + "\n" + message + "\n");

      // Convert the choice collection into something that is
      // easier to work with. See the BuildHotkeysAndPlainLabels
      // method for details.
      string[,] promptData = BuildHotkeysAndPlainLabels(choices);

      // Format the overall choice prompt string to display.
      StringBuilder sb = new StringBuilder();
      for (int element = 0; element < choices.Count; element++)
      {
        sb.Append(String.Format(
                                CultureInfo.CurrentCulture,
                                "|{0}> {1} ",
```

```
                                promptData[0, element],
                                promptData[1, element]));
      }

      Collection<int> defaultResults = new Collection<int>();
      if (defaultChoices != null)
      {
        int countDefaults = 0;
        foreach (int defaultChoice in defaultChoices)
        {
          ++countDefaults;
          defaultResults.Add(defaultChoice);
        }

        if (countDefaults != 0)
        {
          sb.Append(countDefaults == 1 ? "[Default choice is " : "[Default
choices are ");
          foreach (int defaultChoice in defaultChoices)
          {
            sb.AppendFormat(
                            CultureInfo.CurrentCulture,
                            "\"{0}\",",
                            promptData[0, defaultChoice]);
          }

          sb.Remove(sb.Length - 1, 1);
          sb.Append("]");
        }
      }

      this.WriteLine(
                    ConsoleColor.Cyan,
                    ConsoleColor.Black,
                    sb.ToString());
      // Read prompts until a match is made, the default is
      // chosen, or the loop is interrupted with ctrl-C.
      Collection<int> results = new Collection<int>();
      while (true)
      {
        ReadNext:
        string prompt = string.Format(CultureInfo.CurrentCulture,
"Choice[{0}]:", results.Count);
        this.Write(ConsoleColor.Cyan, ConsoleColor.Black, prompt);
        string data =
Console.ReadLine().Trim().ToUpper(CultureInfo.CurrentCulture);

        // If the choice string was empty, no more choices have been made.
        // If there were no choices made, return the defaults
        if (data.Length == 0)
        {
          return (results.Count == 0) ? defaultResults : results;
        }

        // See if the selection matched and return the
```

```
        // corresponding index if it did.
        for (int i = 0; i < choices.Count; i++)
        {
          if (promptData[0, i] == data)
          {
            results.Add(i);
            goto ReadNext;
          }
        }

        this.WriteErrorLine("Invalid choice: " + data);
      }
    }

    #endregion

    /// <summary>
    /// Prompts the user for credentials with a specified prompt window
    /// caption, prompt message, user name, and target name. In this
    /// example this functionality is not needed so the method throws a
    /// NotImplementException exception.
    /// </summary>
    /// <param name="caption">The caption for the message window.</param>
    /// <param name="message">The text of the message.</param>
    /// <param name="userName">The user name whose credential is to be
    /// prompted for.</param>
    /// <param name="targetName">The name of the target for which the
    /// credential is collected.</param>
    /// <returns>Throws a NotImplementedException exception.</returns>
    public override PSCredential PromptForCredential(
                                                    string caption,
                                                    string message,
                                                    string userName,
                                                    string targetName)
    {
      throw new NotImplementedException(
                          "The method or operation is not implemented.");
    }

    /// <summary>
    /// Prompts the user for credentials by using a specified prompt window
    /// caption, prompt message, user name and target name, credential
    /// types allowed to be returned, and UI behavior options. In this
    /// example this functionality is not needed so the method throws a
    /// NotImplementException exception.
    /// </summary>
    /// <param name="caption">The caption for the message window.</param>
    /// <param name="message">The text of the message.</param>
    /// <param name="userName">The user name whose credential is to be
    /// prompted for.</param>
    /// <param name="targetName">The name of the target for which the
    /// credential is collected.</param>
    /// <param name="allowedCredentialTypes">A PSCredentialTypes constant
    /// that identifies the type of credentials that can be returned.
</param>
```

```
    /// <param name="options">A PSCredentialUIOptions constant that
    /// identifies the UI behavior when it gathers the credentials.</param>
    /// <returns>Throws a NotImplementedException exception.</returns>
    public override PSCredential PromptForCredential(
                                        string caption,
                                        string message,
                                        string userName,
                                        string targetName,
                                        PSCredentialTypes
allowedCredentialTypes,
                                        PSCredentialUIOptions options)
    {
      throw new NotImplementedException(
                                "The method or operation is not
implemented.");
    }

    /// <summary>
    /// Reads characters that are entered by the user until a newline
    /// (carriage return) is encountered.
    /// </summary>
    /// <returns>The characters that are entered by the user.</returns>
    public override string ReadLine()
    {
      return Console.ReadLine();
    }

    /// <summary>
    /// Reads characters entered by the user until a newline (carriage
return)
    /// is encountered and returns the characters as a secure string. In
this
    /// example this functionality is not needed so the method throws a
    /// NotImplementException exception.
    /// </summary>
    /// <returns>Throws a NotImplemented exception.</returns>
    public override System.Security.SecureString ReadLineAsSecureString()
    {
      throw new NotImplementedException("The method or operation is not
implemented.");
    }

    /// <summary>
    /// Writes characters to the output display of the host.
    /// </summary>
    /// <param name="value">The characters to be written.</param>
    public override void Write(string value)
    {
      Console.Write(value);
    }

    /// <summary>
    /// Writes characters to the output display of the host with possible
    /// foreground and background colors.
    /// </summary>
```

```
    /// <param name="foregroundColor">The color of the characters.</param>
    /// <param name="backgroundColor">The background color to use.</param>
    /// <param name="value">The characters to be written.</param>
    public override void Write(
                               ConsoleColor foregroundColor,
                               ConsoleColor backgroundColor,
                               string value)
    {
      ConsoleColor oldFg = Console.ForegroundColor;
      ConsoleColor oldBg = Console.BackgroundColor;
      Console.ForegroundColor = foregroundColor;
      Console.BackgroundColor = backgroundColor;
      Console.Write(value);
      Console.ForegroundColor = oldFg;
      Console.BackgroundColor = oldBg;
    }

    /// <summary>
    /// Writes a line of characters to the output display of the host
    /// with foreground and background colors and appends a newline
(carriage return).
    /// </summary>
    /// <param name="foregroundColor">The foreground color of the display.
</param>
    /// <param name="backgroundColor">The background color of the display.
</param>
    /// <param name="value">The line to be written.</param>
    public override void WriteLine(
                                   ConsoleColor foregroundColor,
                                   ConsoleColor backgroundColor,
                                   string value)
    {
      ConsoleColor oldFg = Console.ForegroundColor;
      ConsoleColor oldBg = Console.BackgroundColor;
      Console.ForegroundColor = foregroundColor;
      Console.BackgroundColor = backgroundColor;
      Console.WriteLine(value);
      Console.ForegroundColor = oldFg;
      Console.BackgroundColor = oldBg;
    }

    /// <summary>
    /// Writes a debug message to the output display of the host.
    /// </summary>
    /// <param name="message">The debug message that is displayed.</param>
    public override void WriteDebugLine(string message)
    {
      this.WriteLine(
                     ConsoleColor.DarkYellow,
                     ConsoleColor.Black,
                     String.Format(CultureInfo.CurrentCulture, "DEBUG: {0}",
message));
    }

    /// <summary>
```

```
    /// Writes an error message to the output display of the host.
    /// </summary>
    /// <param name="value">The error message that is displayed.</param>
    public override void WriteErrorLine(string value)
    {
      this.WriteLine(
                     ConsoleColor.Red,
                     ConsoleColor.Black,
                     value);
    }

    /// <summary>
    /// Writes a newline character (carriage return)
    /// to the output display of the host.
    /// </summary>
    public override void WriteLine()
    {
      Console.WriteLine();
    }

       /// <summary>
    /// Writes a line of characters to the output display of the host
    /// and appends a newline character(carriage return).
    /// </summary>
    /// <param name="value">The line to be written.</param>
    public override void WriteLine(string value)
    {
      Console.WriteLine(value);
    }

    /// <summary>
    /// Writes a progress report to the output display of the host.
    /// </summary>
    /// <param name="sourceId">Unique identifier of the source of the
record. </param>
    /// <param name="record">A ProgressReport object.</param>
    public override void WriteProgress(long sourceId, ProgressRecord record)
    {

    }

    /// <summary>
    /// Writes a verbose message to the output display of the host.
    /// </summary>
    /// <param name="message">The verbose message that is displayed.</param>
    public override void WriteVerboseLine(string message)
    {
      this.WriteLine(
                     ConsoleColor.Green,
                     ConsoleColor.Black,
                     String.Format(CultureInfo.CurrentCulture, "VERBOSE:
{0}", message));
    }

    /// <summary>
```

```
    /// Writes a warning message to the output display of the host.
    /// </summary>
    /// <param name="message">The warning message that is displayed.</param>
    public override void WriteWarningLine(string message)
    {
      this.WriteLine(
                    ConsoleColor.Yellow,
                    ConsoleColor.Black,
                    String.Format(CultureInfo.CurrentCulture, "WARNING:
{0}", message));
    }

    /// <summary>
    /// Parse a string containing a hotkey character.
    /// Take a string of the form
    ///    Yes to &all
    /// and returns a two-dimensional array split out as
    ///    "A", "Yes to all".
    /// </summary>
    /// <param name="input">The string to process</param>
    /// <returns>
    /// A two dimensional array containing the parsed components.
    /// </returns>
    private static string[] GetHotkeyAndLabel(string input)
    {
      string[] result = new string[] { String.Empty, String.Empty };
      string[] fragments = input.Split('&');
      if (fragments.Length == 2)
      {
        if (fragments[1].Length > 0)
        {
          result[0] = fragments[1][0].ToString().
          ToUpper(CultureInfo.CurrentCulture);
        }

        result[1] = (fragments[0] + fragments[1]).Trim();
      }
      else
      {
        result[1] = input;
      }

      return result;
    }

    /// <summary>
    /// This is a private worker function splits out the
    /// accelerator keys from the menu and builds a two
    /// dimensional array with the first access containing the
    /// accelerator and the second containing the label string
    /// with the & removed.
    /// </summary>
    /// <param name="choices">The choice collection to process</param>
    /// <returns>
    /// A two dimensional array containing the accelerator characters
```

```
    /// and the cleaned-up labels</returns>
    private static string[,] BuildHotkeysAndPlainLabels(
         Collection<ChoiceDescription> choices)
    {
      // Allocate the result array
      string[,] hotkeysAndPlainLabels = new string[2, choices.Count];

      for (int i = 0; i < choices.Count; ++i)
      {
        string[] hotkeyAndLabel = GetHotkeyAndLabel(choices[i].Label);
        hotkeysAndPlainLabels[0, i] = hotkeyAndLabel[0];
        hotkeysAndPlainLabels[1, i] = hotkeyAndLabel[1];
      }

      return hotkeysAndPlainLabels;
    }
  }
}
```

Example 4

The following code is the implementation of the System.Management.Automation.Host.Pshostrawuserinterface class that is used by this host application. Those elements that are not implemented throw an exception or return nothing.

C#

```
namespace Microsoft.Samples.PowerShell.Host
{
  using System;
  using System.Management.Automation.Host;

  /// <summary>
  /// A sample implementation of the PSHostRawUserInterface for console
  /// applications. Members of this class that easily map to the .NET
  /// console class are implemented. More complex methods are not
  /// implemented and throw a NotImplementedException exception.
  /// </summary>
  internal class MyRawUserInterface : PSHostRawUserInterface
  {
    /// <summary>
    /// Gets or sets the background color of text to be written.
    /// This maps to the corresponding Console.Background property.
    /// </summary>
    public override ConsoleColor BackgroundColor
    {
      get { return Console.BackgroundColor; }
      set { Console.BackgroundColor = value; }
    }
```

```
    /// <summary>
    /// Gets or sets the host buffer size adapted from the Console buffer
    /// size members.
    /// </summary>
    public override Size BufferSize
    {
      get { return new Size(Console.BufferWidth, Console.BufferHeight); }
      set { Console.SetBufferSize(value.Width, value.Height); }
    }

    /// <summary>
    /// Gets or sets the cursor position. In this example this
    /// functionality is not needed so the property throws a
    /// NotImplementException exception.
    /// </summary>
    public override Coordinates CursorPosition
    {
      get { throw new NotImplementedException(
                "The method or operation is not implemented."); }
      set { throw new NotImplementedException(
                "The method or operation is not implemented."); }
    }

    /// <summary>
    /// Gets or sets the cursor size taken directly from the
    /// Console.CursorSize property.
    /// </summary>
    public override int CursorSize
    {
      get { return Console.CursorSize; }
      set { Console.CursorSize = value; }
    }

    /// <summary>
    /// Gets or sets the foreground color of the text to be written.
    /// This maps to the corresponding Console.ForegroundColor property.
    /// </summary>
    public override ConsoleColor ForegroundColor
    {
      get { return Console.ForegroundColor; }
      set { Console.ForegroundColor = value; }
    }

    /// <summary>
    /// Gets a value indicating whether a key is available. This maps to
    /// the corresponding Console.KeyAvailable property.
    /// </summary>
    public override bool KeyAvailable
    {
      get { return Console.KeyAvailable; }
    }

    /// <summary>
    /// Gets the maximum physical size of the window adapted from the
```

```
    /// Console.LargestWindowWidth and Console.LargestWindowHeight
    /// properties.
    /// </summary>
    public override Size MaxPhysicalWindowSize
    {
      get { return new Size(Console.LargestWindowWidth,
Console.LargestWindowHeight); }
    }

    /// <summary>
    /// Gets the maximum window size adapted from the
    /// Console.LargestWindowWidth and console.LargestWindowHeight
    /// properties.
    /// </summary>
    public override Size MaxWindowSize
    {
      get { return new Size(Console.LargestWindowWidth,
Console.LargestWindowHeight); }
    }

    /// <summary>
    /// Gets or sets the window position adapted from the Console window
position
    /// members.
    /// </summary>
    public override Coordinates WindowPosition
    {
      get { return new Coordinates(Console.WindowLeft, Console.WindowTop); }
      set { Console.SetWindowPosition(value.X, value.Y); }
    }

    /// <summary>
    /// Gets or sets the window size adapted from the corresponding Console
    /// calls.
    /// </summary>
    public override Size WindowSize
    {
      get { return new Size(Console.WindowWidth, Console.WindowHeight); }
      set { Console.SetWindowSize(value.Width, value.Height); }
    }

    /// <summary>
    /// Gets or sets the title of the window mapped to the Console.Title
    /// property.
    /// </summary>
    public override string WindowTitle
    {
      get { return Console.Title; }
      set { Console.Title = value; }
    }

    /// <summary>
    /// This API resets the input buffer. In this example this
    /// functionality is not needed so the method returns nothing.
    /// </summary>
```

```
    public override void FlushInputBuffer()
    {
    }

    /// <summary>
    /// This API returns a rectangular region of the screen buffer. In
    /// this example this functionality is not needed so the method throws
    /// a NotImplementException exception.
    /// </summary>
    /// <param name="rectangle">Defines the size of the rectangle.</param>
    /// <returns>Throws a NotImplementedException exception.</returns>
    public override BufferCell[,] GetBufferContents(Rectangle rectangle)
    {
      throw new NotImplementedException(
                "The method or operation is not implemented.");
    }

    /// <summary>
    /// This API Reads a pressed, released, or pressed and released
keystroke
    /// from the keyboard device, blocking processing until a keystroke is
    /// typed that matches the specified keystroke options. In this example
    /// this functionality is not needed so the method throws a
    /// NotImplementException exception.
    /// </summary>
    /// <param name="options">Options, such as IncludeKeyDown,  used when
    /// reading the keyboard.</param>
    /// <returns>Throws a NotImplementedException exception.</returns>
    public override KeyInfo ReadKey(ReadKeyOptions options)
    {
      throw new NotImplementedException(
                "The method or operation is not implemented.");
    }

    /// <summary>
    /// This API crops a region of the screen buffer. In this example
    /// this functionality is not needed so the method throws a
    /// NotImplementException exception.
    /// </summary>
    /// <param name="source">The region of the screen to be scrolled.
</param>
    /// <param name="destination">The region of the screen to receive the
    /// source region contents.</param>
    /// <param name="clip">The region of the screen to include in the
operation.</param>
    /// <param name="fill">The character and attributes to be used to fill
all cell.</param>
    public override void ScrollBufferContents(Rectangle source, Coordinates
destination, Rectangle clip, BufferCell fill)
    {
      throw new NotImplementedException(
                "The method or operation is not implemented.");
    }

    /// <summary>
```

```
    /// This API copies an array of buffer cells into the screen buffer
    /// at a specified location. In this example this  functionality is
    /// not needed si the method  throws a NotImplementedException
exception.
    /// </summary>
    /// <param name="origin">The parameter is not used.</param>
    /// <param name="contents">The parameter is not used.</param>
    public override void SetBufferContents(Coordinates origin, BufferCell[,]
contents)
    {
      throw new NotImplementedException(
                "The method or operation is not implemented.");
    }

    /// <summary>
    /// This API Copies a given character, foreground color, and background
    /// color to a region of the screen buffer. In this example this
    /// functionality is not needed so the method throws a
    /// NotImplementException exception./// </summary>
    /// <param name="rectangle">Defines the area to be filled. </param>
    /// <param name="fill">Defines the fill character.</param>
    public override void SetBufferContents(Rectangle rectangle, BufferCell
fill)
    {
      throw new NotImplementedException(
                "The method or operation is not implemented.");
    }
  }
}
```

Example 5

The following code reads the command line and colors the text as it is entered. Tokens are determined by using the System.Management.Automation.Psparser.Tokenize* method.

C#

```
namespace Microsoft.Samples.PowerShell.Host
{
  using System;
  using System.Collections.ObjectModel;
  using System.Management.Automation;
  using System.Text;

  /// <summary>
  /// This class is used to read the command line and color the text as
  /// it is entered. Tokens are determined using the PSParser.Tokenize
  /// method.
  /// </summary>
  internal class ConsoleReadLine
```

```
{
  /// <summary>
  /// The buffer used to edit.
  /// </summary>
  private StringBuilder buffer = new StringBuilder();

  /// <summary>
  /// The position of the cursor within the buffer.
  /// </summary>
  private int current;

  /// <summary>
  /// The count of characters in buffer rendered.
  /// </summary>
  private int rendered;

  /// <summary>
  /// Store the anchor and handle cursor movement
  /// </summary>
  private Cursor cursor;

  /// <summary>
  /// The array of colors for tokens, indexed by PSTokenType
  /// </summary>
  private ConsoleColor[] tokenColors;

  /// <summary>
  /// We do not pick different colors for every token, those tokens
  /// use this default.
  /// </summary>
  private ConsoleColor defaultColor = Console.ForegroundColor;

  /// <summary>
  /// Initializes a new instance of the ConsoleReadLine class.
  /// </summary>
  public ConsoleReadLine()
  {
    this.tokenColors = new ConsoleColor[]
    {
      this.defaultColor,       // Unknown
      ConsoleColor.Yellow,     // Command
      ConsoleColor.Green,      // CommandParameter
      ConsoleColor.Cyan,       // CommandArgument
      ConsoleColor.Cyan,       // Number
      ConsoleColor.Cyan,       // String
      ConsoleColor.Green,      // Variable
      this.defaultColor,            // Member
      this.defaultColor,            // LoopLabel
      ConsoleColor.DarkYellow, // Attribute
      ConsoleColor.DarkYellow, // Type
      ConsoleColor.DarkCyan,   // Operator
      this.defaultColor,            // GroupStart
      this.defaultColor,            // GroupEnd
      ConsoleColor.Magenta,    // Keyword
      ConsoleColor.Red,        // Comment
```

```
        ConsoleColor.DarkCyan,   // StatementSeparator
                this.defaultColor,            // NewLine
                this.defaultColor,            // LineContinuation
                this.defaultColor,            // Position
      };
    }

    /// <summary>
    /// Read a line of text, colorizing while typing.
    /// </summary>
    /// <returns>The command line read</returns>
    public string Read()
    {
      this.Initialize();

      while (true)
      {
        ConsoleKeyInfo key = Console.ReadKey(true);

        switch (key.Key)
        {
          case ConsoleKey.Backspace:
               this.OnBackspace();
               break;
          case ConsoleKey.Delete:
               this.OnDelete();
               break;
          case ConsoleKey.Enter:
               return this.OnEnter();
          case ConsoleKey.RightArrow:
               this.OnRight(key.Modifiers);
               break;
          case ConsoleKey.LeftArrow:
               this.OnLeft(key.Modifiers);
               break;
          case ConsoleKey.Escape:
               this.OnEscape();
               break;
          case ConsoleKey.Home:
               this.OnHome();
               break;
          case ConsoleKey.End:
               this.OnEnd();
               break;
          case ConsoleKey.UpArrow:
          case ConsoleKey.DownArrow:
          case ConsoleKey.LeftWindows:
          case ConsoleKey.RightWindows:
          // ignore these
          continue;

          default:
          if (key.KeyChar == '\x0D')
          {
            goto case ConsoleKey.Enter;      // Ctrl-M
```

```
          }

          if (key.KeyChar == '\x08')
          {
            goto case ConsoleKey.Backspace;  // Ctrl-H
          }

          this.Insert(key);
          break;
        }
      }
    }

    /// <summary>
    /// Initializes the buffer.
    /// </summary>
    private void Initialize()
    {
      this.buffer.Length = 0;
      this.current = 0;
      this.rendered = 0;
      this.cursor = new Cursor();
    }

    /// <summary>
    /// Inserts a key.
    /// </summary>
    /// <param name="key">The key to insert.</param>
    private void Insert(ConsoleKeyInfo key)
    {
      this.buffer.Insert(this.current, key.KeyChar);
      this.current++;
      this.Render();
    }

    /// <summary>
    /// The End key was entered..
    /// </summary>
    private void OnEnd()
    {
      this.current = this.buffer.Length;
      this.cursor.Place(this.rendered);
    }

    /// <summary>
    /// The Home key was entered.
    /// </summary>
    private void OnHome()
    {
      this.current = 0;
      this.cursor.Reset();
    }

    /// <summary>
    /// The Escape key was entered.
```

```
    /// </summary>
    private void OnEscape()
    {
      this.buffer.Length = 0;
      this.current = 0;
      this.Render();
    }

    /// <summary>
    /// Moves to the left of the cursor position.
    /// </summary>
    /// <param name="consoleModifiers">Enumeration for Alt, Control,
    /// and Shift keys.</param>
    private void OnLeft(ConsoleModifiers consoleModifiers)
    {
      if ((consoleModifiers & ConsoleModifiers.Control) != 0)
      {
        // Move back to the start of the previous word.
        if (this.buffer.Length > 0 && this.current != 0)
        {
          bool nonLetter = IsSeparator(this.buffer[this.current - 1]);
          while (this.current > 0 && (this.current - 1 <
this.buffer.Length))
          {
            this.MoveLeft();

            if (IsSeparator(this.buffer[this.current]) != nonLetter)
            {
              if (!nonLetter)
              {
                this.MoveRight();
                break;
              }

              nonLetter = false;
            }
          }
        }
      }
      else
      {
        this.MoveLeft();
      }
    }

    /// <summary>
    /// Determines if a character is a separator.
    /// </summary>
    /// <param name="ch">Character to investigate.</param>
    /// <returns>A value that indicates whether the character
    /// is a separator.</returns>
    private static bool IsSeparator(char ch)
    {
      return !Char.IsLetter(ch);
    }
```

```
    /// <summary>
    /// Moves to what is to the right of the cursor position.
    /// </summary>
    /// <param name="consoleModifiers">Enumeration for Alt, Control,
    /// and Shift keys.</param>
    private void OnRight(ConsoleModifiers consoleModifiers)
    {
      if ((consoleModifiers & ConsoleModifiers.Control) != 0)
      {
        // Move to the next word.
        if (this.buffer.Length != 0 && this.current < this.buffer.Length)
        {
          bool nonLetter = IsSeparator(this.buffer[this.current]);
          while (this.current < this.buffer.Length)
          {
            this.MoveRight();

            if (this.current == this.buffer.Length)
            {
              break;
            }

            if (IsSeparator(this.buffer[this.current]) != nonLetter)
            {
              if (nonLetter)
              {
                break;
              }

              nonLetter = true;
            }
          }
        }
      }
      else
      {
        this.MoveRight();
      }
    }

    /// <summary>
    /// Moves the cursor one character to the right.
    /// </summary>
    private void MoveRight()
    {
      if (this.current < this.buffer.Length)
      {
        char c = this.buffer[this.current];
        this.current++;
        Cursor.Move(1);
      }
    }

    /// <summary>
```

```
    /// Moves the cursor one character to the left.
    /// </summary>
    private void MoveLeft()
    {
      if (this.current > 0 && (this.current - 1 < this.buffer.Length))
      {
        this.current--;
        char c = this.buffer[this.current];
        Cursor.Move(-1);
      }
    }

    /// <summary>
    /// The Enter key was entered.
    /// </summary>
    /// <returns>A newline character.</returns>
    private string OnEnter()
    {
      Console.Out.Write("\n");
      return this.buffer.ToString();
    }

    /// <summary>
    /// The delete key was entered.
    /// </summary>
    private void OnDelete()
    {
      if (this.buffer.Length > 0 && this.current < this.buffer.Length)
      {
        this.buffer.Remove(this.current, 1);
        this.Render();
      }
    }

    /// <summary>
    /// The Backspace key was entered.
    /// </summary>
    private void OnBackspace()
    {
      if (this.buffer.Length > 0 && this.current > 0)
      {
        this.buffer.Remove(this.current - 1, 1);
        this.current--;
        this.Render();
      }
    }

    /// <summary>
    /// Displays the line.
    /// </summary>
    private void Render()
    {
      string text = this.buffer.ToString();

      // The PowerShell tokenizer is used to decide how to colorize
```

```
      // the input.  Any errors in the input are returned in 'errors',
      // but we won't be looking at those here.
      Collection<PSParseError> errors = null;
      Collection<PSToken> tokens = PSParser.Tokenize(text, out errors);

      if (tokens.Count > 0)
      {
        // We can skip rendering tokens that end before the cursor.
        int i;
        for (i = 0; i < tokens.Count; ++i)
        {
          if (this.current >= tokens[i].Start)
          {
            break;
          }
        }

        // Place the cursor at the start of the first token to render.  The
        // last edit may require changes to the colorization of characters
        // preceding the cursor.
        this.cursor.Place(tokens[i].Start);

        for (; i < tokens.Count; ++i)
        {
          // Write out the token.  We don't use tokens[i].Content, instead
we
          // use the actual text from our input because the content
sometimes
          // excludes part of the token, e.g. the quote characters of a
string.
          Console.ForegroundColor = this.tokenColors[(int)tokens[i].Type];
          Console.Out.Write(text.Substring(tokens[i].Start,
tokens[i].Length));

          // Whitespace doesn't show up in the array of tokens.  Write it
out here.
          if (i != (tokens.Count - 1))
          {
            Console.ForegroundColor = this.defaultColor;
            for (int j = (tokens[i].Start + tokens[i].Length); j < tokens[i
+ 1].Start; ++j)
            {
              Console.Out.Write(text[j]);
            }
          }
        }

        // It's possible there is text left over to output.  This happens
when there is
        // some error during tokenization, e.g. a string literal is missing
a closing quote.
        Console.ForegroundColor = this.defaultColor;
        for (int j = tokens[i - 1].Start + tokens[i - 1].Length; j <
text.Length; ++j)
        {
```

```
          Console.Out.Write(text[j]);
        }
      }
      else
      {
        // If tokenization completely failed, just redraw the whole line.
This
        // happens most frequently when the first token is incomplete, like
a string
        // literal missing a closing quote.
        this.cursor.Reset();
        Console.Out.Write(text);
      }

      // If characters were deleted, we must write over previously written
characters
      if (text.Length < this.rendered)
      {
        Console.Out.Write(new string(' ', this.rendered - text.Length));
      }

      this.rendered = text.Length;
      this.cursor.Place(this.current);
    }

    /// <summary>
    /// A helper class for maintaining the cursor while editing the command
line.
    /// </summary>
    internal class Cursor
    {
      /// <summary>
      /// The top anchor for reposition the cursor.
      /// </summary>
      private int anchorTop;

      /// <summary>
      /// The left anchor for repositioning the cursor.
      /// </summary>
      private int anchorLeft;

      /// <summary>
      /// Initializes a new instance of the Cursor class.
      /// </summary>
      public Cursor()
      {
        this.anchorTop = Console.CursorTop;
        this.anchorLeft = Console.CursorLeft;
      }

      /// <summary>
      /// Moves the cursor.
      /// </summary>
      /// <param name="delta">The number of characters to move.</param>
      internal static void Move(int delta)
```

```
      {
        int position = Console.CursorTop * Console.BufferWidth +
Console.CursorLeft + delta;

        Console.CursorLeft = position % Console.BufferWidth;
        Console.CursorTop = position / Console.BufferWidth;
      }

      /// <summary>
      /// Resets the cursor position.
      /// </summary>
      internal void Reset()
      {
        Console.CursorTop = this.anchorTop;
        Console.CursorLeft = this.anchorLeft;
      }

      /// <summary>
      /// Moves the cursor to a specific position.
      /// </summary>
      /// <param name="position">The new position.</param>
      internal void Place(int position)
      {
        Console.CursorLeft = (this.anchorLeft + position) %
Console.BufferWidth;
        int cursorTop = this.anchorTop + (this.anchorLeft + position) /
Console.BufferWidth;
        if (cursorTop >= Console.BufferHeight)
        {
          this.anchorTop -= cursorTop - Console.BufferHeight + 1;
          cursorTop = Console.BufferHeight - 1;
        }

        Console.CursorTop = cursorTop;
      }
    } // End Cursor
  }
}
```

See Also

System.Management.Automation.Host.PSHost

System.Management.Automation.Host.Pshostuserinterface

System.Management.Automation.Host.Pshostrawuserinterface

Runspace Samples

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This section includes sample code that shows how to use different types of runspaces to run commands synchronously and asynchronously. You can use Microsoft Visual Studio to create a console application and then copy the code from the topics in this section into your host application.

In This Section

> **Note**
>
> For samples of host applications that create custom host interfaces, see **Custom Host Samples**.

Runspace01 Sample This sample shows how to use the System.Management.Automation.Powershell class to run the Get-Process cmdlet synchronously and display its output in a console window.

Runspace02 Sample This sample shows how to use the System.Management.Automation.Powershell class to run the Get-Process and Sort-Object cmdlets synchronously. The results of these commands is displayed by using a System.Windows.Forms.Datagridview control.

Runspace03 Sample This sample shows how to use the System.Management.Automation.Powershell class to run a script synchronously, and how to handle non-terminating errors. The script receives a list of process names and then retrieves those processes. The results of the script, including any non-terminating errors that were generated when running the script, are displayed in a console window.

Runspace04 Sample This sample shows how to use the System.Management.Automation.Powershell class to run commands, and how to catch terminating errors that are thrown when running the commands. Two commands are run, and the last command is passed a parameter argument that is not valid. As a result no objects are returned and a terminating error is thrown.

Runspace05 Sample This sample shows how to add a snap-in to an System.Management.Automation.Runspaces.Initialsessionstate object so that the cmdlet of the snap-in is available when the runspace is opened. The snap-in provides a Get-

Proc cmdlet (defined by the GetProcessSample01 Sample) that is run synchronously using a System.Management.Automation.Powershell object.

Runspace06 Sample This sample shows how to add a module to an System.Management.Automation.Runspaces.Initialsessionstate object so that the module is loaded when the runspace is opened. The module provides a Get-Proc cmdlet (defined by the GetProcessSample02 Sample) that is run synchronously using a System.Management.Automation.Powershell object.

Runspace07 Sample This sample shows how to create a runspace, and then use that runspace to run two cmdlets synchronously by using a System.Management.Automation.Powershell object.

Runspace08 Sample This sample shows how to add commands and arguments to the pipeline of a System.Management.Automation.Powershell object and how to run the commands synchronously.

Runspace09 Sample This sample shows how to add a script to the pipeline of a System.Management.Automation.Powershell object and how to run the script asynchronously. Events are used to handle the output of the script.

Runspace10 Sample This sample shows how to create a default initial session state, how to add a cmdlet to the System.Management.Automation.Runspaces.Initialsessionstate, how to create a runspace that uses the initial session state, and how to run the command by using a System.Management.Automation.Powershell object.

Runspace11 Sample This shows how to use the System.Management.Automation.Proxycommand class to create a proxy command that calls an existing cmdlet, but restricts the set of available parameters. The proxy command is then added to an initial session state that is used to create a constrained runspace. This means that the user can access the functionality of the cmdlet only through the proxy command.

See Also

Runspace01 Sample

Article • 09/17/2021

This sample shows how to use the System.Management.Automation.Powershell class to run the Get-Process cmdlet synchronously. The Get-Process cmdlet returns System.Diagnostics.Process objects for each process running on the local computer. The values of the System.Diagnostics.Process.Processname* and System.Diagnostics.Process.Handlecount* properties are then extracted from the returned objects and displayed in a console window.

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

- Creating a System.Management.Automation.Powershell object to run a command.
- Adding a command to the pipeline of the System.Management.Automation.Powershell object.
- Running the command synchronously.
- Using System.Management.Automation.PSObject objects to extract properties from the objects returned by the command.

Example

This sample runs the Get-Process cmdlet synchronously in the default runspace provided by Windows PowerShell.

C#

```
namespace Microsoft.Samples.PowerShell.Runspaces
{
  using System;
  using System.Management.Automation;
  using PowerShell = System.Management.Automation.PowerShell;

  /// <summary>
  /// This class contains the Main entry point for this host application.
  /// </summary>
  internal class Runspace01
```

```
  {
    /// <summary>
    /// This sample uses the PowerShell class to execute
    /// the get-process cmdlet synchronously. The name and
    /// handlecount are then extracted from the PSObjects
    /// returned and displayed.
    /// </summary>
    /// <param name="args">Parameter not used.</param>
    /// <remarks>
    /// This sample demonstrates the following:
    /// 1. Creating a PowerShell object to run a command.
    /// 2. Adding a command to the pipeline of the PowerShell object.
    /// 3. Running the command synchronously.
    /// 4. Using PSObject objects to extract properties from the objects
    ///    returned by the command.
    /// </remarks>
    private static void Main(string[] args)
    {
      // Create a PowerShell object. Creating this object takes care of
      // building all of the other data structures needed to run the
command.
      using (PowerShell powershell = PowerShell.Create().AddCommand("get-
process"))
      {
        Console.WriteLine("Process             HandleCount");
        Console.WriteLine("-------------------------------");

        // Invoke the command synchronously and display the
        // ProcessName and HandleCount properties of the
        // objects that are returned.
        foreach (PSObject result in powershell.Invoke())
        {
          Console.WriteLine(
                      "{0,-20} {1}",
                      result.Members["ProcessName"].Value,
                      result.Members["HandleCount"].Value);
        }
      }

      System.Console.WriteLine("Hit any key to exit...");
      System.Console.ReadKey();
    }
  }
}
```

See Also

Runspace02 Sample

Article • 09/17/2021

This sample shows how to use the System.Management.Automation.Powershell class to run the Get-Process and Sort-Object cmdlets synchronously. The Get-Process cmdlet returns System.Diagnostics.Process objects for each process running on the local computer, and the `Sort-Object` sorts the objects based on their System.Diagnostics.Process.Id* property. The results of these commands is displayed by using a System.Windows.Forms.Datagridview control.

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

This sample demonstrates the following.

- Creating a System.Management.Automation.Powershell object to run commands.
- Adding commands to the pipeline of System.Management.Automation.Powershell object.
- Running the commands synchronously.
- Using a System.Windows.Forms.Datagridview control to display the output of the commands in a Windows Forms application.

Example

This sample runs the Get-Process and Sort-Object cmdlets synchronously in the default runspace provided by Windows PowerShell. The output is displayed in a form using a System.Windows.Forms.Datagridview control.

C#

```
namespace Microsoft.Samples.PowerShell.Runspaces
{
  using System;
  using System.Collections;
  using System.Collections.ObjectModel;
  using System.Management.Automation;
```

```
  using System.Management.Automation.Runspaces;
  using System.Windows.Forms;
  using PowerShell = System.Management.Automation.PowerShell;

  /// <summary>
  /// This class contains the Main entry point for this host application.
  /// </summary>
  internal class Runspace02
  {
    /// <summary>
    /// This method creates the form where the output is displayed.
    /// </summary>
    private static void CreateForm()
    {
      Form form = new Form();
      DataGridView grid = new DataGridView();
      form.Controls.Add(grid);
      grid.Dock = DockStyle.Fill;

      // Create a PowerShell object. Creating this object takes care of
      // building all of the other data structures needed to run the
command.
      using (PowerShell powershell = PowerShell.Create())
      {
        powershell.AddCommand("get-process").AddCommand("sort-
object").AddArgument("ID");
        if (Runspace.DefaultRunspace == null)
        {
          Runspace.DefaultRunspace = powershell.Runspace;
        }

        Collection<PSObject> results = powershell.Invoke();

        // The generic collection needs to be re-wrapped in an ArrayList
        // for data-binding to work.
        ArrayList objects = new ArrayList();
        objects.AddRange(results);

        // The DataGridView will use the PSObjectTypeDescriptor type
        // to retrieve the properties.
        grid.DataSource = objects;
      }

      form.ShowDialog();
    }

    /// <summary>
    /// This sample uses a PowerShell object to run the Get-Process
    /// and Sort-Object cmdlets synchronously. Windows Forms and
    /// data binding are then used to display the results in a
    /// DataGridView control.
    /// </summary>
    /// <param name="args">The parameter is not used.</param>
    /// <remarks>
    /// This sample demonstrates the following:
```

```
    /// 1. Creating a PowerShell object.
    /// 2. Adding commands and arguments to the pipeline of
    ///    the PowerShell object.
    /// 3. Running the commands synchronously.
    /// 4. Using a DataGridView control to display the output
    ///    of the commands in a Windows Forms application.
    /// </remarks>
    private static void Main(string[] args)
    {
      Runspace02.CreateForm();
    }
  }
}
```

See Also

Writing a Windows PowerShell Host Application

Runspace03 Sample

Article • 09/17/2021

This sample shows how to use the System.Management.Automation.Powershell class to run a script synchronously, and how to handle non-terminating errors. The script receives a list of process names and then retrieves those processes. The results of the script, including any non-terminating errors that were generated when running the script, are displayed in a console window.

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

This sample demonstrates the following.

- Creating a System.Management.Automation.Powershell object to run a script.
- Adding a script to the pipeline of the System.Management.Automation.Powershell object.
- Passing input objects to the script from the calling program.
- Running the script synchronously.
- Using System.Management.Automation.PSObject objects to extract and display properties from the objects returned by the script.
- Retrieving and displaying error records that were generated when the script was run.

Example

This sample runs a script synchronously in the default runspace provided by Windows PowerShell. The output of the script and any non-terminating errors that were generated are displayed in a console window.

C#

```
namespace Microsoft.Samples.PowerShell.Runspaces
{
```

```
using System;
using System.Collections;
using System.Management.Automation;
using System.Management.Automation.Runspaces;
using PowerShell = System.Management.Automation.PowerShell;

/// <summary>
/// This class contains the Main entry point for this host application.
/// </summary>
internal class Runspace03
{
  /// <summary>
  /// This sample shows how to use the PowerShell class to run a
  /// script that retrieves process information for the list of
  /// process names passed to the script. It shows how to pass input
  /// objects to a script and how to retrieve error objects as well
  /// as the output objects.
  /// </summary>
  /// <param name="args">Parameter not used.</param>
  /// <remarks>
  /// This sample demonstrates the following:
  /// 1. Creating a PowerSHell object to run a script.
  /// 2. Adding a script to the pipeline of the PowerShell object.
  /// 3. Passing input objects to the script from the calling program.
  /// 4. Running the script synchronously.
  /// 5. Using PSObject objects to extract and display properties from
  ///    the objects returned by the script.
  /// 6. Retrieving and displaying error records that were generated
  ///    when the script was run.
  /// </remarks>
  private static void Main(string[] args)
  {
    // Define a list of processes to look for.
    string[] processNames = new string[]
    {
      "lsass", "nosuchprocess", "services", "nosuchprocess2"
    };

    // The script to run to get these processes. Input passed
    // to the script will be available in the $input variable.
    string script = "$input | get-process -name {$_}";

    // Create a PowerShell object. Creating this object takes care of
    // building all of the other data structures needed to run the script.
    using (PowerShell powershell = PowerShell.Create())
    {
      powershell.AddScript(script);

      Console.WriteLine("Process             HandleCount");
      Console.WriteLine("-------------------------------");

      // Invoke the script synchronously and display the
      // ProcessName and HandleCount properties of the
      // objects that are returned.
      foreach (PSObject result in powershell.Invoke(processNames))
```

```
        {
          Console.WriteLine(
                            "{0,-20} {1}",
                            result.Members["ProcessName"].Value,
                            result.Members["HandleCount"].Value);
        }

        // Process any error records that were generated while running
        //  the script.
        Console.WriteLine("\nThe following non-terminating errors
occurred:\n");
        PSDataCollection<ErrorRecord> errors = powershell.Streams.Error;
        if (errors != null && errors.Count > 0)
        {
          foreach (ErrorRecord err in errors)
          {
            System.Console.WriteLine("    error: {0}", err.ToString());
          }
        }
      }

      System.Console.WriteLine("\nHit any key to exit...");
      System.Console.ReadKey();
    }
  }
}
```

See Also

Writing a Windows PowerShell Host Application

Runspace04 Sample

Article • 09/17/2021

This sample shows how to use the System.Management.Automation.Powershell class to run commands, and how to catch terminating errors that are thrown when running the commands. Two commands are run, and the last command is passed a parameter argument that is not valid. As a result, no objects are returned and a terminating error is thrown.

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

This sample demonstrates the following.

- Creating a System.Management.Automation.Powershell object.
- Adding commands to the pipeline of the System.Management.Automation.Powershell object.
- Adding parameter arguments to the pipeline.
- Invoking the commands synchronously.
- Using System.Management.Automation.PSObject objects to extract and display properties from the objects returned by the commands.
- Retrieving and displaying error records that were generated during the running of the commands.
- Catching and displaying terminating exceptions thrown by the commands.

Example

This sample runs commands synchronously in the default runspace provided by Windows PowerShell. The last command throws a terminating error because a parameter argument that is not valid is passed to the command. The terminating error is trapped and displayed.

```
```

C#

```
namespace Microsoft.Samples.PowerShell.Runspaces
{
  using System;
  using System.Management.Automation;
  using System.Management.Automation.Runspaces;
  using PowerShell = System.Management.Automation.PowerShell;

  /// <summary>
  /// This class contains the Main entry point for this host application.
  /// </summary>
  internal class Runspace04
  {
    /// <summary>
    /// This sample shows how to use a PowerShell object to run commands.
    /// The commands generate a terminating exception that the caller
    /// should catch and process.
    /// </summary>
    /// <param name="args">The parameter is not used.</param>
    /// <remarks>
    /// This sample demonstrates the following:
    /// 1. Creating a PowerShell object to run commands.
    /// 2. Adding commands to the pipeline of  the PowerShell object.
    /// 3. Passing input objects to the commands from the calling program.
    /// 4. Using PSObject objects to extract and display properties from the
    ///    objects returned by the commands.
    /// 5. Retrieving and displaying error records that were generated
    ///    while running the commands.
    /// 6. Catching and displaying terminating exceptions generated
    ///    while running the commands.
    /// </remarks>
    private static void Main(string[] args)
    {
      // Create a PowerShell object.
      using (PowerShell powershell = PowerShell.Create())
      {
        // Add the commands to the PowerShell object.
        powershell.AddCommand("Get-ChildItem").AddCommand("Select-
String").AddArgument("*");

        // Run the commands synchronously. Because of the bad regular
expression,
        // no objects will be returned. Instead, an exception will be
thrown.
        try
        {
          foreach (PSObject result in powershell.Invoke())
          {
            Console.WriteLine("'{0}'", result.ToString());
          }

          // Process any error records that were generated while running the
commands.
```

```
            Console.WriteLine("\nThe following non-terminating errors
occurred:\n");
            PSDataCollection<ErrorRecord> errors = powershell.Streams.Error;
            if (errors != null && errors.Count > 0)
            {
              foreach (ErrorRecord err in errors)
              {
                System.Console.WriteLine("    error: {0}", err.ToString());
              }
            }
          }
          catch (RuntimeException runtimeException)
          {
            // Trap any exception generated by the commands. These exceptions
            // will all be derived from the RuntimeException exception.
            System.Console.WriteLine(
                          "Runtime exception: {0}: {1}\n{2}",

runtimeException.ErrorRecord.InvocationInfo.InvocationName,
                          runtimeException.Message,

runtimeException.ErrorRecord.InvocationInfo.PositionMessage);
          }
        }

        System.Console.WriteLine("\nHit any key to exit...");
        System.Console.ReadKey();
      }
    }
}
```

See Also

Writing a Windows PowerShell Host Application

Runspace05 Sample

Article • 09/17/2021

This sample shows how to add a snap-in to an System.Management.Automation.Runspaces.Initialsessionstate object so that the cmdlet of the snap-in is available when the runspace is opened. The snap-in provides a Get-Proc cmdlet (defined by the GetProcessSample01 Sample) that is run synchronously by using a System.Management.Automation.Powershell object.

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

This sample demonstrates the following.

- Creating an System.Management.Automation.Runspaces.Initialsessionstate object.
- Adding the snap-in to the System.Management.Automation.Runspaces.Initialsessionstate object.
- Creating a System.Management.Automation.Runspaces.Runspace object that uses the System.Management.Automation.Runspaces.Initialsessionstate object.
- Creating a System.Management.Automation.Powershell object that uses the runspace.
- Adding the snap-in's get-proc cmdlet to the pipeline of the System.Management.Automation.Powershell object.
- Running the command synchronously.
- Extracting properties from the System.Management.Automation.PSObject objects returned by the command.

Example

This sample creates a runspace that uses an System.Management.Automation.Runspaces.Initialsessionstate object to define the

elements that are available when the runspace is opened. In this sample, a snap-in that defines a Get-Proc cmdlet is added to the initial session state.

C#

```
namespace Microsoft.Samples.PowerShell.Runspaces
{
  using System;
  using System.Collections.ObjectModel;
  using System.Management.Automation;
  using System.Management.Automation.Runspaces;
  using PowerShell = System.Management.Automation.PowerShell;

  /// <summary>
  /// This class contains the Main entry point for this host application.
  /// </summary>
  internal class Runspace05
  {
    /// <summary>
    /// This sample shows how to define an initial session state that is
    /// used when creating a runspace. The sample invokes a command from
    /// a Windows PowerShell snap-in that is present in the console file.
    /// </summary>
    /// <param name="args">The parameter is not used.</param>
    /// <remarks>
    /// This sample assumes that user has coppied the GetProcessSample01.dll
    /// that is produced by the GetProcessSample01 sample to the current
    /// directory.
    /// This sample demonstrates the following:
    /// 1. Creating a default initial session state.
    /// 2. Adding a snap-in to the initial session state.
    /// 3. Creating a runspace that uses the initial session state.
    /// 4. Creating a PowerShell object that uses the runspace.
    /// 5. Adding the snap-in's get-proc cmdlet to the PowerShell object.
    /// 6. Using PSObject objects to extract and display properties from
    ///    the objects returned by the cmdlet.
    /// </remarks>
    private static void Main(string[] args)
    {
      // Create the default initial session state. The default initial
      // session state contains all the elements provided by Windows
      // PowerShell.
      InitialSessionState iss = InitialSessionState.CreateDefault();
      PSSnapInException warning;
      iss.ImportPSSnapIn("GetProcPSSnapIn01", out warning);

      // Create a runspace. Notice that no PSHost object is supplied to the
      // CreateRunspace method so the default host is used. See the Host
      // samples for more information on creating your own custom host.
      using (Runspace myRunSpace = RunspaceFactory.CreateRunspace(iss))
      {
        myRunSpace.Open();

        // Create a PowerShell object.
```

```
        using (PowerShell powershell = PowerShell.Create())
        {
          // Add the snap-in cmdlet and specify the runspace.
          powershell.AddCommand("GetProcPSSnapIn01\\get-proc");
          powershell.Runspace = myRunSpace;

          // Run the cmdlet synchronously.
          Collection<PSObject> results = powershell.Invoke();

          Console.WriteLine("Process             HandleCount");
          Console.WriteLine("-------------------------------");

          // Display the results.
          foreach (PSObject result in results)
          {
            Console.WriteLine(
                            "{0,-20} {1}",
                            result.Members["ProcessName"].Value,
                            result.Members["HandleCount"].Value);
          }
        }

        // Close the runspace to release any resources.
        myRunSpace.Close();
      }
      System.Console.WriteLine("Hit any key to exit...");
      System.Console.ReadKey();
    }
  }
}
```

See Also

Writing a Windows PowerShell Host Application

Runspace06 Sample

Article • 09/17/2021

This sample shows how to add a module to an System.Management.Automation.Runspaces.Initialsessionstate object so that the module is loaded when the runspace is opened. The module provides a Get-Proc cmdlet (defined by the GetProcessSample02 Sample) that is run synchronously by using a System.Management.Automation.Powershell object.

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

This sample demonstrates the following.

- Creating an System.Management.Automation.Runspaces.Initialsessionstate object.
- Adding the module to the System.Management.Automation.Runspaces.Initialsessionstate object.
- Creating a System.Management.Automation.Runspaces.Runspace object that uses the System.Management.Automation.Runspaces.Initialsessionstate object.
- Creating a System.Management.Automation.Powershell object that uses the runspace.
- Adding the module's get-proc cmdlet to the pipeline of the System.Management.Automation.Powershell object.
- Running the command synchronously.
- Extracting properties from the System.Management.Automation.PSObject objects returned by the command.

Example

This sample creates a runspace that uses an System.Management.Automation.Runspaces.Initialsessionstate object to define the

elements that are available when the runspace is opened. In this sample, a module that defines a Get-Proc cmdlet is added to the initial session state.

C#

```
namespace Microsoft.Samples.PowerShell.Runspaces
{
  using System;
  using System.Collections.ObjectModel;
  using System.Management.Automation;
  using System.Management.Automation.Runspaces;
  using PowerShell = System.Management.Automation.PowerShell;

  /// <summary>
  /// This class contains the Main entry point for this host application.
  /// </summary>
  internal class Runspace06
  {
    /// <summary>
    /// This sample shows how to define an initial session state that is
    /// used when creating a runspace. The sample invokes a command from
    /// a binary module that is loaded by the initial session state.
    /// </summary>
    /// <param name="args">Parameter not used.</param>
    /// <remarks>
    /// This sample assumes that user has coppied the GetProcessSample02.dll
    /// that is produced by the GetProcessSample02 sample to the current
    /// directory.
    /// This sample demonstrates the following:
    /// 1. Creating a default initial session state.
    /// 2. Adding a module to the initial session state.
    /// 3. Creating a runspace that uses the initial session state.
    /// 4. Creating a PowerShell object that uses the runspace.
    /// 5. Adding the module's get-proc cmdlet to the PowerShell object.
    /// 6. Running the command synchronously.
    /// 7. Using PSObject objects to extract and display properties from
    ///    the objects returned by the cmdlet.
    /// </remarks>
    private static void Main(string[] args)
    {
        // Create the default initial session state and add the module.
      InitialSessionState iss = InitialSessionState.CreateDefault();
      iss.ImportPSModule(new string[] { @".\GetProcessSample02.dll" });

      // Create a runspace. Notice that no PSHost object is supplied to the
      // CreateRunspace method so the default host is used. See the Host
      // samples for more information on creating your own custom host.
      using (Runspace myRunSpace = RunspaceFactory.CreateRunspace(iss))
      {
        myRunSpace.Open();

        // Create a PowerShell object.
        using (PowerShell powershell = PowerShell.Create())
        {
```

```
            // Add the cmdlet and specify the runspace.
            powershell.AddCommand(@"GetProcessSample02\get-proc");
            powershell.Runspace = myRunSpace;

            Collection<PSObject> results = powershell.Invoke();

            Console.WriteLine("Process             HandleCount");
            Console.WriteLine("-------------------------------");

            // Display the results.
            foreach (PSObject result in results)
            {
              Console.WriteLine(
                                "{0,-20} {1}",
                                result.Members["ProcessName"].Value,
                                result.Members["HandleCount"].Value);
            }
          }

          // Close the runspace to release any resources.
          myRunSpace.Close();
        }

        System.Console.WriteLine("Hit any key to exit...");
        System.Console.ReadKey();
      }
    }
}
```

See Also

Writing a Windows PowerShell Host Application

Runspace07 Sample

Article • 09/17/2021

This sample shows how to create a runspace, and then use that runspace to run two cmdlets synchronously by using a System.Management.Automation.Powershell object.

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

This sample demonstrates the following.

- Creating a System.Management.Automation.Runspaces.Runspace object by using the System.Management.Automation.Runspaces.Runspacefactory class.
- Creating a System.Management.Automation.Powershell object that uses the runspace.
- Adding cmdlets to the pipeline of the System.Management.Automation.Powershell object.
- Running the cmdlets synchronously.
- Extracting properties from the System.Management.Automation.PSObject objects returned by the command.

Example

This sample creates a runspace that used by a System.Management.Automation.PSObject object to run the Get-Process and Measure-Object cmdlets.

C#

```
namespace Microsoft.Samples.PowerShell.Runspaces
{
  using System;
  using System.Collections.ObjectModel;
  using System.Management.Automation;
  using System.Management.Automation.Runspaces;
  using PowerShell = System.Management.Automation.PowerShell;
```

```
/// <summary>
/// This class contains the Main entry point for this host application.
/// </summary>
internal class Runspace07
{
  /// <summary>
  /// This sample shows how to create a runspace and how to run commands
  /// using a PowerShell object. It builds a pipeline that runs the
  /// get-process cmdlet, which is piped to the measure-object
  /// cmdlet to count the number of processes running on the system.
  /// </summary>
  /// <param name="args">The parameter is not used.</param>
  /// <remarks>
  /// This sample demonstrates the following:
  /// 1. Creating a runspace using the RunspaceFactory class.
  /// 2. Creating a PowerShell object that uses the runspace.
  /// 3. Adding cmdlets to the pipeline of the PowerShell object.
  /// 4. Running the cmdlets synchronously.
  /// 5. Working with PSObject objects to extract properties
  ///    from the objects returned by the cmdlets.
  /// </remarks>
  private static void Main(string[] args)
  {
    Collection<PSObject> result;     // Will hold the result
                                     // of running the cmdlets.

    // Create a runspace. We can not use the RunspaceInvoke class
    // because we need to get at the underlying runspace to
    // explicitly add the commands. Notice that no PSHost object is
    // supplied to the CreateRunspace method so the default host is
    // used. See the Host samples for more information on creating
    // your own custom host.
    using (Runspace myRunSpace = RunspaceFactory.CreateRunspace())
    {
      myRunSpace.Open();

      // Create a PowerShell object and specify the runspace.
      PowerShell powershell = PowerShell.Create();
      powershell.Runspace = myRunSpace;

      // Use the using statement so we dispose of the PowerShell object
      // when we're done.
      using (powershell)
      {
        // Add the get-process cmdlet to the PowerShell object. Notice
        // we are specify the name of the cmdlet, not a script.
        powershell.AddCommand("get-process");

        // Add the measure-object cmdlet to count the number
        // of objects being returned. Commands are always added to the end
        // of the pipeline.
        powershell.AddCommand("measure-object");

        // Run the cmdlets synchronously and save the objects returned.
```

```
          result = powershell.Invoke();
        }

        // Even after disposing of the pipeLine, we still need to set
        // the powershell variable to null so that the garbage collector
        // can clean it up.
        powershell = null;

        // Display the results of running the commands (checking that
        // everything is ok first.
        if (result == null || result.Count != 1)
        {
          throw new InvalidOperationException(
                    "pipeline.Invoke() returned the wrong number of
objects");
        }

        PSMemberInfo count = result[0].Properties["Count"];
        if (count == null)
        {
          throw new InvalidOperationException(
                    "The object returned doesn't have a 'count' property");
        }

        Console.WriteLine(
                   "Runspace07: The Get-Process cmdlet returned {0}
objects",
                   count.Value);

        // Close the runspace to release any resources.
        myRunSpace.Close();
      }

      System.Console.WriteLine("Hit any key to exit...");
      System.Console.ReadKey();
    }
  }
}
```

See Also

Writing a Windows PowerShell Host Application

Runspace08 Sample

Article • 09/17/2021

This sample shows how to add commands and arguments to the pipeline of a System.Management.Automation.Powershell object and how to run the commands synchronously.

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

This sample demonstrates the following.

- Creating a System.Management.Automation.Runspaces.Runspace object by using the System.Management.Automation.Runspaces.Runspacefactory class.
- Creating a System.Management.Automation.Powershell object that uses the runspace.
- Adding cmdlets to the pipeline of the System.Management.Automation.Powershell object.
- Running the cmdlets synchronously.
- Extracting properties from the System.Management.Automation.PSObject objects returned by the command.

Example

This sample runs the Get-Process and Sort-Object cmdlets by using a System.Management.Automation.Powershell object.

C#

```
namespace Microsoft.Samples.PowerShell.Runspaces
{
  using System;
  using System.Collections.Generic;
  using System.Collections.ObjectModel;
  using System.Management.Automation;
  using System.Management.Automation.Runspaces;
```

```
  using PowerShell = System.Management.Automation.PowerShell;

  /// <summary>
  /// This class contains the Main entry point for this host application.
  /// </summary>
  internal class Runspace08
  {
    /// <summary>
    /// This sample shows how to use a PowerShell object to run commands.
The
    /// PowerShell object builds a pipeline that include the get-process
cmdlet,
    /// which is then piped to the sort-object cmdlet. Parameters are added
to the
    /// sort-object cmdlet to sort the HandleCount property in descending
order.
    /// </summary>
    /// <param name="args">Parameter is not used.</param>
    /// <remarks>
    /// This sample demonstrates:
    /// 1. Creating a PowerShell object
    /// 2. Adding individual commands to the PowerShell object.
    /// 3. Adding parameters to the commands.
    /// 4. Running the pipeline of the PowerShell object synchronously.
    /// 5. Working with PSObject objects to extract properties
    ///    from the objects returned by the commands.
    /// </remarks>
    private static void Main(string[] args)
    {
      Collection<PSObject> results; // Holds the result of the pipeline
execution.

      // Create the PowerShell object. Notice that no runspace is specified
so a
      // new default runspace is used.
      PowerShell powershell = PowerShell.Create();

      // Use the using statement so that we can dispose of the PowerShell
object
      // when we are done.
      using (powershell)
      {
        // Add the get-process cmdlet to the pipeline of the PowerShell
object.
        powershell.AddCommand("get-process");

        // Add the sort-object cmdlet and its parameters to the pipeline of
        // the PowerShell object so that we can sort the HandleCount
property
        //  in descending order.
        powershell.AddCommand("sort-
object").AddParameter("descending").AddParameter("property", "handlecount");

        // Run the commands of the pipeline synchronously.
        results = powershell.Invoke();
```

```
        }

        // Even after disposing of the PowerShell object, we still
        // need to set the powershell variable to null so that the
        // garbage collector can clean it up.
        powershell = null;

        Console.WriteLine("Process             HandleCount");
        Console.WriteLine("-------------------------------");

        // Display the results returned by the commands.
        foreach (PSObject result in results)
        {
          Console.WriteLine(
                           "{0,-20} {1}",
                           result.Members["ProcessName"].Value,
                           result.Members["HandleCount"].Value);
        }

        System.Console.WriteLine("Hit any key to exit...");
        System.Console.ReadKey();
      }
    }
}
```

See Also

Writing a Windows PowerShell Host Application

Runspace09 Sample

Article • 09/17/2021

This sample shows how to add a script to the pipeline of a System.Management.Automation.Powershell object and how to run the script asynchronously. Events are used to handle the output of the script.

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

This sample demonstrates the following.

- Creating a System.Management.Automation.Powershell object that uses the runspace.
- Adding a script the pipeline of the System.Management.Automation.Powershell object.
- Using the System.Management.Automation.Powershell.Begininvoke* method to run the pipeline asynchronously.
- Using the events of the System.Management.Automation.Powershell object to process the output of the script.
- Using the System.Management.Automation.Powershell.Stop* method to interrupt the invocation of the pipeline.

Example

This sample runs to run a script that generates the numbers from 1 to 10 with delays between each number. The script is run asynchronously and events are used to handle the output.

C#

```
namespace Microsoft.Samples.PowerShell.Runspaces
{
  using System;
  using System.Collections.Generic;
```

```
  using System.Collections.ObjectModel;
  using System.Diagnostics;
  using System.Management.Automation;
  using System.Management.Automation.Runspaces;
  using PowerShell = System.Management.Automation.PowerShell;

  /// <summary>
  /// This class contains the Main entry point for this host application.
  /// </summary>
  internal class Runspace09
  {
    /// <summary>
    /// This sample shows how to use a PowerShell object to run a
    /// script that generates the numbers from 1 to 10 with delays
    /// between each number. The pipeline of the PowerShell object
    /// is run asynchronously and events are used to handle the output.
    /// </summary>
    /// <param name="args">The parameter is not used.</param>
    /// <remarks>
    /// This sample demonstrates the following:
    /// 1. Creating a PowerShell object.
    /// 2. Adding a script to the pipeline of the PowerShell object.
    /// 3. Using the BeginInvoke method to run the pipeline asynchronously.
    /// 4. Using the events of the PowerShell object to process the
    ///    output of the script.
    /// 5. Using the PowerShell.Stop() method to interrupt the invocation of
    ///    the pipeline.
    /// </remarks>
    private static void Main(string[] args)
    {
      Console.WriteLine("Print the numbers from 1 to 10. Hit any key to halt
processing\n");

      using (PowerShell powershell = PowerShell.Create())
      {
        // Add a script to the PowerShell object. The script generates the
        // numbers from 1 to 10 in half second intervals.
        powershell.AddScript("1..10 | foreach {$_ ; start-sleep -milli
500}");

        // Add the event handlers.  If we did not care about hooking the
DataAdded
        // event, we would let BeginInvoke create the output stream for us.
        PSDataCollection<PSObject> output = new PSDataCollection<PSObject>
();
        output.DataAdded += new EventHandler<DataAddedEventArgs>
(Output_DataAdded);
        powershell.InvocationStateChanged += new
EventHandler<PSInvocationStateChangedEventArgs>
(Powershell_InvocationStateChanged);

        // Invoke the pipeline asynchronously.
        IAsyncResult asyncResult = powershell.BeginInvoke<PSObject,
PSObject>(null, output);
```

```
        // Wait for things to happen. If the user hits a key before the
        // script has completed, then call the PowerShell Stop() method
        // to halt processing.
        Console.ReadKey();
        if (powershell.InvocationStateInfo.State !=
PSInvocationState.Completed)
        {
          // Stop the invocation of the pipeline.
          Console.WriteLine("\nStopping the pipeline!\n");
          powershell.Stop();

          // Wait for the Windows PowerShell state change messages to be
displayed.
          System.Threading.Thread.Sleep(500);
          Console.WriteLine("\nPress a key to exit");
          Console.ReadKey();
        }
      }
    }

    /// <summary>
    /// The output data added event handler. This event is called when
    /// data is added to the output pipe. It reads the data that is
    /// available and displays it on the console.
    /// </summary>
    /// <param name="sender">The output pipe this event is associated with.
</param>
    /// <param name="e">Parameter is not used.</param>
    private static void Output_DataAdded(object sender, DataAddedEventArgs
e)
    {
      PSDataCollection<PSObject> myp = (PSDataCollection<PSObject>)sender;

      Collection<PSObject> results = myp.ReadAll();
      foreach (PSObject result in results)
      {
        Console.WriteLine(result.ToString());
      }
    }

    /// <summary>
    /// This event handler is called when the pipeline state is changed.
    /// If the state change is to Completed, the handler issues a message
    /// asking the user to exit the program.
    /// </summary>
    /// <param name="sender">This parameter is not used.</param>
    /// <param name="e">The PowerShell state information.</param>
    private static void Powershell_InvocationStateChanged(object sender,
PSInvocationStateChangedEventArgs e)
    {
      Console.WriteLine("PowerShell object state changed: state: {0}\n",
e.InvocationStateInfo.State);
      if (e.InvocationStateInfo.State == PSInvocationState.Completed)
      {
        Console.WriteLine("Processing completed, press a key to exit!");
```

```
        }
      }
    }
  }
```

See Also

Writing a Windows PowerShell Host Application

Runspace10 Sample

Article • 09/17/2021

This sample shows how to create a default initial session state, how to add a cmdlet to the System.Management.Automation.Runspaces.Initialsessionstate, how to create a runspace that uses the initial session state, and how to run the command by using a System.Management.Automation.Powershell object.

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

This sample demonstrates the following.

- Creating an System.Management.Automation.Runspaces.Initialsessionstate object.
- Adding a cmdlet (defined by the Host application) to the System.Management.Automation.Runspaces.Initialsessionstate object.
- Creating a System.Management.Automation.Runspaces.Runspace object that uses the object.
- Creating a System.Management.Automation.Powershell object that uses the System.Management.Automation.Runspaces.Runspace object.
- Adding the command to the pipeline of the System.Management.Automation.Powershell object.
- Extracting properties from the System.Management.Automation.PSObject objects returned by the command.

Example

This sample creates a runspace that uses an System.Management.Automation.Runspaces.Initialsessionstate object to define the elements that are available when the runspace is opened. In this sample, the Get-Proc cmdlet (defined by the Host application) is added to the initial session state, and the cmdlet is run synchronously by using a System.Management.Automation.Powershell object.

C#

```
namespace Microsoft.Samples.PowerShell.Runspaces
{
  using System;
  using System.Collections.Generic;
  using System.Collections.ObjectModel;
  using System.Diagnostics;
  using System.Management.Automation;
  using System.Management.Automation.Runspaces;
  using PowerShell = System.Management.Automation.PowerShell;

  #region GetProcCommand

  /// <summary>
  /// Class that implements the GetProcCommand.
  /// </summary>
  [Cmdlet(VerbsCommon.Get, "Proc")]
  public class GetProcCommand : Cmdlet
  {
    #region Cmdlet Overrides

    /// <summary>
    /// For each of the requested process names, retrieve and write
    /// the associated processes.
    /// </summary>
    protected override void ProcessRecord()
    {
      // Get the current processes.
      Process[] processes = Process.GetProcesses();

      // Write the processes to the pipeline making them available
      // to the next cmdlet. The second argument (true) tells the
      // system to enumerate the array, and send one process object
      // at a time to the pipeline.
      WriteObject(processes, true);
    }

    #endregion Overrides
  } // End GetProcCommand class.

  #endregion GetProcCommand

  /// <summary>
  /// This class contains the Main entry point for this host application.
  /// </summary>
  internal class Runspace10
  {
    /// <summary>
    /// This sample shows how to create a default initial session state, how
to add
    /// add a cmdlet to the InitialSessionState object, and then how to
create
    /// a Runspace object.
```

```
    /// </summary>
    /// <param name="args">Parameter is not used.</param>
    /// This sample demonstrates:
    /// 1. Creating an InitialSessionState object.
    /// 2. Adding a cmdlet to the InitialSessionState object.
    /// 3. Creating a runspace that uses the InitialSessionState object.
    /// 4. Creating a PowerShell object that uses the Runspace object.
    /// 5. Running the added command synchronously.
    /// 6. Working with PSObject objects to extract properties
    ///    from the objects returned by the pipeline.
    private static void Main(string[] args)
    {
      // Create a default InitialSessionState object. The default
      // InitialSessionState object contains all the elements provided
      // by Windows PowerShell.
      InitialSessionState iss = InitialSessionState.CreateDefault();

      // Add the get-proc cmdlet to the InitialSessionState object.
      SessionStateCmdletEntry ssce = new SessionStateCmdletEntry("get-proc",
typeof(GetProcCommand), null);
      iss.Commands.Add(ssce);

      // Create a Runspace object that uses the InitialSessionState object.
      // Notice that no PSHost object is specified, so the default host is
used.
      // See the Hosting samples for information on creating your own custom
host.
      using (Runspace myRunSpace = RunspaceFactory.CreateRunspace(iss))
      {
        myRunSpace.Open();

        using (PowerShell powershell = PowerShell.Create())
        {
          powershell.Runspace = myRunSpace;

          // Add the get-proc cmdlet to the pipeline of the PowerShell
object.
          powershell.AddCommand("get-proc");

          Collection<PSObject> results = powershell.Invoke();

          Console.WriteLine("Process             HandleCount");
          Console.WriteLine("-------------------------------");

          // Display the output of the pipeline.
          foreach (PSObject result in results)
          {
             Console.WriteLine(
                              "{0,-20} {1}",
                              result.Members["ProcessName"].Value,
                              result.Members["HandleCount"].Value);
          }
        }

        // Close the runspace to release resources.
```

```
            myRunSpace.Close();
        }

        System.Console.WriteLine("Hit any key to exit...");
        System.Console.ReadKey();
    }
  }
}
```

See Also

Writing a Windows PowerShell Host Application

Runspace11 Sample

Article • 09/17/2021

This sample shows how to use the System.Management.Automation.Proxycommand class to create a proxy command that calls an existing cmdlet, but restricts the set of available parameters. The proxy command is then added to an initial session state that is used to create a constrained runspace. This means that the user can access the functionality of the cmdlet only through the proxy command.

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

This sample demonstrates the following.

- Creating a System.Management.Automation.Commandmetadata object that describes the metadata of an existing cmdlet.
- Creating an System.Management.Automation.Runspaces.Initialsessionstate object.
- Modifying the cmdlet metadata to remove a parameter of the cmdlet.
- Adding the cmdlet to the System.Management.Automation.Runspaces.Initialsessionstate object and making the cmdlet private.
- Creating a proxy function that calls the existing cmdlet, but exposes only a restricted set of parameters.
- Adding the proxy function to the initial session state.
- Creating a System.Management.Automation.Powershell object that uses the System.Management.Automation.Runspaces.Runspace object.
- Calling the private cmdlet and the proxy function using a System.Management.Automation.Powershell object to demonstrate the constrained runspace.

Example

This creates a proxy command for a private cmdlet to demonstrate a constrained runspace.

C#

```
namespace Microsoft.Samples.PowerShell.Runspaces
{
  using System;
  using System.Collections.Generic;
  using System.Diagnostics;
  using System.Management.Automation;
  using System.Management.Automation.Runspaces;
  using PowerShell = System.Management.Automation.PowerShell;

  #region GetProcCommand

  /// <summary>
  /// This class implements the get-proc cmdlet. It has been copied
  /// verbatim from the GetProcessSample02.cs sample.
  /// </summary>
  [Cmdlet(VerbsCommon.Get, "Proc")]
  public class GetProcCommand : Cmdlet
  {
    #region Parameters

    /// <summary>
    /// The names of the processes to act on.
    /// </summary>
    private string[] processNames;

    /// <summary>
    /// Gets or sets the list of process names on which
    /// the Get-Proc cmdlet will work.
    /// </summary>
    [Parameter(Position = 0)]
    [ValidateNotNullOrEmpty]
    public string[] Name
    {
      get { return this.processNames; }
      set { this.processNames = value; }
    }

    #endregion Parameters

    #region Cmdlet Overrides

    /// <summary>
    /// The ProcessRecord method calls the Process.GetProcesses
    /// method to retrieve the processes specified by the Name
    /// parameter. Then, the WriteObject method writes the
    /// associated processes to the pipeline.
    /// </summary>
    protected override void ProcessRecord()
    {
```

```
      // If no process names are passed to the cmdlet, get all
      // processes.
      if (this.processNames == null)
      {
        WriteObject(Process.GetProcesses(), true);
      }
      else
      {
        // If process names are passed to cmdlet, get and write
        // the associated processes.
        foreach (string name in this.processNames)
        {
          WriteObject(Process.GetProcessesByName(name), true);
        }
      } // if (processNames...
    } // ProcessRecord

    #endregion Cmdlet Overrides
  } // GetProcCommand

  #endregion GetProcCommand

  /// <summary>
  /// This class contains the Main entry point for this host application.
  /// </summary>
  internal class Runspace11
  {
    /// <summary>
    /// This shows how to use the ProxyCommand class to create a proxy
    /// command that calls an existing cmdlet, but restricts the set of
    /// available parameters. The proxy command is then added to an initial
    /// session state that is used to create a constrained runspace. This
    /// means that the user can access the cmdlet only through the proxy
    /// command.
    /// </summary>
    /// <remarks>
    /// This sample demonstrates the following:
    /// 1. Creating a CommandMetadata object that describes the metadata of
an
    ///    existing cmdlet.
    /// 2. Modifying the cmdlet metadata to remove a parameter of the
cmdlet.
    /// 3. Adding the cmdlet to an initial session state and making it
private.
    /// 4. Creating a proxy function that calls the existing cmdlet, but
exposes
    ///    only a restricted set of parameters.
    /// 6. Adding the proxy function to the initial session state.
    /// 7. Calling the private cmdlet and the proxy function to demonstrate
the
    ///    constrained runspace.
    /// </remarks>
    private static void Main()
    {
      // Create a default initial session state. The default initial session
```

```
state
      // includes all the elements that are provided by Windows PowerShell.
      InitialSessionState iss = InitialSessionState.CreateDefault();

      // Add the get-proc cmdlet to the initial session state.
      SessionStateCmdletEntry cmdletEntry = new
SessionStateCmdletEntry("get-proc", typeof(GetProcCommand), null);
      iss.Commands.Add(cmdletEntry);

      // Make the cmdlet private so that it is not accessible.
      cmdletEntry.Visibility = SessionStateEntryVisibility.Private;

      // Set the language mode of the initial session state to NoLanguage to
      //prevent users from using language features. Only the invocation of
      // public commands is allowed.
      iss.LanguageMode = PSLanguageMode.NoLanguage;

      // Create the proxy command using cmdlet metadata to expose the
      // get-proc cmdlet.
      CommandMetadata cmdletMetadata = new
CommandMetadata(typeof(GetProcCommand));

      // Remove one of the parameters from the command metadata.
      cmdletMetadata.Parameters.Remove("Name");

      // Generate the body of a proxy function that calls the original
cmdlet,
      // but does not have the removed parameter.
      string bodyOfProxyFunction = ProxyCommand.Create(cmdletMetadata);

      // Add the proxy function to the initial session state. The name of
the proxy
      // function can be the same as the name of the cmdlet, but to clearly
      // demonstrate that the original cmdlet is not available a different
name is
      // used for the proxy function.
      iss.Commands.Add(new SessionStateFunctionEntry("get-procProxy",
bodyOfProxyFunction));

      // Create the constrained runspace using the initial session state.
      using (Runspace myRunspace = RunspaceFactory.CreateRunspace(iss))
      {
        myRunspace.Open();

        // Call the private cmdlet to demonstrate that it is not available.
        try
        {
          using (PowerShell powershell = PowerShell.Create())
          {
            powershell.Runspace = myRunspace;
            powershell.AddCommand("get-proc").AddParameter("Name",
"*explore*");
            powershell.Invoke();
          }
        }
```

```
        catch (CommandNotFoundException e)
        {
          System.Console.WriteLine(
                        "Invoking 'get-proc' failed as expected: {0}: {1}",
                        e.GetType().FullName,
                        e.Message);
        }

        // Call the proxy function to demonstrate that the -Name parameter
is
        // not available.
        try
        {
          using (PowerShell powershell = PowerShell.Create())
          {
            powershell.Runspace = myRunspace;
            powershell.AddCommand("get-procProxy").AddParameter("Name",
"idle");
            powershell.Invoke();
          }
        }
        catch (ParameterBindingException e)
        {
          System.Console.WriteLine(
                        "\nInvoking 'get-procProxy -Name idle' failed as
expected: {0}: {1}",
                        e.GetType().FullName,
                        e.Message);
        }

        // Call the proxy function to demonstrate that it calls into the
        // private cmdlet to retrieve the processes.
        using (PowerShell powershell = PowerShell.Create())
        {
          powershell.Runspace = myRunspace;
          powershell.AddCommand("get-procProxy");
          List<Process> processes = new List<Process>
(powershell.Invoke<Process>());
          System.Console.WriteLine(
                        "\nInvoking the get-procProxy function called into
the get-proc cmdlet and returned {0} processes",
                        processes.Count);
        }

        // Close the runspace to release resources.
        myRunspace.Close();
      }

      System.Console.WriteLine("Hit any key to exit...");
      System.Console.ReadKey();
    }
  }
}
```

See Also

Writing a Windows PowerShell Host Application

Remote Runspace Samples

Article • 09/17/2021

This section includes sample code that shows how to create runspaces that can be used to connect to a computer by using WS-Management-based Windows PowerShell remoting. You can use Microsoft Visual Studio to create a console application and then copy the code from the topics in this section into your host application.

In This Section

> **Note**
>
> For more information about running commands on a remote computer, see **Windows PowerShell Remoting**.

RemoteRunspace01 Sample This sample shows how to create a remote runspace that is used to establish a remote connection.

RemoteRunspacePool01 Sample This sample shows how to construct a remote runspace pool and how to run multiple commands concurrently by using this pool.

RemoteRunspace01 Sample

Article • 09/17/2021

This sample shows how to create a remote runspace that is used to establish a remote connection.

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

- Creating a System.Management.Automation.Runspaces.Wsmanconnectioninfo object.
- Setting the System.Management.Automation.Runspaces.Runspaceconnectioninfo.Operationtimeout* and System.Management.Automation.Runspaces.Runspaceconnectioninfo.Opentimeout* properties of the System.Management.Automation.Runspaces.Wsmanconnectioninfo object.
- Creating a remote runspace that uses the System.Management.Automation.Runspaces.Wsmanconnectioninfo object to establish the remote connection.
- Closing the remote runspace to release the remote connection.

Example

This sample defines a remote connection and then uses that connection information to establish a remote connection.

C#

```
namespace Microsoft.Samples.PowerShell.Runspaces
{
  using System;
  using System.Management.Automation;             // Windows PowerShell
namespace.
  using System.Management.Automation.Runspaces;   // Windows PowerShell
namespace.
```

```
  /// <summary>
  /// This class contains the Main entry point for the application.
  /// </summary>
  internal class RemoteRunspace01
  {
    /// <summary>
    /// This sample shows how to use a WSManConnectionInfo object to set
    /// various timeouts and how to establish a remote connection.
    /// </summary>
    /// <param name="args">This parameter is not used.</param>
    public static void Main(string[] args)
    {
      // Create a WSManConnectionInfo object using the default constructor
      // to connect to the "localHost". The WSManConnectionInfo object can
      // also specify connections to remote computers.
      WSManConnectionInfo connectionInfo = new WSManConnectionInfo();

      // Set the OperationTimeout property. The OperationTimeout is used to
tell
      // Windows PowerShell how long to wait (in milliseconds) before timing
out
      // for any operation. This includes sending input data to the remote
computer,
      // receiving output data from the remote computer, and more. The user
can
      // change this timeout depending on whether the connection is to a
computer
      // in the data center or across a slow WAN.
      connectionInfo.OperationTimeout = 4 * 60 * 1000; // 4 minutes.

      // Set the OpenTimeout property. OpenTimeout is used to tell Windows
PowerShell
      // how long to wait (in milliseconds) before timing out while
establishing a
      // remote connection. The user can change this timeout depending on
whether the
      // connection is to a computer in the data center or across a slow
WAN.
      connectionInfo.OpenTimeout = 1 * 60 * 1000; // 1 minute.

      // Create a remote runspace using the connection information.
      using (Runspace remoteRunspace =
RunspaceFactory.CreateRunspace(connectionInfo))
      {
        // Establish the connection by calling the Open() method to open the
runspace.
        // The OpenTimeout value set previously will be applied while
establishing
        // the connection. Establishing a remote connection involves sending
and
        // receiving some data, so the OperationTimeout will also play a
role in this process.
        remoteRunspace.Open();
```

```
        // Add the code to run commands in the remote runspace here. The
        // OperationTimeout value set previously will play a role here
because
        // running commands involves sending and receiving data.

        // Close the connection. Call the Close() method to close the remote
        // runspace. The Dispose() method (called by using primitive) will
call
        // the Close() method if it is not already called.
        remoteRunspace.Close();
      }
    }
  }
}
```

RemoteRunspacePool01 Sample

Article • 09/17/2021

This sample shows how to construct a remote runspace pool and how to run multiple commands concurrently by using this pool.

Requirements

This sample requires Windows PowerShell 2.0.

Demonstrates

- Creating a System.Management.Automation.Runspaces.Wsmanconnectioninfo object.
- Setting the System.Management.Automation.Runspaces.Runspaceconnectioninfo.Operationtimeout* and System.Management.Automation.Runspaces.Runspaceconnectioninfo.Opentimeout* properties of the System.Management.Automation.Runspaces.Wsmanconnectioninfo object.
- Creating a remote runspace that uses the System.Management.Automation.Runspaces.Wsmanconnectioninfo object to establish the remote connection.
- Running the Get-Process and Get-Service cmdlets concurrently by using the remote runspace pool.
- Closing the remote runspace pool to release the remote connection.

Example

This sample shows how to construct a remote runspace pool and how to run multiple commands concurrently by using this pool.

C#

```
namespace Samples
{
  using System;
```

```
  using System.Management.Automation;            // Windows PowerShell
namespace.
  using System.Management.Automation.Runspaces;  // Windows PowerShell
namespace.

  /// <summary>
  /// This class contains the Main entry point for the application.
  /// </summary>
  internal class RemoteRunspacePool01
  {
    /// <summary>
    /// This sample shows how to construct a remote RunspacePool and how to
    /// concurrently run the get-process and get-service commands using the
    /// runspaces of the pool.
    /// </summary>
    /// <param name="args">Parameter is not used.</param>
    public static void Main(string[] args)
    {
      // Create a WSManConnectionInfo object using the default constructor
to
      // connect to the "localhost". The WSManConnectionInfo object can also
      // specify connections to remote computers.
      WSManConnectionInfo connectionInfo = new WSManConnectionInfo();

      // Create a remote runspace pool that uses the WSManConnectionInfo
object.
      // The minimum runspaces value of 1 specifies that Windows PowerShell
will
      // keep at least 1 runspace open. The maximum runspaces value of 2
specifies
      // that Windows PowerShell will allows 2 runspaces to be opened at the
      // same time so that two commands can be run concurrently.
      using (RunspacePool remoteRunspacePool =
             RunspaceFactory.CreateRunspacePool(1, 2, connectionInfo))
      {
        // Call the Open() method to open the runspace pool and establish
        // the connection.
        remoteRunspacePool.Open();

        // Call the Create() method to create a pipeline, call the
AddCommand(string)
        // method to add the "get-process" command, and then call the
BeginInvoke()
        // method to run the command asynchronously using a runspace of the
pool.
        PowerShell gpsCommand = PowerShell.Create().AddCommand("get-
process");
        gpsCommand.RunspacePool = remoteRunspacePool;
        IAsyncResult gpsCommandAsyncResult = gpsCommand.BeginInvoke();

        // The previous call does not block the current thread because it is
        // running asynchronously. Because the remote runspace pool can open
two
        // runspaces, the second command can be run.
        PowerShell getServiceCommand = PowerShell.Create().AddCommand("get-
```

```
service");
        getServiceCommand.RunspacePool = remoteRunspacePool;
        IAsyncResult getServiceCommandAsyncResult =
getServiceCommand.BeginInvoke();

        // When you are ready to handle the output, wait for the command to
complete
        // before extracting results. A call to the EndInvoke() method will
block and return
        // the output.
        PSDataCollection<PSObject> gpsCommandOutput =
gpsCommand.EndInvoke(gpsCommandAsyncResult);

        // Process the output from the first command.
        if ((gpsCommandOutput != null) && (gpsCommandOutput.Count > 0))
        {
          Console.WriteLine("The first output from running get-process
command: ");
          Console.WriteLine(
                           "Process Name: {0} Process Id: {1}",

gpsCommandOutput[0].Properties["ProcessName"].Value,
                           gpsCommandOutput[0].Properties["Id"].Value);
          Console.WriteLine();
        }

        // Now process the output from the second command. As discussed
previously, wait
        // for the command to complete before extracting the results.
        PSDataCollection<PSObject> getServiceCommandOutput =
getServiceCommand.EndInvoke(
                                   getServiceCommandAsyncResult);

        // Process the output of the second command as needed.
        if ((getServiceCommandOutput != null) &&
(getServiceCommandOutput.Count > 0))
        {
          Console.WriteLine("The first output from running get-service
command: ");
          Console.WriteLine(
                           "Service Name: {0} Description: {1} State: {2}",

getServiceCommandOutput[0].Properties["ServiceName"].Value,

getServiceCommandOutput[0].Properties["DisplayName"].Value,

getServiceCommandOutput[0].Properties["Status"].Value);
        }

        // Once done with running all the commands, close the remote
runspace pool.
        // The Dispose() method (called by using primitive) will call
Close(), if it
        // is not already called.
        remoteRunspacePool.Close();
```

```
      } // End Using.
    } // End Main.
  } // End RemoteRunspacePool01 class
}
```

See Also

Formatting File Overview

Article • 03/13/2023

The display format for the objects that are returned by commands (cmdlets, functions, and scripts) are defined by using formatting files (format.ps1xml files). Several of these files are provided by PowerShell to define the display format for those objects returned by PowerShell-provided commands, such as the System.Diagnostics.Process object returned by the `Get-Process` cmdlet. However, you can also create your own custom formatting files to overwrite the default display formats or you can write a custom formatting file to define the display of objects returned by your own commands.

> **Important**
>
> Formatting files do not determine the elements of an object that are returned to the pipeline. When an object is returned to the pipeline, all members of that object are available even if some are not displayed.

PowerShell uses the data in these formatting files to determine what is displayed and how the displayed data is formatted. The displayed data can include the properties of an object or the value of a script. Scripts are used if you want to display some value that is not available directly from the properties of an object, such as adding the value of two properties of an object and then displaying the sum as a piece of data. Formatting of the displayed data is done by defining views for the objects that you want to display. You can define a single view for each object, you can define a single view for multiple objects, or you can define multiple views for the same object. There is no limit to the number of views that you can define.

Common Features of Formatting Files

Each formatting file can define the following components that can be shared across all the views defined by the file:

- Default configuration setting, such as whether the data displayed in the rows of tables will be displayed on the next line if the data is longer than the width of the column. For more information about these settings, see Wrap Element for TableRowEntry.
- Sets of objects that can be displayed by any of the views of the formatting file. For more information about these sets (referred to as **selection sets**), see Defining Sets of Objects.

- Common controls that can be used by all the views of the formatting file. Controls give you finer control on how data is displayed. For more information about controls, see Defining Custom Controls.

Formatting Views

Formatting views can display objects in a table format, list format, wide format, and custom format. For the most part, each formatting definition is described by a set of XML tags that describe the view. Each view contains the name of the view, the objects that use the view, and the elements of the view, such as the column and row information for a table view.

Table View

Lists the properties of an object or a script block value in one or more columns. Each column represents a single property of the object or a script value. You can define a table view that displays all the properties of an object, a subset of the properties of an object, or a combination of properties and script values. Each row of the table represents a returned object. Creating a table view is very similar to when you pipe an object to the `Format-Table` cmdlet. For more information about this view, see Table View.

List View

Lists the properties of an object or a script value in a single column. Each row of the list displays an optional label or the property name followed by the value of the property or script. Creating a list view is very similar to piping an object to the `Format-List` cmdlet. For more information about this view, see List View.

Wide View

Lists a single property of an object or a script value in one or more columns. There is no label or header for this view. Creating a wide view is very similar to piping an object to the `Format-Wide` cmdlet. For more information about this view, see Wide View.

Custom View

Displays a customizable view of object properties or script values that does not adhere to the rigid structure of table views, list views, or wide views. You can define a stand-alone custom view, or you can define a custom view that is used by another view, such

as a table view or list view. Creating a custom view is very similar to piping an object to the `Format-Custom` cmdlet. For more information about this view, see Custom View.

Components of a View

The following XML examples show the basic XML components of a view. The individual XML elements vary depending on which view you want to create, but the basic components of the views are all the same.

To start with, each view has a `Name` element that specifies a user friendly name that is used to reference the view. a `ViewSelectedBy` element that defines which .NET objects are displayed by the view, and a **control** element that defines the view.

XML

```
<ViewDefinitions>
  <View>
    <Name>NameOfView</Name>
    <ViewSelectedBy>...</ViewSelectedBy>
    <TableControl>...</TableControl>
  </View>
  <View>
    <Name>NameOfView</Name>
    <ViewSelectedBy>...</ViewSelectedBy>
    <ListControl>...</ListControl>
  <View>
  <View>
    <Name>NameOfView</Name>
    <ViewSelectedBy>...</ViewSelectedBy>
    <WideControl>...</WideControl>
  <View>
  <View>
    <Name>NameOfView</Name>
    <ViewSelectedBy>...</ViewSelectedBy>
    <CustomControl>...</CustomControl>
  </View>
</ViewDefinitions>
```

Within the control element, you can define one or more **entry** elements. If you use multiple definitions, you must specify which .NET objects use each definition. Typically only one entry, with only one definition, is needed for each control.

XML

```
<ListControl>
  <ListEntries>
    <ListEntry>
```

```
      <EntrySelectedBy>...</EntrySelectedBy>
      <ListItems>...</ListItems>
    </ListEntry>
    <ListEntry>
        <EntrySelectedBy>...</EntrySelectedBy>
      <ListItems>...</ListItems>
    </ListEntry>
    <ListEntry>
        <EntrySelectedBy>...</EntrySelectedBy>
      <ListItems>...</ListItems>
    </ListEntry>
  </ListEntries>
</ListControl>
```

Within each entry element of a view, you specify the **item** elements that define the .NET properties or scripts that are displayed by that view.

XML

```
<ListItems>
  <ListItem>...</ListItem>
  <ListItem>...</ListItem>
  <ListItem>...</ListItem>
</ListItems>
```

As shown in the preceding examples, the formatting file can contain multiple views, a view can contain multiple definitions, and each definition can contain multiple items.

Example of a Table View

The following example shows the XML tags used to define a table view that contains two columns. The ViewDefinitions element is the container element for all the views defined in the formatting file. The View element defines the specific table, list, wide, or custom view. Within each View element, the Name element specifies the name of the view, the ViewSelectedBy element defines the objects that use the view, and the different control elements (such as the `TableControl` element shown in the following example) define the type of the view.

XML

```
<ViewDefinitions>
  <View>
    <Name>Name of View</Name>
    <ViewSelectedBy>
      <TypeName>Object to display using this view</TypeName>
```

```
      <TypeName>Object to display using this view</TypeName>
    </ViewSelectedBy>
    <TableControl>
      <TableHeaders>
        <TableColumnHeader>
          <Width></Width>
        </TableColumnHeader>
        <TableColumnHeader>
          <Width></Width>
        </TableColumnHeader>
      </TableHeaders>
      <TableRowEntries>
        <TableRowEntry>
          <TableColumnItems>
            <TableColumnItem>
              <PropertyName>Header for column 1</PropertyName>
            </TableColumnItem>
            <TableColumnItem>
              <PropertyName>Header for column 2</PropertyName>
            </TableColumnItem>
          </TableColumnItems>
        </TableRowEntry>
      </TableRowEntries>
    </TableControl>
  </View>
</ViewDefinitions>
```

See Also

Creating a List View

Creating a Table View

Creating a Wide View

Creating Custom Controls

Writing a PowerShell Formatting and Types File

Formatting File Concepts

Article • 09/17/2021

The topics in this section provide information that you might need to know when creating your own formatting files, such as the different types of views that you can define and the special components of those views.

In This Section

Creating a Table View Provides an example of a displayed table view and the XML elements used to define the view.

Creating a List View Provides an example of a displayed list view and the XML elements used to define the view.

Creating a Wide View Provides an example of a displayed wide view and the XML elements used to define the view.

Creating Custom Controls Provides an example of a custom control.

Defining Selection Sets Provides information, an example, and describes the XML elements used to create a selection set.

Defining Conditions for Displaying Data When defining what data is displayed by a view or a control, you can specify a condition that must exist for the data to be displayed.

Formatting Displayed Data You can specify how the individual data points in your List, Table, or Wide view are displayed.

PowerShell Formatting Files Lists the available formatting files provided by PowerShell.

Creating a Table View

Article • 01/20/2022

A table view displays data in one or more columns. Each row in the table represents a .NET object, and each column of the table represents a property of the object or a script value. You can define a table view that displays all the properties of an object or a subset of the properties of an object.

A Table View Display

The following example shows how Windows PowerShell displays the System.Serviceprocess.Servicecontroller object that is returned by the Get-Service cmdlet. For this object, Windows PowerShell has defined a table view that displays the `Status` property, the `Name` property (this property is an alias property for the `ServiceName` property), and the `DisplayName` property. Each row in the table represents an object returned by the cmdlet.

Output

```
Status   Name               DisplayName
------   ----               -----------
Stopped  AJRouter           AllJoyn Router Service
Stopped  ALG                Application Layer Gateway Service
Stopped  AppIDSvc           Application Identity
Running  Appinfo            Application Information
```

Defining the Table View

The following XML shows the table view schema for displaying the System.Serviceprocess.Servicecontroller?Displayproperty=Fullname object. You must specify each property that you want displayed in the table view.

XML

```
<View>
  <Name>service</Name>
  <ViewSelectedBy>
    <TypeName>System.ServiceProcess.ServiceController</TypeName>
  </ViewSelectedBy>
  <TableControl>
    <TableHeaders>
      <TableColumnHeader>
        <Width>8</Width>
```

```
      </TableColumnHeader>
      <TableColumnHeader>
        <Width>18</Width>
      </TableColumnHeader>
      <TableColumnHeader>
        <Width>38</Width>
      </TableColumnHeader>
    </TableHeaders>
    <TableRowEntries>
      <TableRowEntry>
        <TableColumnItems>
          <TableColumnItem>
           <PropertyName>Status</PropertyName>
          </TableColumnItem>
          <TableColumnItem>
            <PropertyName>Name</PropertyName>
          </TableColumnItem>
          <TableColumnItem>
            <PropertyName>DisplayName</PropertyName>
          </TableColumnItem>
        </TableColumnItems>
      </TableRowEntry>
    </TableRowEntries>
  </TableControl>
</View>
```

The following XML elements are used to define a list view:

- The View element is the parent element of the table view. (This is the same parent element for the list, wide, and custom control views.)
- The Name element specifies the name of the view. This element is required for all views.
- The ViewSelectedBy element defines the objects that use the view. This element is required.
- The GroupBy element (not shown in this example) defines when a new group of objects is displayed. A new group is started whenever the value of a specific property or script changes. This element is optional.
- The Controls element (not shown in this example) defines the custom controls that are defined by the table view. Controls give you a way to further specify how the data is displayed. This element is optional. A view can define its own custom controls, or it can use common controls that can be used by any view in the formatting file. For more information about custom controls, see Creating Custom Controls.

- The HideTableHeaders element (not show in this example) specifies that the table will not show any labels at the top of the table. This element is optional.
- The TableControl element that defines the header and row information of the table. Similar to all other views, a table view can display the values of object properties or values generated by scripts.

Defining Column Headers

1. The TableHeaders element and its child elements define what is displayed at the top of the table.
2. The TableColumnHeader element defines what is displayed at the top of a column of the table. Specify these elements in the order that you want the headers displayed.

   There is no limit to the number of these element that you can use, but the number of TableColumnHeader elements in your table view must equal the number of TableRowEntry elements that you use.
3. The Label element specifies the text that is displayed. This element is optional.
4. The Width element specifies the width (in characters) of the column. This element is optional.
5. The Alignment element specifies how the label is displayed. The label can be aligned to the left, to the right, or centered. This element is optional.

Defining the Table Rows

Table views can provide one or more definitions that specify what data is displayed in the rows of the table by using the child elements of the TableRowEntries element. Notice that you can specify multiple definitions for the rows of the table, but the headers for the rows remains the same, regardless of what row definition is used. Typically, a table will have only one definition.

In the following example, the view provides a single definition that displays the values of several properties of the System.Diagnostics.Process?Displayproperty=Fullname object. A table view can display the value of a property or the value of a script (not shown in the example) in its rows.

```
XML
```

```
<TableRowEntries>
      <TableRowEntry>
        <TableColumnItems>
          <TableColumnItem>
           <PropertyName>Status</PropertyName>
          </TableColumnItem>
          <TableColumnItem>
            <PropertyName>Name</PropertyName>
          </TableColumnItem>
          <TableColumnItem>
            <PropertyName>DisplayName</PropertyName>
          </TableColumnItem>
        </TableColumnItems>
      </TableRowEntry>
    </TableRowEntries>
```

The following XML elements can be used to provide definitions for a row:

- The TableRowEntries element and its child elements define what is displayed in the rows of the table.
- The TableRowEntry element provides a definition of the row. At least one TableRowEntry is required; however, there is no maximum limit to the number of elements that you can add. In most cases, a view will have only one definition.
- The EntrySelectedBy element specifies the objects that are displayed by a specific definition. This element is optional and is needed only when you define multiple TableRowEntry elements that display different objects.
- The Wrap element specifies that text that exceeds the column width is displayed on the next line. By default, text that exceeds the column width is truncated.
- The TableColumnItems element defines the properties or scripts whose values are displayed in the row.
- The TableColumnItem element defines the property or script whose value is displayed in the column of the row. A TableColumnItem element is required for each column of the row. The first entry is displayed in first column, the second entry in the second column, and so on.
- The PropertyName element specifies the property whose value is displayed in the row. You must specify either a property or a script, but you cannot specify both.
- The ScriptBlock element specifies the script whose value is displayed in the row. You must specify either a script or a property, but you cannot specify both.

- The FormatString element specifies a format pattern that defines how the property or script value is displayed. This element is optional.
- The Alignment element specifies how the value of the property or script is displayed. The value can be aligned to the left, to the right, or centered. This element is optional.

Defining the Objects That Use the Table View

There are two ways to define which .NET objects use the table view. You can use the ViewSelectedBy element to define the objects that can be displayed by all the definitions of the view, or you can use the EntrySelectedBy element to define which objects are displayed by a specific definition of the view. In most cases, a view has only one definition, so objects are typically defined by the ViewSelectedBy element.

The following example shows how to define the objects that are displayed by the table view using the ViewSelectedBy and TypeName elements. There is no limit to the number of TypeName elements that you can specify, and their order is not significant.

XML

```
<View>
  <Name>System.ServiceProcess.ServiceController</Name>
  <ViewSelectedBy>
    <TypeName>System.ServiceProcess.ServiceController</TypeName>
  </ViewSelectedBy>
  <TableControl>...</TableControl>
</View>
```

The following XML elements can be used to specify the objects that are used by the table view:

- The ViewSelectedBy element defines which objects are displayed by the list view.
- The TypeName element specifies the .NET object that is displayed by the view. The fully qualified .NET type name is required. You must specify at least one type or selection set for the view, but there is no maximum number of elements that can be specified.

The following example uses the ViewSelectedBy and SelectionSetName elements. Use selection sets where you have a related set of objects that are displayed using multiple views, such as when you define a list view and a table view for the same objects. For more information about how to create a selection set, see Defining Selection Sets.

XML

```
<View>
  <Name>System.ServiceProcess.ServiceController</Name>
  <ViewSelectedBy>
    <SelectionSetName>.NET Type Set</SelectionSetName>
  </ViewSelectedBy>
  <TableControl>...</TableControl>
</View>
```

The following XML elements can be used to specify the objects that are used by the list view:

- The ViewSelectedBy element defines which objects are displayed by the list view.
- The SelectionSetName element specifies a set of objects that can be displayed by the view. You must specify at least one selection set or type for the view, but there is no maximum number of elements that can be specified.

The following example shows how to define the objects displayed by a specific definition of the table view using the EntrySelectedBy element. Using this element, you can specify the .NET type name of the object, a selection set of objects, or a selection condition that specifies when the definition is used. For more information about how to create a selection conditions, see Defining Conditions for Displaying Data.

> **Note**
>
> When creating multiple definitions of the table view you cannot specify different column headers. You can specify only what is displayed in the rows of the table, such as what objects are displayed.

XML

```
<TableRowEntry>
  <EntrySelectedBy>
    <TypeName>.NET Type</TypeName>
  </EntrySelectedBy>
</TableRowEntry>
```

The following XML elements can be used to specify the objects that are used by a specific definition of the list view:

- The EntrySelectedBy element defines which objects are displayed by the definition.

- The TypeName element specifies the .NET object that is displayed by the definition. When using this element, the fully qualified .NET type name is required. You must specify at least one type, selection set, or selection condition for the definition, but there is no maximum number of elements that can be specified.
- The SelectionSetName element (not shown) specifies a set of objects that can be displayed by this definition. You must specify at least one type, selection set, or selection condition for the definition, but there is no maximum number of elements that can be specified.
- The SelectionCondition element (not shown) specifies a condition that must exist for this definition to be used. You must specify at least one type, selection set, or selection condition for the definition, but there is no maximum number of elements that can be specified. For more information about defining selection conditions, see Defining Conditions for Displaying Data.

Using Format Strings

Formatting strings can be added to a view to further define how the data is displayed. The following example shows how to define a formatting string for the value of the `StartTime` property.

XML

```
<TableColumnItem>
  <PropertyName>StartTime</PropertyName>
  <FormatString>{0:MMM} {0:DD} {0:HH}:{0:MM}</FormatString>
</TableColumnItem>
```

The following XML elements can be used to specify a format pattern:

- The TableColumnItem element defines the property or script whose value is displayed in the column of the row. A TableColumnItem element is required for each column of the row. The first entry is displayed in first column, the second entry in the second column, and so on.
- The PropertyName element specifies the property whose value is displayed in the row. You must specify either a property or a script, but you cannot specify both.
- The FormatString element specifies a format pattern that defines how the property or script value is displayed.

In the following example, the `ToString` method is called to format the value of the script. Scripts can call any method of an object. Therefore, if an object has a method, such as `ToString`, that has formatting parameters, the script can call that method to format the output value of the script.

XML

```
<ListItem>
  <ScriptBlock>
    [String]::Format("{0,-10} {1,-8}", $_.LastWriteTime.ToString("d"),
$_.LastWriteTime.ToString("t"))
  </ScriptBlock>
</ListItem>
```

The following XML element can be used to calling the `ToString` method:

- The TableColumnItem element defines the property or script whose value is displayed in the column of the row. A TableColumnItem element is required for each column of the row. The first entry is displayed in first column, the second entry in the second column, and so on.
- The ScriptBlock element specifies the script whose value is displayed in the row. You must specify either a script or a property, but you cannot specify both.

See Also

Writing a PowerShell Formatting File

Creating a List View

Article • 01/20/2022

A list view displays data in a single column (in sequential order). The data displayed in the list can be the value of a .NET property or the value of a script.

A List View Display

The following output shows how Windows PowerShell displays the properties of System.Serviceprocess.Servicecontroller?Displayproperty=Fullname objects that are returned by the Get-Service cmdlet. In this example, three objects were returned, with each object separated from the preceding object by a blank line.

PowerShell

```
Get-Service | format-list
```

Output

```
Name                  : AEADIFilters
DisplayName           : Andrea ADI Filters Service
Status                : Running
DependentServices     : {}
ServicesDependedOn    : {}
CanPauseAndContinue   : False
CanShutdown           : False
CanStop               : True
ServiceType           : Win32OwnProcess

Name                  : AeLookupSvc
DisplayName           : Application Experience
Status                : Running
DependentServices     : {}
ServicesDependedOn    : {}
CanPauseAndContinue   : False
CanShutdown           : False
CanStop               : True
ServiceType           : Win32ShareProcess

Name                  : AgereModemAudio
DisplayName           : Agere Modem Call Progress Audio
Status                : Running
DependentServices     : {}
ServicesDependedOn    : {}
CanPauseAndContinue   : False
CanShutdown           : False
CanStop               : True
```

```
ServiceType         : Win32OwnProcess
...
```

Defining the List View

The following XML shows the list view schema for displaying several properties of the System.Serviceprocess.Servicecontroller?Displayproperty=Fullname object. You must specify each property that you want displayed in the list view.

XML

```
<View>
  <Name>System.ServiceProcess.ServiceController</Name>
  <ViewSelectedBy>
    <TypeName>System.ServiceProcess.ServiceController</TypeName>
  </ViewSelectedBy>
  <ListControl>
    <ListEntries>
      <ListEntry>
        <ListItems>
          <ListItem>
            <PropertyName>Name</PropertyName>
          </ListItem>
          <ListItem>
            <PropertyName>DisplayName</PropertyName>
          </ListItem>
          <ListItem>
            <PropertyName>Status</PropertyName>
          </ListItem>
          <ListItem>
            <PropertyName>ServiceType</PropertyName>
          </ListItem>
        </ListItems>
      </ListEntry>
    </ListEntries>
  </ListControl>
</View>
```

The following XML elements are used to define a list view:

- The View element is the parent element of the list view. (This is the same parent element for the table, wide, and custom control views.)
- The Name element specifies the name of the view. This element is required for all views.
- The ViewSelectedBy element defines the objects that use the view. This element is required.

- The GroupBy element defines when a new group of objects is displayed. A new group is started whenever the value of a specific property or script changes. This element is optional.
- The Controls element defines the custom controls that are defined by the list view. Controls give you a way to further specify how the data is displayed. This element is optional. A view can define its own custom controls, or it can use common controls that can be used by any view in the formatting file. For more information about custom controls, see Creating Custom Controls.
- The ListControl element defines what is displayed in the view and how it is formatted. Similar to all other views, a list view can display the values of object properties or values generated by script.

For an example of a complete formatting file that defines a simple list view, see List View (Basic).

Providing Definitions for Your List View

List views can provide one or more definitions by using the child elements of the ListControl element. Typically, a view will have only one definition. In the following example, the view provides a single definition that displays several properties of the System.Diagnostics.Process?Displayproperty=Fullname object. A list view can display the value of a property or the value of a script (not shown in the example).

XML

```
<ListControl>
    <ListEntries>
      <ListEntry>
        <ListItems>
          <ListItem>
            <PropertyName>Name</PropertyName>
          </ListItem>
          <ListItem>
            <PropertyName>DisplayName</PropertyName>
          </ListItem>
          <ListItem>
            <PropertyName>Status</PropertyName>
          </ListItem>
          <ListItem>
            <PropertyName>ServiceType</PropertyName>
          </ListItem>
        </ListItems>
      </ListEntry>
    </ListEntries>
```

```
    </ListControl>
```

The following XML elements can be used to provide definitions for a list view:

- The ListControl element and its child elements define what is displayed in the view.
- The ListEntries element provides the definitions of the view. In most cases, a view will have only one definition. This element is required.
- The ListEntry element provides a definition of the view. At least one ListEntry is required; however, there is no maximum limit to the number of elements that you can add. In most cases, a view will have only one definition.
- The EntrySelectedBy element specifies the objects that are displayed by a specific definition. This element is optional and is needed only when you define multiple ListEntry elements that display different objects.
- The ListItems element specifies the properties and scripts whose values are displayed in the rows of the list view.
- The ListItem element specifies a property or script whose value is displayed in a row of the list view. A list view must specify at least one property or script. There is no maximum limit to the number of rows that can be specified.
- The PropertyName element specifies the property whose value is displayed in the row. You must specify either a property or a script, but you cannot specify both.
- The ScriptBlock element specifies the script whose value is displayed in the row. You must specify either a script or a property, but you cannot specify both.
- The Label element specifies the label that is displayed to the left of the property or script value in the row. This element is optional. If a label is not specified, the name of the property or the script is displayed. For a complete example, see List View (Labels).
- The ItemSelectionCondition element specifies a condition that must exist for the row to be displayed. For more information about adding conditions to the list view, see Defining Conditions for Displaying Data. This element is optional.
- The FormatString element specifies a pattern that is used to display the value of the property or script. This element is optional.

For an example of a complete formatting file that defines a simple list view, see List View (Basic).

Defining the Objects That Use the List View

There are two ways to define which .NET objects use the list view. You can use the ViewSelectedBy element to define the objects that can be displayed by all the definitions of the view, or you can use the EntrySelectedBy element to define which objects are displayed by a specific definition of the view. In most cases, a view has only one definition, so objects are typically defined by the ViewSelectedBy element.

The following example shows how to define the objects that are displayed by the list view using the ViewSelectedBy and TypeName elements. There is no limit to the number of TypeName elements that you can specify, and their order is not significant.

XML

```
<View>
  <Name>System.ServiceProcess.ServiceController</Name>
  <ViewSelectedBy>
    <TypeName>System.Diagnostics.Process</TypeName>
  </ViewSelectedBy>
  <ListControl>...</ListControl>
</View>
```

The following XML elements can be used to specify the objects that are used by the list view:

- The ViewSelectedBy element defines which objects are displayed by the list view.
- The TypeName element specifies the .NET object that is displayed by the view. The fully qualified .NET type name is required. You must specify at least one type or selection set for the view, but there is no maximum number of elements that can be specified.

For an example of a complete formatting file, see List View (Basic).

The following example uses the ViewSelectedBy and SelectionSetName elements. Use selection sets where you have a related set of objects that are displayed using multiple views, such as when you define a list view and a table view for the same objects. For more information about how to create a selection set, see Defining Selection Sets.

XML

```
<View>
  <Name>System.ServiceProcess.ServiceController</Name>
  <ViewSelectedBy>
    <SelectionSetName>.NET Type Set</SelectionSetName>
  </ViewSelectedBy>
```

```
  <ListControl>...</ListControl>
</View>
```

The following XML elements can be used to specify the objects that are used by the list view:

- The ViewSelectedBy element defines which objects are displayed by the list view.
- The SelectionSetName element specifies a set of objects that can be displayed by the view. You must specify at least one selection set or type for the view, but there is no maximum number of elements that can be specified.

The following example shows how to define the objects displayed by a specific definition of the list view using the EntrySelectedBy element. Using this element, you can specify the .NET type name of the object, a selection set of objects, or a selection condition that specifies when the definition is used. For more information about how to create a selection conditions, see Defining Conditions for Displaying Data.

XML

```
<ListEntry>
  <EntrySelectedBy>
    <TypeName>.NET Type</TypeName>
  </EntrySelectedBy>
</ListEntry>
```

The following XML elements can be used to specify the objects that are used by a specific definition of the list view:

- The EntrySelectedBy element defines which objects are displayed by the definition.
- The TypeName element specifies the .NET object that is displayed by the definition. When using this element, the fully qualified .NET type name is required. You must specify at least one type, selection set, or selection condition for the definition, but there is no maximum number of elements that can be specified.
- The SelectionSetName element (not shown) specifies a set of objects that can be displayed by this definition. You must specify at least one type, selection set, or selection condition for the definition, but there is no maximum number of elements that can be specified.
- The SelectionCondition element (not shown) specifies a condition that must exist for this definition to be used. You must specify at least one type, selection set, or selection condition for the definition, but there is no maximum number of

elements that can be specified. For more information about defining selection conditions, see Defining Conditions for Displaying Data.

Displaying Groups of Objects in a List View

You can separate the objects that are displayed by the list view into groups. This does not mean that you define a group, only that Windows PowerShell starts a new group whenever the value of a specific property or script changes. In the following example, a new group is started whenever the value of the System.Serviceprocess.Servicecontroller.Servicetype property changes.

XML

```
<GroupBy>
  <Label>Service Type</Label>
  <PropertyName>ServiceType</PropertyName>
</GroupBy>
```

The following XML elements are used to define when a group is started:

- The GroupBy element defines the property or script that starts the new group and defines how the group is displayed.
- The PropertyName element specifies the property that starts a new group whenever its value changes. You must specify a property or script to start the group, but you cannot specify both.
- The ScriptBlock element specifies the script that starts a new group whenever its value changes. You must specify a script or property to start the group, but you cannot specify both.
- The Label element defines a label that is displayed at the beginning of each group. In addition to the text specified by this element, Windows PowerShell displays the value that triggered the new group and adds a blank line before and after the label. This element is optional.
- The CustomControl element defines a control that is used to display the data. This element is optional.
- The CustomControlName element specifies a common or view control that is used to display the data. This element is optional.

For an example of a complete formatting file that defines groups, see List View (GroupBy).

Using Format Strings

Formatting strings can be added to a view to further define how the data is displayed. The following example shows how to define a formatting string for the value of the `StartTime` property.

XML

```
<ListItem>
  <PropertyName>StartTime</PropertyName>
  <FormatString>{0:MMM} {0:DD} {0:HH}:{0:MM}</FormatString>
</ListItem>
```

The following XML elements can be used to specify a format pattern:

- The ListItem element specifies the data that is displayed by the view.
- The PropertyName element specifies the property whose value is displayed by the view. You must specify either a property or a script, but you cannot specify both.
- The FormatString element specifies a format pattern that defines how the property or script value is displayed in the view.
- The ScriptBlock element (not shown) specifies the script whose value is displayed by the view. You must specify either a script or a property, but you cannot specify both.

In the following example, the `ToString` method is called to format the value of the script. Scripts can call any method of an object. Therefore, if an object has a method, such as `ToString`, that has formatting parameters, the script can call that method to format the output value of the script.

XML

```
<ListItem>
  <ScriptBlock>
    [String]::Format("{0,-10} {1,-8}", $_.LastWriteTime.ToString("d"),
$_.LastWriteTime.ToString("t"))
  </ScriptBlock>
</ListItem>
```

The following XML element can be used to calling the `ToString` method:

- The ListItem element specifies the data that is displayed by the view.
- The ScriptBlock element (not shown) specifies the script whose value is displayed by the view. You must specify either a script or a property, but you cannot specify both.

See Also

Writing a Windows PowerShell Cmdlet

Creating a Wide View

Article • 03/13/2023

A wide view displays a single value for each object that's displayed. The displayed value can be the value of a .NET object property or the value of a script. By default, there is no label or header for this view.

A Wide View Display

The following example shows how Windows PowerShell displays the System.Diagnostics.Process object that's returned by the Get-Process cmdlet when its output is piped to the Format-Wide cmdlet. (By default, the Get-Process cmdlet returns a table view.) In this example, the two columns are used to display the name of the process for each returned object. The name of the object's property isn't displayed, only the value of the property.

PowerShell

```
Get-Process | format-wide
```

Output

```
AEADISRV                    agrsmsvc
Ati2evxx                    Ati2evxx
audiodg                     CCC
CcmExec                     communicator
Crypserv                    csrss
csrss                       DevDtct2
DM1Service                  dpupdchk
dwm                         DxStudio
EXCEL                       explorer
GoogleToolbarNotifier       GrooveMonitor
hpqwmiex                    hpservice
Idle                        InoRpc
InoRT                       InoTask
ipoint                      lsass
lsm                         MOM
MSASCui                     notepad
...                         ...
```

Defining the Wide View

The following XML shows the wide view schema for the System.Diagnostics.Process object.

```xml
<View>
  <Name>process</Name>
  <ViewSelectedBy>
    <TypeName>System.Diagnostics.Process</TypeName>
  </ViewSelectedBy>
  <GroupBy>...</GroupBy>
  <Controls>...</Controls>
  <WideControl>
    <WideEntries>
      <WideEntry>
        <WideItem>
          <PropertyName>ProcessName</PropertyName>
        </WideItem>
      </WideEntry>
    </WideEntries>
  </WideControl>
</View>
```

The following XML elements are used to define a wide view:

- The View element is the parent element of the wide view. (This is the same parent element for the table, list, and custom control views.)
- The Name element specifies the name of the view. This element is required for all views.
- The ViewSelectedBy element defines the objects that use the view. This element is required.
- The GroupBy element defines when a new group of objects is displayed. A new group is started whenever the value of a specific property or script changes. This element is optional.
- The Controls elements defines the custom controls that are defined by the wide view. Controls give you a way to further specify how the data is displayed. This element is optional. A view can define its own custom controls, or it can use common controls that can be used by any view in the formatting file. For more information about custom controls, see Creating Custom Controls.
- The WideControl element and its child elements define what's displayed in the view. In the preceding example, the view is designed to display the System.Diagnostics.Process.ProcessName property.

For an example of a complete formatting file that defines a simple wide view, see Wide View (Basic).

Providing Definitions for Your Wide View

Wide views can provide one or more definitions by using the child elements of the WideControl element. Typically, a view will have only one definition. In the following example, the view provides a single definition that displays the System.Diagnostics.Process.ProcessName property. A wide view can display the value of a property or the value of a script (not shown in the example).

XML

```
<WideControl>
  <AutoSize/>
  <ColumnNumber></ColumnNumber>
  <WideEntries>
    <WideEntry>
      <WideItem>
        <PropertyName>ProcessName</PropertyName>
      </WideItem>
    </WideEntry>
  </WideEntries>
</WideControl>
```

The following XML elements can be used to provide definitions for a wide view:

- The WideControl element and its child elements define what's displayed in the view.
- The AutoSize element specifies whether the column size and the number of columns are adjusted based on the size of the data. This element is optional.
- The ColumnNumber element specifies the number of columns displayed in the wide view. This element is optional.
- The WideEntries element provides the definitions of the view. In most cases, a view will have only one definition. This element is required.
- The WideEntry element provides a definition of the view. At least one WideEntry is required; however, there is no maximum limit to the number of elements that you can add. In most cases, a view will have only one definition.
- The EntrySelectedBy element specifies the objects that are displayed by a specific definition. This element is optional and is needed only when you define multiple WideEntry elements that display different objects.
- The WideItem element specifies the data that's displayed by the view. In contrast to other types of views, a wide control can display only one item.
- The PropertyName element specifies the property whose value is displayed by the view. You must specify either a property or a script, but you can't specify both.
- The ScriptBlock element specifies the script whose value is displayed by the view. You must specify either a script or a property, but you can't specify both.

- The FormatString element specifies a pattern that's used to display the data. This element is optional.

For an example of a complete formatting file that defines a wide view definition, see Wide View (Basic).

Defining the Objects That Use the Wide View

There are two ways to define which .NET objects use the wide view. You can use the ViewSelectedBy element to define the objects that can be displayed by all the definitions of the view, or you can use the EntrySelectedBy element to define which objects are displayed by a specific definition of the view. In most cases, a view has only one definition, so objects are typically defined by the ViewSelectedBy element.

The following example shows how to define the objects that are displayed by the wide view using the ViewSelectedBy and TypeName elements. There is no limit to the number of TypeName elements that you can specify, and their order isn't significant.

XML

```
<View>
  <Name>System.ServiceProcess.ServiceController</Name>
  <ViewSelectedBy>
    <TypeName>System.Diagnostics.Process</TypeName>
  </ViewSelectedBy>
  <WideControl>...</WideControl>
</View>
```

The following XML elements can be used to specify the objects that are used by the wide view:

- The ViewSelectedBy element defines which objects are displayed by the wide view.
- The TypeName element specifies the .NET that's displayed by the view. The fully qualified .NET type name is required. You must specify at least one type or selection set for the view, but there is no maximum number of elements that can be specified.

For an example of a complete formatting file, see Wide View (Basic).

The following example uses the ViewSelectedBy and SelectionSetName elements. Use selection sets where you have a related set of objects that are displayed using multiple views, such as when you define a wide view and a table view for the same objects. For more information about how to create a selection set, see Defining Selection Sets.

XML

```
<View>
  <Name>System.ServiceProcess.ServiceController</Name>
  <ViewSelectedBy>
    <SelectionSetName>.NET Type Set</SelectionSetName>
  </ViewSelectedBy>
  <WideControl>...</WideControl>
</View>
```

The following XML elements can be used to specify the objects that are used by the wide view:

- The ViewSelectedBy element defines which objects are displayed by the wide view.
- The SelectionSetName element specifies a set of objects that can be displayed by the view. You must specify at least one selection set or type for the view, but there is no maximum number of elements that can be specified.

The following example shows how to define the objects displayed by a specific definition of the wide view using the EntrySelectedBy element. Using this element, you can specify the .NET type name of the object, a selection set of objects, or a selection condition that specifies when the definition is used. For more information about how to create a selection conditions, see Defining Conditions for Displaying Data.

XML

```
<WideEntry>
  <EntrySelectedBy>
    <TypeName>.NET Type</TypeName>
  </EntrySelectedBy>
</WideEntry>
```

The following XML elements can be used to specify the objects that are used by a specific definition of the wide view:

- The EntrySelectedBy element defines which objects are displayed by the definition.
- The TypeName element specifies the .NET that's displayed by the definition. When using this element the fully qualified .NET type name is required. You must specify at least one type, selection set, or selection condition for the definition, but there is no maximum number of elements that can be specified.
- The SelectionSetName element (not shown) specifies a set of objects that can be displayed by this definition. You must specify at least one type, selection set, or selection condition for the definition, but there is no maximum number of elements that can be specified.

- The SelectionCondition element (not shown) specifies a condition that must exist for this definition to be used. You must specify at least one type, selection set, or selection condition for the definition, but there is no maximum number of elements that can be specified. For more information about defining selection conditions, see Defining Conditions for Displaying Data.

Displaying Groups of objects in a Wide View

You can separate the objects that are displayed by the wide view into groups. This doesn't mean that you define a group, only that Windows PowerShell starts a new group whenever the value of a specific property or script changes. In the following example, a new group is started whenever the value of the System.Serviceprocess.Servicecontroller.Servicetype property changes.

XML

```
<GroupBy>
  <Label>Service Type</Label>
  <PropertyName>ServiceType</PropertyName>
</GroupBy>
```

The following XML elements are used to define when a group is started:

- The GroupBy element defines the property or script that starts the new group and defines how the group is displayed.
- The PropertyName element specifies the property that starts a new group whenever its value changes. You must specify a property or script to start the group, but you can't specify both.
- The ScriptBlock element specifies the script that starts a new group whenever its value changes. You must specify a script or property to start the group, but you can't specify both.
- The Label element defines a label that's displayed at the beginning of each group. In addition to the text specified by this element, Windows PowerShell displays the value that triggered the new group and adds a blank line before and after the label. This element is optional.
- The CustomControl element defines a control that's used to display the data. This element is optional.
- The CustomControlName element specifies a common or view control that's used to display the data. This element is optional.

For an example of a complete formatting file that defines groups, see Wide View (GroupBy).

Using Format Strings

Formatting strings can be added to a wide view to further define how the data is displayed. The following example shows how to define a formatting string for the value of the `StartTime` property.

XML

```
<WideItem>
  <PropertyName>StartTime</PropertyName>
  <FormatString>{0:MMM} {0:DD} {0:HH}:{0:MM}</FormatString>
</WideItem>
```

The following XML elements can be used to specify a format pattern:

- The WideItem element specifies the data that's displayed by the view.
- The PropertyName element specifies the property whose value is displayed by the view. You must specify either a property or a script, but you can't specify both.
- The FormatString element specifies a format pattern that defines how the property or script value is displayed in the view
- The ScriptBlock element (not shown) specifies the script whose value is displayed by the view. You must specify either a script or a property, but you can't specify both.

In the following example, the `ToString` method is called to format the value of the script. Scripts can call any method of an object. Therefore, if an object has a method, such as `ToString`, that has formatting parameters, the script can call that method to format the output value of the script.

XML

```
<WideItem>
  <ScriptBlock>
    [String]::Format("{0,-10} {1,-8}", $_.LastWriteTime.ToString("d"),
$_.LastWriteTime.ToString("t"))
  </ScriptBlock>
</WideItem>
```

The following XML element can be used to calling the `ToString` method:

- The WideItem element specifies the data that's displayed by the view.

- The ScriptBlock element (not shown) specifies the script whose value is displayed by the view. You must specify either a script or a property, but you can't specify both.

See Also

- Wide View (Basic)
- Wide View (GroupBy)
- Writing a PowerShell Formatting File

Creating Custom Controls

Article • 09/17/2021

Custom controls are the most flexible components of a formatting file. Unlike table, list, and wide views that define a formal structure of data, such as a table of data, custom controls allow you to define how an individual piece of data is displayed. You can define a common set of custom controls that are available to all the views of the formatting file, you can define custom controls that are available to a specific view, or you can define a set of controls that are available to a group of objects.

Custom Control Example

The following example shows a custom control that is defined in the Certificates.Format.ps1xml file. This custom control is used to separate the System.Management.Automation.Signature objects displayed in a table view.

XML

```
<Controls>
  <Control>
    <Name>SignatureTypes-GroupingFormat</Name>
    <CustomControl>
      <CustomEntries>
        <CustomEntry>
          <CustomItem>
            <Frame>
              <LeftIndent>4</LeftIndent>
              <CustomItem>
                <Text AssemblyName="System.Management.Automation"
BaseName="FileSystemProviderStrings"
                  ResourceId="DirectoryDisplayGrouping"/>
              <ExpressionBinding>
                <ScriptBlock>split-path $_.Path</ScriptBlock>
              </ExpressionBinding>
              <NewLine/>
            </CustomItem>
          </Frame>
        </CustomItem>
      </CustomEntry>
    </CustomEntries>
  </CustomControl>
</Control>
</Controls>
```

See Also

Writing a PowerShell Formatting File

Loading and Exporting Formatting Data

Article • 03/07/2023

Once you've created your formatting file, you need to update the format data of the session by loading your files into the current session. PowerShell loads a predefined set of formats. Once the format data of the current session is updated, PowerShell uses that data to display the .NET objects associated with the views defined in the loaded formats. There's no limit to the number of formats that you can load into the current session. You can also export the format data in the current session back to a formatting file.

Loading format data

Formatting files can be loaded into the current session using the following methods:

- You can import the formatting file into the current session from the command line. Use the Update-FormatData cmdlet as described in the following procedure.
- You can create a module manifest that references your formatting file. Modules allow you to package your formatting files for distribution. Use the New-ModuleManifest cmdlet to create the manifest, and the Import-Module cmdlet to load the module into the current session. For more information about modules, see Writing a Windows PowerShell Module.
- You can create a snap-in that references your formatting file. Use the System.Management.Automation.PSSnapIn.Formats to reference your formatting files. However, best practice recommendation is to use modules to package cmdlets and associated formatting and types files.
- If you're invoking commands programmatically, you can add formatting files to the initial session state of the runspace where the commands are run. For more information, see the System.Management.Automation.Runspaces.SessionStateFormatEntry class.

When a formatting file is loaded, it's added to an internal list that PowerShell uses to choose the view used when displaying objects in the host. You can prepend your formatting file to the beginning of the list, or you can append it to the end of the list.

Knowing where your formatting file is added to this list is important.

- If you're loading a formatting file that defines the only view for an object, you can use any of the methods described previously.

- If you're loading a formatting file that defines a view for an object that has an existing view defined, it must be added to the beginning of the list. You must use the Update-FormatData cmdlet and prepend your file to the beginning of the list.

Storing Your Formatting File

You can store formatting files anywhere on disk. However, it's recommended that you store them in the same folder as your profile script.

Use the following command to determine the location of your profile script.

PowerShell

```
Split-Path -Path $PROFILE -Parent
```

Loading a format file

1. Store your formatting file to disk.
2. Run the Update-FormatData cmdlet using one of the following commands.

   If you're changing how an object is displayed, use the following command to add your formatting file to the front of the list.

   PowerShell

   ```
   Update-FormatData -PrependPath PathToFormattingFile
   ```

   Use the following command to add your formatting file to the end of the list.

   PowerShell

   ```
   Update-FormatData -AppendPath PathToFormattingFile
   ```

   > **Note**
   >
   > Once format data has been loaded in a session it can't be removed. You must open a new session without the format data loaded.

Exporting format data

PowerShell includes format definitions for many .NET types. You can use the Get-FormatData cmdlet to view the format data that's loaded in the current session. You can export the format data for a type to a file using the Export-FormatData cmdlet.

The following commands export the format data for the `System.Guid` type to a file named `System.Guid.format.ps1xml` in the current directory.

PowerShell

```
Get-FormatData System.Guid | Export-FormatData -Path
./System.Guid.format.ps1xml
Get-Content ./System.Guid.format.ps1xml
```

Output

```
<?xml version="1.0" encoding="utf-8"?>
<Configuration>
  <ViewDefinitions>
    <View>
      <Name>System.Guid</Name>
      <ViewSelectedBy>
        <TypeName>System.Guid</TypeName>
      </ViewSelectedBy>
      <TableControl>
        <TableHeaders />
        <TableRowEntries>
          <TableRowEntry>
            <TableColumnItems>
              <TableColumnItem>
                <PropertyName>Guid</PropertyName>
              </TableColumnItem>
            </TableColumnItems>
          </TableRowEntry>
        </TableRowEntries>
      </TableControl>
    </View>
  </ViewDefinitions>
</Configuration>
```

You can edit the exported file create a custom format definition for that type.

Defining Selection Sets

Article • 09/17/2021

When creating multiple views and controls, you can define sets of objects that are referred to as selection sets. A selection set enables you to define the objects one time, without having to define them repeatedly for each view or control. Typically, selection sets are used when you have a set of related .NET objects. For example, The `FileSystem` formatting file (FileSystem.format.ps1xml) defines a selection set of the file system types that several views use.

Where Selection Sets are Defined and Referenced

You define selection sets as part of the common data that can be used by all the views and controls defined in the formatting file. The following example shows how to define three selection sets.

XML

```
<Configuration>
  <SelectionSets>
    <SelectionSet>...</SelectionSet>
    <SelectionSet>...</SelectionSet>
    <SelectionSet>...</SelectionSet>
  </SelectionSets>
</Configuration>
```

You can reference a selection sets in the following ways:

- Each view has a `ViewSelectedBy` element that defines which objects are displayed by using the view. The `ViewSelectedBy` element has a `SelectionSetName` child element that specifies the selection set that all the definitions of the view use. There is no restriction on the number of selection sets that you can reference from a view.

- In each definition of a view or control, the `EntrySelectedBy` element defines which objects are displayed by using that definition. Typically a view or control has only one definition so the objects are defined by the `ViewSelectedBy` element. The `EntrySelectedBy` element of the definition has a `SelectionSetName` child element that specifies the selection set. If you specify the selection set for a definition, you cannot specify any of the other child elements of the `EntrySelectedBy` element.

- In each definition of a view or control, the `SelectionCondition` element can be used to specify a condition for when the definition is used. The `SelectionCondition` element has a `SelectionSetName` child element that specifies the selection set that triggers the condition. The condition is triggered when any of the objects defined in the selection set are displayed. For more information about how to set these conditions, see Defining Conditions for when Data is Displayed.

Selection Set Example

The following example shows a selection set that is taken directly from the `FileSystem` formatting file provided by Windows PowerShell. For more information about other Windows PowerShell formatting files, see Windows PowerShell Formatting Files.

XML

```
<SelectionSets>
  <SelectionSet>
    <Name>FileSystemTypes</Name>
    <Types>
     <TypeName>System.IO.DirectoryInfo</TypeName>
     <TypeName>System.IO.FileInfo</TypeName>
     <TypeName>Deserialized.System.IO.DirectoryInfo</TypeName>
     <TypeName>Deserialized.System.IO.FileInfo</TypeName>
    </Types>
  </SelectionSet>
</SelectionSets>
```

The previous selection set is referenced in the `ViewSelectedBy` element of a table view.

XML

```
<ViewDefinitions>
  <View>
    <Name>Files</Name>
    <ViewSelectedBy>
      <SelectionSetName>FileSystemTypes</SelectionSetName>
    </ViewSelectedBy>
    <TableControl>...</TableControl>
  </View>
</ViewDefinitions>
```

XML Elements

There is no limit to the number of selection sets that you can define. The following XML elements are used to create a selection set.

- The SelectionSets element defines the sets of .NET objects that are referenced by the views and controls of the formatting file.
- The SelectionSet element defines a single set of .NET objects.
- The Name element specifies the name that is used to reference the selection set.
- The Types element specifies the .NET types of the objects of the selection set. (Within formatting files, objects are specified by their .NET type.)

The following XML elements are used to specify a selection set.

- The following element specifies the selection set to use in all the definitions of the view:
  - SelectionSetName Element for ViewSelectedBy (Format)
  - SelectionSetName Element for EntrySelectedBy for GroupBy (Format)
- The following elements specify the selection set used by a single view definition:
  - SelectionSetName Element for EntrySelectedBy for ListControl (Format)
  - SelectionSetName Element for EntrySelectedBy for TableControl (Format)
  - SelectionSetName Element for EntrySelectedBy for WideControl (Format)
  - SelectionSetName Element for EntrySelectedBy for CustomControl for View (Format)
- The following elements specify the selection set used by common and view control definitions:
  - SelectionSetName Element for EntrySelectedBy for Controls for View (Format)
  - SelectionSetName Element for EntrySelectedBy for Controls for Configuration (Format)
- The following elements specify the selection set used when you define which object to expand:
  - SelectionSetName Element for EntrySelectedBy for EnumerableExpansion (Format)
- The following elements specify the selection set used by selection conditions.

- SelectionSetName Element for SelectionCondition for Controls for Configuration (Format)
- SelectionSetName Element for SelectionCondition for Controls for View (Format)
- SelectionSetName Element for SelectionCondition for CustomControl for View (Format)
- SelectionSetName Element for SelectionCondition for EntrySelectedBy for EnumerableExpansion (Format)
- SelectionSetName Element for SelectionCondition for EntrySelectedBy for ListEntry (Format)
- SelectionSetName Element for SelectionCondition for EntrySelectedBy for TableControl (Format)
- SelectionSetName Element for SelectionCondition for EntrySelectedBy for WideEntry (Format)
- SelectionSetName Element for SelectionCondition for GroupBy (Format)

See Also

SelectionSets

SelectionSet

Name

Types

PowerShell Formatting Files

Defining Conditions for when Data is Displayed

Writing a PowerShell Formatting and Types File

Defining Conditions for Displaying Data

Article • 09/17/2021

When defining what data is displayed by a view or a control, you can specify a condition that must exist for the data to be displayed. The condition can be triggered by a specific property, or when a script or property value evaluates to `true`. When the selection condition is met, the definition of the view or control is used.

Specifying a Selection Condition for a Definition

When creating a definition for a view or control, the `EntrySelectedBy` element is used to specify which objects will use the definition or what condition must exist for the definition to be used. The condition is specified by the `SelectionCondition` element.

In the following example, a selection condition is specified for a definition of a table view. In this example, the definition is used only when the specified script is evaluated to `true`.

XML

```
<TableRowEntry>
  <EntrySelectedBy>
    <SelectionCondition>
      <ScriptBlock>ScriptToEvaluate</ScriptBlock>
    </SelectionCondition>
  </EntrySelectedBy>
  <TableColumnItems>
  </TableColumnItems>
</TableRowEntry>
```

There is no limit to the number of selection conditions that you can specify for a definition of a view or control. The only requirements are the following:

- The selection condition must specify one property name or script to trigger the condition, but cannot specify both.
- The selection condition can specify any number of .NET types or selection sets, but cannot specify both.

Specifying a Selection Condition for an Item

You can also specify when an item of a list view or control is used by including the `ItemSelectionCondition` element in the item definition. In the following example, a selection condition is specified for an item of a list view. In this example, the item is used only when the script is evaluated to `true`.

XML

```
<ListItem>
  <ItemSelectionCondition>
    <ScriptBlock>ScriptToEvaluate</ScriptBlock>
  </ItemSelectionCondition>
</ListItem>
```

You can specify only one selection condition for an item. And the condition must specify one property name or script to trigger the condition, but cannot specify both.

XML Elements

The following XML elements are used to create a selection condition.

- The following elements specify selection conditions for view definitions:
  - SelectionCondition Element for EntrySelectedBy for TableControl (Format)
  - SelectionCondition Element for EntrySelectedBy for ListControl (Format)
  - SelectionCondition Element for EntrySelectedBy for WideControl (Format)
  - SelectionCondition Element for EntrySelectedBy for CustomControl (Format)
- The following elements specify selection conditions for common and view control definitions:
  - SelectionCondition Element for EntrySelectedBy for Controls for Configuration (Format)
  - SelectionCondition Element for EntrySelectedBy for Controls for View (Format)
- The following element specifies the selection condition for expanding collection objects:
  - SelectionCondition Element for EntrySelectedBy for EnumerableExpansion (Format)

- The following element specifies the selection condition for displaying a new group of data:
  - SelectionCondition Element for EntrySelectedBy for GroupBy (Format)
- The following element specifies an item selection condition for a list view:
  - ItemSelectionCondition Element for ListItem for ListControl (Format)
- The following elements specify an item selection condition for controls:
  - ItemSelectionCondition Element for ExpressionBinding for Controls for Configuration (Format)
  - ItemSelectionCondition Element for ExpressionBinding for Controls for View (Format)
  - ItemSelectionCondition Element for ExpressionBinding for CustomControl (Format)

See Also

Writing a PowerShell Formatting File

Formatting Displayed Data

Article • 03/13/2023

You can specify how the individual data points in your List, Table, or Wide view are displayed. You can use the `FormatString` element when defining the items of your view, or you can use the `ScriptBlock` element to call the `FormatString` method on the data.

Using the FormatString Element

In the following example the value of the **TotalProcessorTime** property of the System.Diagnostics.Process object is formatted using the FormatString element. the **TotalProcessorTime** property

XML

```
<TableColumnItem>
  <PropertyName>TotalProcessorTime</PropertyName>
  <FormatString>{0:MMM}{0:dd}{0:HH}:{0:mm}</FormatString>
</TableColumnItem>
```

Windows PowerShell Formatting Files

Article • 09/17/2021

Windows PowerShell provides several formatting files (.format.ps1xml) that are located in the installation directory (`$pshome`). Each of these files defines the default display for a specific set of .NET objects. These files should never be changed. However, you can use them as a reference for creating your own custom formatting files.

`Certificate.Format.ps1xml` Defines the display of objects in the Certificate store such as x.509 certificates and certificate stores.

`DotNetTypes.Format.ps1xml` Defines the display of miscellaneous .NET objects such as CultureInfo, FileVersionInfo, and EventLogEntry objects.

`FileSystem.Format.ps1xml` Defines the display of file system objects such as file and directory objects.

`Help.Format.ps1xml` Defines the different views used by the Get-Help cmdlet, such as the detailed, full, parameters, and example views.

`PowerShellCore.Format.ps1xml` Defines the display of the objects generated by Windows PowerShell core cmdlets, such as the objects returned by the Get-Member and Get-History cmdlets.

`PowerShellTrace.Format.ps1xml` Defines the display of trace objects such as those generated by the Trace-Command cmdlet.

`Registry.Format.ps1xml` Defines the display of registry objects such as key and entry objects.

See Also

Writing a Windows PowerShell Cmdlet

How to Create a Formatting File (.format.ps1xml)

Article • 09/17/2021

This topic describes how to create a formatting file (.format.ps1xml).

> **Note**
>
> You can also create a formatting file by making a copy of one of the files provided by Windows PowerShell. If you make a copy of an existing file, delete the existing digital signature, and add your own signature to the new file.

Create a .format.ps1xml file.

1. Create a text file (.txt) using a text editor such as Notepad.

2. Copy the following lines into the formatting file.

   XML

   ```xml
   <?xml version="1.0" encoding="utf-8" ?>
   <Configuration>
   <ViewDefinitions>
   </ViewDefinitions>
   </Configuration>
   ```

   - The `<Configuration></Configuration>` tags define the root `Configuration` node. All additional XML tags will be enclosed within this node.
   - The `<ViewDefinitions></ViewDefinitions>` tags define the `ViewDefinitions` node. All views are defined within this node.

3. Save the file to the Windows PowerShell installation folder, to your module folder, or to a subfolder of the module folder. Use the following name format when you save the file: `MyFile.format.ps1xml`. Formatting files must use the `.format.ps1xml` extension.

   You are now ready to add views to the formatting file. There is no limit to the number of views that can be defined in a formatting file. You can add a single view for each object, multiple views for the same object, or a single view that is used by multiple objects.

See Also

Writing a Windows PowerShell Formatting and Types File

Wide View (Basic)

Article • 09/17/2021

This example shows how to implement a basic wide view that displays the System.Serviceprocess.Servicecontroller?Displayproperty=Fullname objects returned by the `Get-Service` cmdlet. For more information about the components of a wide view, see Creating a Wide View.

Load this formatting file

1. Copy the XML from the Example section of this topic into a text file.
2. Save the text file. Be sure to add the `format.ps1xml` extension to the file to identify it as a formatting file.
3. Open Windows PowerShell, and run the following command to load the formatting file into the current session: `Update-FormatData -PrependPath <PathToFormattingFile>`.

> ⚠ **Warning**
>
> This formatting file defines the display of an object that is already defined by a Windows PowerShell formatting file. You must use the **PrependPath** parameter when you run the cmdlet, and you cannot load this formatting file as a module.

Demonstrates

This formatting file demonstrates the following XML elements:

- The Name element for the view.
- The ViewSelectedBy element that defines what objects are displayed by the view.
- The WideItem element that defines what property is displayed by the view.

Example

The following XML defines a wide view that displays the value of the System.Serviceprocess.Servicecontroller.Servicename property.

XML

```xml
<?xml version="1.0" encoding="utf-8" ?>

<Configuration>
  <ViewDefinitions>
    <View>
      <Name>ServiceWideView</Name>
      <ViewSelectedBy>
        <TypeName>System.ServiceProcess.ServiceController</TypeName>
      </ViewSelectedBy>
      <WideControl>
        <WideEntries>
          <WideEntry>
            <WideItem>
              <PropertyName>ServiceName</PropertyName>
            </WideItem>
          </WideEntry>
        </WideEntries>
      </WideControl>
    </View>
  </ViewDefinitions>
</Configuration>
```

The following example shows how Windows PowerShell displays the System.Serviceprocess.Servicecontroller?Displayproperty=Fullname objects after this format file is loaded.

PowerShell

```powershell
Get-Service f*
```

Output

```
Fax                    FCSAM
fdPHost                FDResPub
FontCache              FontCache3.0.0.0
FSysAgent              FwcAgent
```

See Also

Examples of Formatting Files

Writing a PowerShell Formatting File

Wide View (GroupBy)

Article • 09/17/2021

This example shows how to implement a wide view that displays groups of System.Serviceprocess.Servicecontroller?Displayproperty=Fullname objects returned by the `Get-Service` cmdlet. For more information about the components of a wide view, see Creating a Wide View.

Load this formatting file

1. Copy the XML from the Example section of this topic into a text file.
2. Save the text file. Be sure to add the `format.ps1xml` extension to the file to identify it as a formatting file.
3. Open Windows PowerShell, and run the following command to load the formatting file into the current session: `Update-FormatData -PrependPath <Path to file>`.

> ⚠ **Warning**
>
> This formatting file defines the display of an object that is already defined by a Windows PowerShell formatting files. You must use the **PrependPath** parameter when you run the cmdlet, and you cannot load this formatting file as a module.

Demonstrates

This formatting file demonstrates the following XML elements:

- The Name element for the view.
- The ViewSelectedBy element that defines what objects are displayed by the view.
- The GroupBy element that defines when a new group is displayed.
- The WideItem element that defines what property is displayed by the view.

Example

The following XML defines a wide view that displays groups of objects. Each new group is started when the value of the System.Serviceprocess.Servicecontroller.Servicetype property changes.

XML

```
<?xml version="1.0" encoding="utf-8" ?>

<Configuration>
  <ViewDefinitions>
    <View>
      <Name>ServiceWideView</Name>
      <ViewSelectedBy>
        <TypeName>System.ServiceProcess.ServiceController</TypeName>
      </ViewSelectedBy>
      <GroupBy>
        <Label>Service Type</Label>
        <PropertyName>ServiceType</PropertyName>
      </GroupBy>
      <WideControl>
        <WideEntries>
          <WideEntry>
            <WideItem>
              <PropertyName>ServiceName</PropertyName>
            </WideItem>
          </WideEntry>
        </WideEntries>
      </WideControl>
    </View>
  </ViewDefinitions>
</Configuration>
```

The following example shows how Windows PowerShell displays the System.Serviceprocess.Servicecontroller?Displayproperty=Fullname objects after this format file is loaded.

PowerShell

```
Get-Service f*
```

Output

```
   Service Type: Win32OwnProcess

Fax                           FCSAM

   Service Type: Win32ShareProcess

fdPHost                       FDResPub
FontCache
```

```
   Service Type: Win32OwnProcess

FontCache3.0.0.0                FSysAgent
FwcAgent
```

See Also

Examples of Formatting Files

Writing a PowerShell Formatting File

List View (Basic)

Article • 09/17/2021

This example shows how to implement a basic list view that displays the System.Serviceprocess.Servicecontroller?Displayproperty=Fullname objects returned by the Get-Service cmdlet. For more information about the components of a list view, see Creating a List View.

Load this formatting file

1. Copy the XML from the Example section of this topic into a text file.
2. Save the text file. Be sure to add the `format.ps1xml` extension to the file to identify it as a formatting file.
3. Open Windows PowerShell, and run the following command to load the formatting file into the current session: `Update-formatdata -prependpath PathToFormattingFile`.

> ⚠ **Warning**
>
> This formatting file defines the display of an object that is already defined by a Windows PowerShell formatting file. You must use the `prependPath` parameter when you run the cmdlet, and you cannot load this formatting file as a module.

Demonstrates

This formatting file demonstrates the following XML elements:

- The Name element for the view.
- The ViewSelectedBy element that defines what objects are displayed by the view.
- The ListControl element that defines what property is displayed by the view.
- The ListItem element that defines what is displayed in a row of the list view.
- The PropertyName element that defines which property is displayed.

Example

The following XML defines a list view that displays four properties of the System.Serviceprocess.Servicecontroller?Displayproperty=Fullname object. In each row, the name of the property is displayed followed by the value of the property.

XML

```
<Configuration>
  <View>
    <Name>System.ServiceProcess.ServiceController</Name>
    <ViewSelectedBy>
      <TypeName>System.ServiceProcess.ServiceController</TypeName>
    </ViewSelectedBy>
    <ListControl>
      <ListEntries>
        <ListEntry>
          <ListItems>
            <ListItem>
              <PropertyName>Name</PropertyName>
            </ListItem>
            <ListItem>
              <PropertyName>DisplayName</PropertyName>
            </ListItem>
            <ListItem>
              <PropertyName>Status</PropertyName>
            </ListItem>
            <ListItem>
              <PropertyName>ServiceType</PropertyName>
            </ListItem>
          </ListItems>
        </ListEntry>
      </ListEntries>
    </ListControl>
  </View>
</Configuration>
```

The following example shows how Windows PowerShell displays the System.Serviceprocess.Servicecontroller?Displayproperty=Fullname objects after this format file is loaded.

PowerShell

```
Get-Service f*
```

Output

```
Name        : Fax
DisplayName : Fax
Status      : Stopped
ServiceType : Win32OwnProcess
```

```
Name        : FCSAM
DisplayName : Microsoft Antimalware Service
Status      : Running
ServiceType : Win32OwnProcess

Name        : fdPHost
DisplayName : Function Discovery Provider Host
Status      : Stopped
ServiceType : Win32ShareProcess

Name        : FDResPub
DisplayName : Function Discovery Resource Publication
Status      : Running
ServiceType : Win32ShareProcess

Name        : FontCache
DisplayName : Windows Font Cache Service
Status      : Running
ServiceType : Win32ShareProcess

Name        : FontCache3.0.0.0
DisplayName : Windows Presentation Foundation Font Cache 3.0.0.0
Status      : Stopped
ServiceType : Win32OwnProcess

Name        : FSysAgent
DisplayName : Microsoft Forefront System Agent
Status      : Running
ServiceType : Win32OwnProcess

Name        : FwcAgent
DisplayName : Firewall Client Agent
Status      : Running
ServiceType : Win32OwnProcess
```

See Also

Examples of Formatting Files

Writing a PowerShell Formatting File

List View (Labels)

Article • 09/17/2021

This example shows how to implement a list view that displays a custom label for each row of the list. This list view displays the properties of the System.Serviceprocess.Servicecontroller?Displayproperty=Fullname object that is returned by the Get-Service cmdlet. For more information about the components of a list view, see Creating a List View.

Load this formatting file

1. Copy the XML from the Example section of this topic into a text file.
2. Save the text file. Be sure to add the `format.ps1xml` extension to the file to identify it as a formatting file.
3. Open Windows PowerShell, and run the following command to load the formatting file into the current session: `Update-formatdata -prependpath PathToFormattingFile`.

⚠ Warning

> This formatting file defines the display of an object that is already defined by a Windows PowerShell formatting file. You must use the `prependPath` parameter when you run the cmdlet, and you cannot load this formatting file as a module.

Demonstrates

This formatting file demonstrates the following XML elements:

- The Name element for the view.
- The ViewSelectedBy element that defines what objects are displayed by the view.
- The ListControl element that defines what property is displayed by the view.
- The ListItem element that defines what is displayed in a row of the list view.
- The Label element that defines what is displayed in a row of the list view.
- The PropertyName element that defines which property is displayed.

Example

The following XML defines a list view that displays a custom label in each row. In this case, the label includes the property name with each letter capitalized and the word "property". In each row, the name of the property is displayed followed by the value of the property.

XML

```
<Configuration>
  <ViewDefinitions>
    <View>
  <Name>System.ServiceProcess.ServiceController</Name>
  <ViewSelectedBy>
    <TypeName>System.ServiceProcess.ServiceController</TypeName>
  </ViewSelectedBy>
  <ListControl>
    <ListEntries>
      <ListEntry>
        <ListItems>
          <ListItem>
            <Label>NAME property</Label>
            <PropertyName>Name</PropertyName>
          </ListItem>
          <ListItem>
            <Label>DISPLAYNAME property</Label>
            <PropertyName>DisplayName</PropertyName>
          </ListItem>
          <ListItem>
            <Label>STATUS property</Label>
            <PropertyName>Status</PropertyName>
          </ListItem>
          <ListItem>
            <Label>SERVICETYPE property</Label>
            <PropertyName>ServiceType</PropertyName>
          </ListItem>
        </ListItems>
      </ListEntry>
    </ListEntries>
  </ListControl>
</View>

  </ViewDefinitions>
</Configuration>
```

The following example shows how Windows PowerShell displays the System.Serviceprocess.Servicecontroller?Displayproperty=Fullname objects after this format file is loaded.

PowerShell

```
Get-Service f*
```

Output

```
NAME property        : Fax
DISPLAYNAME property : Fax
STATUS property      : Stopped
SERVICETYPE property : Win32OwnProcess

NAME property        : FCSAM
DISPLAYNAME property : Microsoft Antimalware Service
STATUS property      : Running
SERVICETYPE property : Win32OwnProcess

NAME property        : fdPHost
DISPLAYNAME property : Function Discovery Provider Host
STATUS property      : Stopped
SERVICETYPE property : Win32ShareProcess

NAME property        : FDResPub
DISPLAYNAME property : Function Discovery Resource Publication
STATUS property      : Running
SERVICETYPE property : Win32ShareProcess

NAME property        : FontCache
DISPLAYNAME property : Windows Font Cache Service
STATUS property      : Running
SERVICETYPE property : Win32ShareProcess

NAME property        : FontCache3.0.0.0
DISPLAYNAME property : Windows Presentation Foundation Font Cache 3.0.0.0
STATUS property      : Stopped
SERVICETYPE property : Win32OwnProcess

NAME property        : FSysAgent
DISPLAYNAME property : Microsoft Forefront System Agent
STATUS property      : Running
SERVICETYPE property : Win32OwnProcess

NAME property        : FwcAgent
DISPLAYNAME property : Firewall Client Agent
STATUS property      : Running
SERVICETYPE property : Win32OwnProcess
```

See Also

Examples of Formatting Files

Writing a PowerShell Formatting File

List View (GroupBy)

Article • 09/17/2021

This example shows how to implement a list view that separates the rows of the list into groups. This list view displays the properties of the System.Serviceprocess.Servicecontroller?Displayproperty=Fullname objects returned by the Get-Service cmdlet. For more information about the components of a list view, see Creating a List View.

Load this formatting file

1. Copy the XML from the Example section of this topic into a text file.
2. Save the text file. Be sure to add the `format.ps1xml` extension to the file to identify it as a formatting file.
3. Open Windows PowerShell, and run the following command to load the formatting file into the current session: `Update-formatdata -prependpath PathToFormattingFile`.

> ⚠ **Warning**
>
> This formatting file defines the display of an object that is already defined by a Windows PowerShell formatting file. You must use the `prependPath` parameter when you run the cmdlet, and you cannot load this formatting file as a module.

Demonstrates

This formatting file demonstrates the following XML elements:

- The Name element for the view.
- The ViewSelectedBy element that defines what objects are displayed by the view.
- The GroupBy element that defines how a new group of objects is displayed.
- The ListControl element that defines what property is displayed by the view.
- The ListItem element that defines what is displayed in a row of the list view.
- The PropertyName element that defines which property is displayed.

Example

The following XML defines a list view that starts a new group whenever the value of the System.Serviceprocess.Servicecontroller.Status property changes. When each group is started, a custom label is displayed that includes the new value of the property.

XML

```
<Configuration>
  <ViewDefinitions>
    <View>
      <Name>System.ServiceProcess.ServiceController</Name>
      <ViewSelectedBy>
        <TypeName>System.ServiceProcess.ServiceController</TypeName>
      </ViewSelectedBy>
      <GroupBy>
        <PropertyName>Status</PropertyName>
        <Label>New Service Status</Label>
      </GroupBy>
      <ListControl>
        <ListEntries>
          <ListEntry>
            <ListItems>
              <ListItem>
                <PropertyName>Name</PropertyName>
              </ListItem>
              <ListItem>
                <PropertyName>DisplayName</PropertyName>
              </ListItem>
              <ListItem>
                <PropertyName>ServiceType</PropertyName>
              </ListItem>
            </ListItems>
          </ListEntry>
        </ListEntries>
      </ListControl>
    </View>
  </ViewDefinitions>
</Configuration>
```

The following example shows how Windows PowerShell displays the System.Serviceprocess.Servicecontroller?Displayproperty=Fullname objects after this format file is loaded. The blank lines added before and after the group label are automatically added by Windows PowerShell.

PowerShell

```
Get-Service f*
```

Output

```
   New Service Status: Stopped

Name        : Fax
DisplayName : Fax
ServiceType : Win32OwnProcess

   New Service Status: Running

Name        : FCSAM
DisplayName : Microsoft Antimalware Service
ServiceType : Win32OwnProcess

   New Service Status: Stopped

Name        : fdPHost
DisplayName : Function Discovery Provider Host
ServiceType : Win32ShareProcess

   New Service Status: Running

Name        : FDResPub
DisplayName : Function Discovery Resource Publication
ServiceType : Win32ShareProcess

Name        : FontCache
DisplayName : Windows Font Cache Service
ServiceType : Win32ShareProcess

   New Service Status: Stopped

Name        : FontCache3.0.0.0
DisplayName : Windows Presentation Foundation Font Cache 3.0.0.0
ServiceType : Win32OwnProcess

   New Service Status: Running

Name        : FSysAgent
DisplayName : Microsoft Forefront System Agent
ServiceType : Win32OwnProcess

Name        : FwcAgent
DisplayName : Firewall Client Agent
ServiceType : Win32OwnProcess
```

See Also

Examples of Formatting Files

Writing a PowerShell Formatting File

Format Schema XML Reference

Article • 09/17/2021

The topics in this section describe the XML elements used by formatting files (Format.ps1xml files). Formatting files define how the .NET object is displayed; they do not change the object itself.

In This Section

Alignment Element for TableColumnHeader for TableControl (Format) Defines how the data in a column header is displayed.

Alignment Element for TableColumnItem for TableControl (Format) Defines how the data in the row is displayed.

AutoSize Element for TableControl (Format) Specifies whether the column size and the number of columns are adjusted based on the size of the data.

Autosize Element for WideControl (Format) Specifies whether the column size and the number of columns are adjusted based on the size of the data.

ColumnNumber Element for WideControl (Format) Specifies the number of columns displayed in the wide view.

Configuration Element (Format) Represents the top-level element of the formatting file.

Control Element for Controls for Configuration (Format) Defines a common control that can be used by all the views of the formatting file and the name that is used to reference the control.

Control Element for Controls for View (Format) Defines a control that can be used by the view and the name that is used to reference the control.

Controls Element for Configuration (Format) Defines the common controls that can be used by all views of the formatting file.

Controls Element for View (Format) Defines the view controls that can be used by a specific view.

CustomControl Element for Control for Configuration (Format) Defines a control. This element is used when defining a common control that can be used by all the views in the formatting file.

CustomControl Element for Control for Controls for View (Format) Defines a control that is used by the view.

CustomControl Element for GroupBy (Format) Defines the custom control that displays the new group.

CustomControl Element (Format) Defines a custom control format for the view.

CustomControlName Element for ExpressionBinding for Controls for Configuration (Format) Specifies the name of a common control. This element is used when defining a common control that can be used by all the views in the formatting file.

CustomControlName Element for ExpressionBindine for Controls for View (Format) Specifies the name of a common control or a view control. This element is used when defining controls that can be used by a view.

CustomControlName Element of GroupBy (Format) Specifies the name of a custom control that is used to display the new group. This element is used when defining a table, list, wide or custom control view.

CustomEntry Element for CustomControl for Controls for Configuration (Format) Provides a definition of the common control. This element is used when defining a common control that can be used by all the views in the formatting file.

CustomEntry Element for CustomEntries for Controls for View (Format) Provides a definition of the control. This element is used when defining controls that can be used by a view.

CustomEntry Element for CustomEntries for View (Format) Provides a definition of the custom control view.

CustomEntry Element for CustomControl for GroupBy (Format) Provides a definition of the control. This element is used when defining how a new group of objects is displayed.

CustomEntries Element for CustomControl for Configuration (Format) Provides the definitions of a common control. This element is used when defining a common control that can be used by all the views in the formatting file.

CustomEntries Element for CustomControl for Controls for View (Format) Provides the definitions for the control. This element is used when defining controls that can be used by a view.

CustomEntries Element for CustomControl for GroupBy (Format) Provides the definitions for the control. This element is used when defining how a new group of objects is displayed.

CustomEntries Element for CustomControl for View (Format) Provides the definitions of the custom control view. The custom control view must specify one or more definitions.

CustomItem Element for CustomEntry for Controls for Configuration Defines what data is displayed by the control and how it is displayed. This element is used when defining a common control that can be used by all the views in the formatting file.

CustomItem Element for CustomEntry for Controls for View (Format) Defines what data is displayed by the control and how it is displayed. This element is used when defining controls that can be used by a view.

CustomItem Element for CustomEntry for View (Format) Defines what data is displayed by the custom control view and how it is displayed. This element is used when defining a custom control view.

CustomItem Element for CustomEntry for GroupBy (Format) Defines what data is displayed by the custom control view and how it is displayed. This element is used when defining how a new group of objects is displayed.

DefaultSettings Element (Format) Defines common settings that apply to all the views of the formatting file. Common settings include displaying errors, wrapping text in tables, defining how collections are expanded, and more.

DisplayError Element (Format) Specifies that the string #ERR is displayed when an error occurs displaying a piece of data.

EntrySelectedBy Element for CustomEntry for Controls for Configuration (Format) Defines the .NET types that use the definition of the common control or the condition that must exist for this control to be used. This element is used when defining a common control that can be used by all the views in the formatting file.

EntrySelectedBy Element for CustomEntry for Controls for View (Format) Defines the .NET types that use this control definition or the condition that must exist for this definition to be used. This element is used when defining controls that can be used by a view.

EntrySelectedBy Element for CustomEntry for View (Format) Defines the .NET types that use this custom entry or the condition that must exist for this entry to be used.

EntrySelectedBy Element for EnumerableExpansion (Format) Defines the .NET types that use this definition or the condition that must exist for this definition to be used.

EntrySelectedBy Element for CustomEntry for GroupBy (Format) Defines the .NET types that use this control definition or the condition that must exist for this definition to be used. This element is used when defining how a new group of objects is displayed.

EntrySelectedBy Element for ListEntry for ListControl (Format) Defines the .NET types that use this list view definition or the condition that must exist for this definition to be used. In most cases only one definition is needed for a list view. However, you can provide multiple definitions for the list view if you want to use the same list view to display different data for different objects.

EntrySelectedBy Element for TableRowEntry (Format) Defines the .NET types whose property values are displayed in the row.

EntrySelectedBy Element for WideEntry (Format) Defines the .NET types that use this definition of the wide view or the condition that must exist for this definition to be used.

EnumerableExpansion Element (Format) Defines how specific .NET collection objects are expanded when they are displayed in a view.

EnumerableExpansions Element (Format) Defines how .NET collection objects are expanded when they are displayed in a view.

EnumerateCollection Element for ExpressionBinding for Controls for Configuration (Format) Specified that the elements of collections are displayed by the control. This element is used when defining a common control that can be used by all the views in the formatting file.

EnumerateCollection Element for ExpressionBinding for Controls for View (Format) Specified that the elements of collections are displayed. This element is used when defining controls that can be used by a view.

EnumerateCollection Element for Expression Binding for CustomControl for View (Format) Specifies that the elements of collections are displayed. This element is used when defining a custom control view.

EnumerateCollection Element for ExpressionBinding for GroupBy (Format) Specifies that the elements of collections are displayed. This element is used when defining how a new group of objects is displayed.

Expand Element (Format) Specifies how the collection object is expanded for this definition.

ExpressionBinding Element for CustomItem for Controls for Configuration (Format) Defines the data that is displayed by the control. This element is used when defining a common control that can be used by all the views in the formatting file.

ExpressionBinding Element for CustomItem for Controls for View (Format) Defines the data that is displayed by the control. This element is used when defining controls that can be used by a view.

ExpressionBinding Element for CustomItem for CustomControl for View (Format) Defines the data that is displayed by the control. This element is used when defining a custom control view.

ExpressionBinding Element for CustomItem for GroupBy (Format) Defines the data that is displayed by the control. This element is used when defining how a new group of objects is displayed.

FirstLineHanging Element for Frame for Controls for Configuration (Format) Specifies how many characters the first line of data is shifted to the left. This element is used when defining a common control that can be used by all the views in the formatting file.

FirstLineHanging Element of Frame of Controls of View (Format) Specifies how many characters the first line of data is shifted to the left. This element is used when defining controls that can be used by a view.

FirstLineHanging Element for Frame for CustomControl for View (Format) Specifies how many characters the first line of data is shifted to the left. This element is used when defining a custom control view.

FirstLineHanging Element for Frame for GroupBy (Format) Specifies how many characters the first line of data is shifted to the left. This element is used when defining how a new group of objects is displayed.

FirstLineIndent Element for Frame for Controls for Configuration (Format) Specifies how many characters the first line of data is shifted to the right. This element is used when defining a common control that can be used by all the views in the formatting file.

FirstLineIndent Element of Frame of Controls of View (Format) Specifies how many characters the first line of data is shifted to the right. This element is used when defining controls that can be used by a view.

FirstLineIndent Element Specifies how many characters the first line of data is shifted to the right. This element is used when defining a custom control view.

FirstLineIndent Element for Frame for GroupBy (Format) Specifies how many characters the first line of data is shifted to the right. This element is used when defining how a new group of objects is displayed.

FormatString Element for ListItem (Format) Specifies a format pattern that defines how the property or script value is displayed.

FormatString Element for TableColumnItem (Format) Specifies a format pattern that defines how the property or script value of the table is displayed.

FormatString Element for WideItem for WideControl (Format) Specifies a format pattern that defines how the property or script value is displayed in the view.

Frame Element for CustomItem for Controls for Configuration (Format) Defines how the data is displayed, such as shifting the data to the left or right. This element is used when defining a common control that can be used by all the views in the formatting file.

Frame Element for CustomItem for Controls for View (Format) Defines how the data is displayed, such as shifting the data to the left or right. This element is used when defining controls that can be used by a view.

Frame Element for CustomItem for CustomControl for View (Format) Defines how the data is displayed, such as shifting the data to the left or right. This element is used when defining a custom control view.

Frame Element for CustomItem for GroupBy (Format) Defines how the data is displayed, such as shifting the data to the left or right. This element is used when defining how a new group of objects is displayed.

GroupBy Element for View (Format) Defines how Windows PowerShell displays a new group of objects.

HideTableHeaders Element (Format) Specifies that the headers of the table are not displayed.

ItemSelectionCondition Element for ExpressionBinding for Controls for Configuration (Format) Defines the condition that must exist for this control to be used. This element is used when defining a common control that can be used by all the views in the formatting file.

ItemSelectionCondition Element of ExpressionBinding for Controls for View (Format) Defines the condition that must exist for this control to be used. This element is used when defining controls that can be used by a view.

ItemSelectionCondition Element for Expression Binding for CustomControl for View (Format) Defines the condition that must exist for this control to be used. There is no limit to the number of selection conditions that can be specified for a control item. This element is used when defining a custom control view.

ItemSelectionCondition Element for ExpressionBinding for GroupBy (Format) Defines the condition that must exist for this control to be used. There is no limit to the number of selection conditions that can be specified for a control item. This element is used when defining how a new group of objects is displayed.

ItemSelectionCondition Element for ListItem (Format) Defines the condition that must exist for this list item to be used.

Label Element for ListItem for ListControl(Format) Specifies the label for the property or script value in the row.

Label Element for GroupBy (Format) Specifies a label that is displayed when a new group is encountered.

Label Element for TableColumnHeader (Format) Defines the label that is displayed at the top of a column.

LeftIndent Element for Frame for Controls for Configuration (Format) Specifies how many characters the data is shifted away from the left margin. This element is used when defining a common control that can be used by all the views in the formatting file.

LeftIndent Element of Frame of Controls of View (Format) Specifies how many characters the data is shifted away from the left margin. This element is used when defining controls that can be used by a view.

LeftIndent Element for Frame for CustomControl for View (Format) Specifies how many characters the data is shifted away from the left margin. This element is used when defining a custom control view.

LeftIndent Element for Frame for GroupBy (Format) Specifies how many characters the data is shifted away from the left margin. This element is used when defining how a new group of objects is displayed.

ListControl Element (Format) Defines a list format for the view.

ListEntry Element (Format) Provides a definition of the list view.

ListEntries Element (Format) Defines how the rows of the list view are displayed.

ListItem Element (Format) Defines the property or script whose value is displayed in a row of the list view.

ListItems Element (Format) Defines the properties and scripts that are displayed in the list view.

Name Element for Control for Controls for Configuration (Format) Specifies the name of the control. This element is used when defining a common control that can be used by all the views in the formatting file.

Name Element for SelectionSet (Format) Specifies the name used to reference the selection set.

Name Element for View (Format) Specifies the name that is used to identify the view.

NewLine Element for CustomItem for Controls for Configuration (Format) Adds a blank line to the display of the control. This element is used when defining a common control that can be used by all the views in the formatting file.

NewLine Element for CustomItem for Controls for View (Format) Adds a blank line to the display of the control. This element is used when defining controls that can be used by a view.

NewLine Element for CustomItem for CustomControl for View (Format) Adds a blank line to the display of the control. This element is used when defining a custom control view.

NewLine Element for CustomItem for GroupBy (Format) Adds a blank line to the display of the control. This element is used when defining how a new group of objects is displayed.

PropertyName Element for ExpressionBinding for Controls for Configuration (Format) Specifies the .NET property whose value is displayed by the common control. This element is used when defining a common control that can be used by all the views in the formatting file.

PropertyName Element for ExpressionBinding for Controls for View (Format) Specifies the .NET property whose value is displayed by the control. This element is used when defining controls that can be used by a view.

PropertyName Element for ExpressionBinding for CustomControl for View (Format) Specifies the .NET property whose value is displayed by the control. This element is used when defining a custom control view

PropertyName Element for ExpressionBinding for GroupBy (Format) Specifies the .NET property whose value is displayed by the control. This element is used when defining how a new group of objects is displayed.

PropertyName Element for GroupBy (Format) Specifies the .NET property that starts a new group whenever its value changes.

PropertyName Element for ItemSelectionCondition for Controls for Configuration (Format) Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the control is used. This element is used when defining a common control that can be used by all the views in the formatting file.

PropertyName Element for ItemSelectionCondition for Controls for View (Format)
Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the control is used. This element is used when defining controls that can be used by a view.

PropertyName Element for ItemSelectionCondition for CustomControl for View (Format
Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the control is used. This element is used when defining a custom control view.

PropertyName Element for ItemSelectionCondition for GroupBy (Format) Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the control is used. This element is used when defining how a new group of objects is displayed.

PropertyName Element for ItemSelectionCondition for ListItem (Format) Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the view is used. This element is used when defining a list view.

PropertyName Element for ListItem for ListControl (Format) Specifies the .NET property whose value is displayed in the list.

PropertyName Element for SelectionCondition for EntrySelectedBy for ListEntry (Format)
Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the entry is used. This element is used when defining a common control that can be used by all the views in the formatting file.

PropertyName Element for SelectionCondition for Controls for View (Format) Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the entry is used. This element is used when defining controls that can be used by a view.

PropertyName Element for SelectionCondition for CustomControl for View (Format)
Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the definition is used. This element is used when defining a custom control view.

PropertyName Element for SelectionCondition for EntrySelectedBy for EnumerableExpansion (Format) Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the definition is used.

PropertyName Element for SelectionCondition for GroupBy (Format) Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the definition is used. This element is used when defining how a new group of objects is displayed.

PropertyName Element for SelectionCondition for EntrySelectedBy for ListEntry (Format) Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the list entry is used.

PropertyName Element for SelectionCondition for EntrySelectedBy for TableRowEntry (Format) Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the table entry is used.

PropertyName Element for SelectionCondition for EntrySelectedBy for WideEntry (Format) Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the definition is used.

PropertyName Element for TableColumnItem (Format) Specifies the property whose value is displayed in the column of the row.

PropertyName Element for WideItem (Format) Specifies the property of the object whose value is displayed in the wide view.

RightIndent Element for Frame for Controls for Configuration (Format) Specifies how many characters the data is shifted away from the right margin. This element is used when defining a common control that can be used by all the views in the formatting file.

RightIndent Element of Frame of Controls of View (Format) Specifies how many characters the data is shifted away from the right margin. This element is used when defining controls that can be used by a view.

RightIndent Element Specifies how many characters the data is shifted away from the right margin. This element is used when defining a custom control view.

RightIndent Element for Frame for GroupBy (Format) Specifies how many characters the data is shifted away from the right margin. This element is used when defining how a new group of objects is displayed.

ScriptBlock Element for ExpressionBinding for Controls for Configuration (Format) Specifies the script whose value is displayed by the common control. This element is used when defining a common control that can be used by all the views in the formatting file.

ScriptBlock Element for ExpressionBinding for Controls for View (Format) Specifies the script whose value is displayed by the control. This element is used when defining controls that can be used by a view.

ScriptBlock Element for ExpressionBinding for CustomCustomControl for View (Format) Specifies the script whose value is displayed by the control. This element is used when defining a custom control view.

ScriptBlock Element for ExpressionBinding for GroupBy (Format) Specifies the script whose value is displayed by the control. This element is used when defining how a new group of objects is displayed.

ScriptBlock Element for GroupBy (Format) Specifies the script that starts a new group whenever its value changes.

ScriptBlock Element for ItemSelectionCondition for Controls for Configuration (Format) Specifies the script that triggers the condition. When this script is evaluated to `true`, the condition is met, and the control is used. This element is used when defining a common control that can be used by all the views in the formatting file.

ScriptBlock Element for ItemSelectionCondition for Controls for View (Format) Specifies the script that triggers the condition. When this script is evaluated to `true`, the condition is met, and the control is used. This element is used when defining controls that can be used by a view.

ScriptBlock Element for ItemSelectionCondition for CustomControl for View (Format) Specifies the script that triggers the condition. When this script is evaluated to `true`, the condition is met, and the control is used. This element is used when defining a custom control view.

ScriptBlock Element for ItemSelectionCondition for GroupBy (Format) Specifies the script that triggers the condition. When this script is evaluated to `true`, the condition is met, and the control is used. This element is used when defining how a new group of objects is displayed.

ScriptBlock Element for ItemSelectionCondition for ListControl (Format) Specifies the script that triggers the condition. When this script is evaluated to `true`, the condition is met, and the list item is used. This element is used when defining a list view.

ScriptBlock Element for ListItem (Format) Specifies the script whose value is displayed in the row of the list.

ScriptBlock Element for SelectionCondition for Controls for Configuration (Format) Specifies the script that triggers the condition. When this script is evaluated to `true`, the

condition is met, and the definition is used. This element is used when defining a common control that can be used by all the views in the formatting file.

ScriptBlock Element for SelectionCondition for Controls for View (Format) Specifies the script that triggers the condition. When this script is evaluated to `true`, the condition is met, and the definition is used. This element is used when defining controls that can be used by a view.

ScriptBlock Element for SelectionCondition for CustomControl for View (Format) Specifies the script that triggers the condition. When this script is evaluated to `true`, the condition is met, and the definition is used. This element is used when defining a custom control view.

ScriptBlock Element for SelectionCondition for EntrySelectedBy for EnumerableExpansion (Format) Specifies the script that triggers the condition.

ScriptBlock Element for SelectionCondition for GroupBy (Format) Specifies the script that triggers the condition. When this script is evaluated to `true`, the condition is met, and the definition is used. This element is used when defining how a new group of objects is displayed.

ScriptBlock Element for SelectionCondition for EntrySelectedBy for ListEntry (Format) Specifies the script that triggers the condition. When this script is evaluated to `true`, the condition is met, and the list entry is used.

ScriptBlock Element for SelectionCondition for EntrySelectedBy for TableRowEntry (Format) Specifies the script block that triggers the condition. When this script is evaluated to `true`, the condition is met, and the table entry is used.

ScriptBlock Element for SelectionCondition for EntrySelectedBy for WideEntry (Format) Specifies the script that triggers the condition. When this script is evaluated to `true`, the condition is met, and the wide entry definition is used.

ScriptBlock Element for TableColumnItem (Format) Specifies the script whose value is displayed in the column of the row.

ScriptBlock Element for WideItem (Format) Specifies the script whose value is displayed in the wide view.

SelectionCondition Element for EntrySelectedBy for CustomEntry for Configuration (Format) Defines a condition that must exist for a common control definition to be used. This element is used when defining a common control that can be used by all the views in the formatting file.

SelectionCondition Element for EntrySelectedBy for Controls for View (Format) Defines a condition that must exist for the control definition to be used. This element is used when defining controls that can be used by a view.

SelectionCondition Element for EntrySelectedBy for CustomControl for View (Format) Defines a condition that must exist for a control definition to be used. This element is used when defining a custom control view.

SelectionCondition Element for EntrySelectedBy for EnumerableExpansion (Format) Defines the condition that must exist to expand the collection objects of this definition.

SelectionCondition Element for EntrySelectedBy for GroupBy (Format) Defines a condition that must exist for a control definition to be used. This element is used when defining how a new group of objects is displayed.

SelectionCondition Element for EntrySelectedBy for ListEntry (Format) Defines the condition that must exist to use this definition of the list view. There is no limit to the number of selection conditions that can be specified for a list definition.

SelectionCondition Element for EntrySelectedBy for TableRowEntry (Format) Defines the condition that must exist to use for this definition of the table view. There is no limit to the number of selection conditions that can be specified for a table definition.

SelectionCondition Element for EntrySelectedBy for WideEntry (Format) Defines the condition that must exist for this definition to be used. There is no limit to the number of selection conditions that can be specified for a wide entry definition.

SelectionSet Element (Format) Defines a set of .NET objects that can be referenced by the name of the set.

SelectionSetName Element for EntrySelectedBy for Controls for Configuration (Format) Specifies a set of .NET types that use this definition of the control. This element is used when defining a common control that can be used by all the views in the formatting file.

SelectionSetName Element for EntrySelectedBy for Controls for View (Format) Specifies a set of .NET types that use this definition of the control. This element is used when defining controls that can be used by a view.

SelectionSetName Element for EntrySelectedBy for CustomEntry (Format) Specifies a set of .NET objects for the list entry. There is no limit to the number of selection sets that can be specified for an entry.

SelectionSetName Element for EntrySelectedBy for EnumerableExpansion (Format) Specifies the set of .NET types that are expanded by this definition.

SelectionSetName Element for EntrySelectedBy for GroupBy (Format) Specifies a set of .NET objects for the list entry. There is no limit to the number of selection sets that can be specified for an entry. This element is used when defining how a new group of objects is displayed.

SelectionSetName Element for EntrySelectedBy for ListEntry (Format) Specifies a set of .NET objects for the list entry. There is no limit to the number of selection sets that can be specified for an entry.

SelectionSetName Element for EntrySelectedBy for TableRowEntry (Format) Specifies a set of .NET types the use this entry of the table view. There is no limit to the number of selection sets that can be specified for an entry.

SelectionSetName Element for EntrySelectedBy for WideEntry (Format) Specifies a set of .NET objects for the definition. The definition is used whenever one of these objects is displayed.

SelectionSetName Element for SelectionCondition for Controls for Configuration (Format) Specifies the set of .NET types that trigger the condition. When any of the types in this set are present, the condition is met, and the object is displayed by using this control. This element is used when defining a common control that can be used by all the views in the formatting file.

SelectionSetName Element for SelectionCondition for Controls for View (Format) Specifies the set of .NET types that trigger the condition. When any of the types in this set are present, the condition is met and the object is displayed using this control. This element is used when defining controls that can be used by a view.

EntrySelectedBy Element for CustomEntry for View (Format) Specifies the set of .NET types that trigger the condition. When any of the types in this set are present, the condition is met and the object is displayed using this control. This element is used when defining a custom control view.

SelectionSetName Element for SelectionCondition for EntrySelectedBy for EnumerableExpansion (Format) Specifies the set of .NET types that trigger the condition. When any of the types in this set are present, the condition is met.

SelectionSetName Element for SelectionCondition for GroupBy (Format) Specifies the set of .NET types that trigger the condition. When any of the types in this set are present, the condition is met, and the object is displayed by using this control. This element is used when defining how a new group of objects is displayed.

SelectionSetName Element for SelectionCondition for EntrySelectedBy for ListEntry (Format) Specifies the set of .NET types that trigger the condition. When any of the

types in this set are present, the condition is met, and the object is displayed by using this definition of the list view.

SelectionSetName Element for SelectionCondition for EntrySelectedBy for TableRowEntry (Format) Specifies the set of .NET types that trigger the condition. When any of the types in this set are present, the condition is met, and the object is displayed by using this definition of the table view.

SelectionSetName Element for SelectionCondition for EntrySelectedBy for WideEntry (Format) Specifies the set of .NET types that trigger the condition. When any of the types in this set are present, the condition is met, and the object is displayed by using this definition of the wide view.

SelectionSetName Element for ViewSelectedBy (Format) Specifies a set of .NET objects that are displayed by the view.

SelectionSets Element (Format) Defines the sets of .NET objects that can be used by individual format views.

ShowError Element (Format) Specifies that the full error record is displayed when an error occurs while displaying a piece of data.

TableColumnHeader Element for TableHeaders for TableControl (Format) Defines the label, the width of the column, and the alignment of the label for a column of the table.

TableColumnItem Element (Format) Defines the property or script whose value is displayed in the column of the row.

TableColumnItems Element (Format) Defines the properties or scripts whose values are displayed in the row.

TableControl Element (Format) Defines a table format for a view.

TableHeaders Element (Format) Defines the headers for the columns of a table.

TableRowEntries Element (Format) Defines the rows of the table.

TableRowEntry Element (Format) Defines the data that is displayed in a row of the table.

Text Element for CustomItem for Controls for Configuration (Format) Specifies text that is added to the data that is displayed by the control, such as a label, brackets to enclose the data, and spaces to indent the data. This element is used when defining a common control that can be used by all the views in the formatting file.

Text Element for CustomItem for Controls for View (Format) Specifies text that is added to the data that is displayed by the control, such as a label, brackets to enclose the data,

and spaces to indent the data. This element is used when defining controls that can be used by a view.

Text Element for CustomItem (Format) Specifies text that is added to the data that is displayed by the control, such as a label, brackets to enclose the data, and spaces to indent the data. This element is used when defining a custom control view.

Text Element for CustomItem for GroupBy (Format) Specifies text that is added to the data that is displayed by the control, such as a label, brackets to enclose the data, and spaces to indent the data. This element is used when defining how a new group of objects is displayed.

TypeName Element for EntrySelectedBy for Controls for Configuration (Format) Specifies a .NET type that uses this definition of the control. This element is used when defining a common control that can be used by all the views in the formatting file.

TypeName Element for EntrySelectedBy for Controls for View (Format) Specifies a .NET type that uses this definition of the control. This element is used when defining controls that can be used by a view.

TypeName Element for EntrySelectedBy for CustomEntry for View (Format) Specifies a .NET type that uses this definition of the custom control view. There is no limit to the number of types that can be specified for a definition.

TypeName Element for EntrySelectedBy for EnumerableExpansion (Format) Specifies a .NET type that is expanded by this definition. This element is used when defining a default settings.

TypeName Element for EntrySelectedBy for GroupBy (Format) Specifies a .NET type that uses this definition of the custom control. This element is used when defining how a new group of objects is displayed.

TypeName Element for EntrySelectedBy for ListControl (Format) Specifies a .NET type that uses this entry of the list view. There is no limit to the number of types that can be specified for a list entry.

TypeName Element for EntrySelectedBy for TableRowEntry (Format) Specifies a .NET type that uses this entry of the table view. There is no limit to the number of types that can be specified for a table entry.

TypeName Element for EntrySelectedBy for WideEntry (Format) Specifies a .NET type for the definition. The definition is used whenever this object is displayed.

TypeName Element for SelectionCondition for Controls for Configuration (Format) Specifies a .NET type that triggers the condition. This element is used when defining a

common control that can be used by all the views in the formatting file.

TypeName Element for SelectionCondition for Controls for View (Format) Specifies a .NET type that triggers the condition. This element is used when defining controls that can be used by a view.

TypeName Element for SelectionCondition for CustomControl for View (Format) Specifies a .NET type that triggers the condition. This element is used when defining a custom control view.

TypeName Element for SelectionCondition for EntrySelectedBy for EnumerableExpansion (Format) Specifies a .NET type that triggers the condition.

TypeName Element for SelectionCondition for GroupBy (Format) Specifies a .NET type that triggers the condition. This element is used when defining how a new group of objects is displayed.

TypeName Element for SelectionCondition for EntrySelectedBy for ListControl (Format) Specifies a .NET type that triggers the condition. When this type is present, the list entry is used.

TypeName Element for SelectionCondition for EntrySelectedBy for TableRowEntry (Format) Specifies a .NET type that triggers the condition. When this type is present, the condition is met, and the table row is used.

TypeName Element for SelectionCondition for EntrySelectedBy for WideEntry (Format) Specifies a .NET type that triggers the condition. When this type is present, the definition is used.

TypeName Element for Types (Format) Specifies the .NET type of an object that belongs to the selection set.

TypeName Element for ViewSelectedBy (Format) Specifies a .NET object that is displayed by the view.

Types Element (Format) Defines the .NET objects that are in the selection set.

View Element (Format) Defines a view that is used to display one or more .NET objects.

ViewDefinitions Element (Format) Defines the views used to display objects.

ViewSelectedBy Element (Format) Defines the .NET objects that are displayed by the view.

WideControl Element (Format) Defines a wide (single value) list format for the view. This view displays a single property value or script value for each object.

WideEntries Element (Format) Provides the definitions of the wide view. The wide view must specify one or more definitions.

WideEntry Element (Format) Provides a definition of the wide view.

WideItem Element (Format) Defines the property or script whose value is displayed.

Width Element (Format) Defines the width (in characters) of a column.

Wrap Element (Format) Specifies that text that exceeds the column width is displayed on the next line.

WrapTables Element (Format) Specifies that data in a table cell is moved to the next line if the data is longer than the width of the column.

See Also

Writing a PowerShell Formatting File

Configuration Element

Article • 09/17/2021

Represents the top-level element of a formatting file.

Schema

- Configuration Element

Syntax

XML

```
<Configuration>
  <DefaultSettings>...</DefaultSettings>
  <SelectionSets>...</SelectionSets>
  <Controls>...</Controls>
  <ViewDefinitions>...</ViewDefinitions>
</Configuration>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `Configuration` element. This element must be the root element for each formatting file, and this element must contain at least one child element.

Attributes

None.

Child Elements

Element	Description
Controls Element for Configuration	Optional element. Defines the common controls that can be used by all views of the formatting file.

Element	Description
DefaultSettings Element	Optional element. Defines common settings that apply to all the views of the formatting file.
SelectionSets Element Format	Optional element. Defines the common sets of .NET objects that can be used by all views of the formatting file.
ViewDefinitions Element	Optional element. Defines the views used to display objects.

Parent Elements

None.

Remarks

Formatting files define how objects are displayed. In most cases, this root element contains a ViewDefinitions element that defines the table, list, and wide views of the formatting file. In addition to the view definitions, the formatting file can define common selection sets, settings, and controls that those views can use.

See Also

Controls Element for Configuration

DefaultSettings Element

SelectionSets Element

ViewDefinitions Element

Writing a PowerShell Formatting File

Controls Element for Configuration

Article • 09/17/2021

Defines the common controls that can be used by all views of the formatting file.

Schema

- Configuration Element
- Controls Element

Syntax

XML

```
<Controls>
  <Control>...</Control>
</Controls>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `Controls` element.

Attributes

None.

Child Elements

Element	Description
Control Element for Controls for Configuration	Required element. Defines a common control that can be used by all views of the formatting file.

Parent Elements

Element	Description
Configuration Element	Represents the top-level element of a formatting file.

Remarks

You can create any number of common controls. For each control, you must specify the name that is used to reference the control and the components of the control.

See Also

Configuration Element

Control Element for Controls for Configuration

Writing a PowerShell Formatting File

Control Element for Controls for Configuration

Article • 09/17/2021

Defines a common control that can be used by all the views of the formatting file and the name that is used to reference the control.

Schema

- Configuration Element
- Controls Element
- Control Element

Syntax

XML

```
<Control>
  <Name>NameOfControl</Name>
  <CustomControl>...</CustomControl>
</Control>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element for the `Control` element. You must specify only one of each child element.

Attributes

None.

Child Elements

Element	Description
CustomControl Element for Control for Controls for Configuration	Required element. Defines the control.

Element	Description
Name Element for Control for Configuration	Required element. Specifies the name used to reference the control.

Parent Elements

Element	Description
Controls Element of Configuration	Defines the common controls that can be used by all views of the formatting file or by other controls.

Remarks

The name given to this control can be referenced in the following elements:

- ExpressionBinding Element for CustomItem
- GroupBy Element for View

See Also

Controls Element of Configuration

CustomControl element for Control for Configuration

ExpressionBinding Element for CustomItem

GroupBy Element for View(Format)

Name Element for Control for Controls for Configuration

Writing a PowerShell Formatting File

CustomControl Element for Control for Controls for Configuration

Article • 09/17/2021

Defines a control. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element

Syntax

XML

```
<CustomControl>
  <CustomEntries>...</CustomEntries>
</CustomControl>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `CustomControl` element. This element must have at least one child element. There is no maximum limit to the number of child elements that can be specified.

Attributes

None.

Child Elements

Element	Description

Element	Description
CustomEntries Element for CustomControl for Configuration	Required element. Provides the definitions of a control.

Parent Elements

Element	Description
Control Element for Controls for Configuration	Defines a common control that can be used by all the views of the formatting file and the name that is used to reference the control.

Remarks

See Also

Control Element for Controls for Configuration

CustomEntries Element for CustomControl for Configuration

Writing a PowerShell Formatting File

CustomEntries Element for CustomControl for Controls for Configuration

Article • 09/17/2021

Provides the definitions of a common control. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element

Syntax

XML

```
<CustomEntries>
  <CustomEntry>...</CustomEntry>
</CustomEntries>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `CustomEntries` element. You must specify one or more child elements.

Attributes

None.

Child Elements

Element	Description

Element	Description
CustomEntry Element for CustomControl for Controls for Configuration	Provides a definition of the common control.

Parent Elements

Element	Description
CustomControl Element for Control for Configuration	Defines a common control.

Remarks

In most cases, a control has only one definition, which is defined in a single `CustomEntry` element. However it is possible to have multiple definitions if you want to use the same control to display different .NET objects. In those cases, you can define a `CustomEntry` element for each object or set of objects.

See Also

CustomControl Element for Control for Configuration

CustomEntry Element for CustomControl for Controls for Configuration

Writing a PowerShell Formatting File

CustomEntry Element for CustomControl for Controls for Configuration

Article • 09/17/2021

Provides a definition of the common control. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element

Syntax

XML

```
<CustomEntry>
  <EntrySelectedBy>...</EntrySelectedBy>
  <CustomItem>...</CustomItem>
</CustomEntry>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `CustomEntry` element. You must specify the items displayed by the definition.

Attributes

None.

Child Elements

Element	Description
EntrySelectedBy Element for CustomEntry for Controls for Configuration	Optional element. Defines the .NET types that use the definition of the common control or the condition that must exist for this control to be used.
CustomItem Element for CustomEntry for Controls for Configuration	Required element. Defines what data is displayed by the control and how it is displayed.

Parent Elements

Element	Description
CustomEntries Element for CustomControl for Configuration	Provides the definitions of the common control.

Remarks

In most cases, only one definition is required for each common custom control, but it is possible to have multiple definitions if you want to use the same control to display different .NET objects. In those cases, you can provide a separate definition for each object or set of objects.

See Also

CustomEntries Element for CustomControl for Configuration

CustomItem Element for CustomEntry for Controls for Configuration

Writing a PowerShell Formatting File

CustomItem Element for CustomEntry for Controls for Configuration

Article • 09/17/2021

Defines what data is displayed by the control and how it is displayed. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element

Syntax

XML

```
<CustomItem>
  <ExpressionBinding>...</ExpressionBinding>
  <NewLine/>
  <Text>TextToDisplay</Text>
  <Frame>...</Frame>
</CustomItem>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `CustomItem` element. For more information, see Remarks.

Attributes

None.

Child Elements

Element	Description
ExpressionBinding Element for CustomItem for Controls for Configuration	Optional element. Defines the data that is displayed by the control.
Frame Element for CustomItem for Controls for Configuration	Optional element. Defines how the data is displayed, such as shifting the data to the left or right.
NewLine Element for CustomItem for Controls for Configuration	Optional element. Adds a blank line to the display of the control.
Text Element for CustomItem for Controls for Configuration	Optional element. Adds text, such as parentheses or brackets, to the display of the control.

Parent Elements

Element	Description
CustomEntry Element for CustomControl for Controls for Configuration	Provides a definition of the control.

Remarks

When specifying the child elements of the `CustomItem` element, keep the following in mind:

- The child elements must be added in the following sequence: `ExpressionBinding`, `NewLine`, `Text`, and `Frame`.
- There is no maximum limit to the number of sequences that you can specify.
- In each sequence, there is no maximum limit to the number of `ExpressionBinding` elements that you can use.

See Also

ExpressionBinding Element for CustomItem for Controls for Configuration

Frame Element for CustomItem for Controls for Configuration

NewLine Element for CustomItem for Controls for Configuration

Text Element for CustomItem for Controls for Configuration

Writing a PowerShell Formatting File

ExpressionBinding Element for CustomItem for Controls for Configuration

Article • 09/17/2021

Defines the data that is displayed by the control. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element

Syntax

XML

```
<ExpressionBinding>
  <CustomControl>...</CustomControl>
  <CustomControlName>NameofCommonCustomControl</CustomControlName>
  <EnumerateCollection/>
  <ItemSelectionCondition>...</ItemSelectionCondition>
  <PropertyName>Nameof.NetTypeProperty</PropertyName>
  <ScriptBlock>ScriptToEvaluate></ScriptBlock>
</ExpressionBinding>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ExpressionBinding` element.

Attributes

None.

Child Elements

Element	Description
`CustomControl Element`	Optional element. Defines a control that is used by this control.
CustomControlName Element for ExpressionBinding for Controls for Configuration	Optional element. Specifies the name of a common control or a view control.
EnumerateCollection Element for ExpressionBinding for Controls for Configuration	Optional element. Specified that the elements of collections are displayed by the control.
ItemSelectionCondition Element for ExpressionBinding for Controls for Configuration	Optional element. Defines the condition that must exist for this common control to be used.
PropertyName Element for ExpressionBinding for Controls for Configuration	Optional element. Specifies the .NET property whose value is displayed by the common control.
ScriptBlock Element for ExpressionBinding for Controls for Configuration	Optional element. Specifies the script whose value is displayed by the common control.

Parent Elements

Element	Description
CustomItem Element for CustomEntry for Controls for Configuration	Defines what data is displayed by the custom control view and how it is displayed.

Remarks

See Also

CustomItem Element for CustomEntry for Controls for Configuration

Writing a PowerShell Formatting File

CustomControlName Element for ExpressionBinding for Controls for Configuration

Article • 09/17/2021

Specifies the name of a common control. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- CustomControlName Element

Syntax

XML

```
<CustomControlName>NameofCustomControl</CustomControlName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `CustomControlName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ExpressionBinding Element for CustomItem for Controls for Configuration	Defines the data that is displayed by the control.

Text Value

Specify the name of the control.

Remarks

You can create common controls that can be used by all the views of a formatting file, and you can create view controls that can be used by a specific view. The following elements specify the names of these controls:

- Name Element for Control for Controls for Configuration
- Name Element for Control for Controls for View

See Also

Name Element for Control for Controls for Configuration

Name Element for Control for Controls for View

ExpressionBinding Element for CustomItem for Controls for Configuration

Writing a PowerShell Formatting File

EnumerateCollection Element for ExpressionBinding for Controls for Configuration

Article • 09/17/2021

Specified that the elements of collections are displayed by the control. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- EnumerateCollection Element

Syntax

XML

```
<EnumerateCollection/>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `EnumerateCollection` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ExpressionBinding Element for CustomItem for Controls for Configuration	Defines the data that is displayed by the control.

Remarks

See Also

ExpressionBinding Element for CustomItem for Controls for Configuration

Writing a PowerShell Formatting File

ItemSelectionCondition Element for ExpressionBinding for Controls for Configuration

Article • 09/17/2021

Defines the condition that must exist for this control to be used. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- ItemSelectionCondition Element

Syntax

XML

```
<ItemSelectionCondition>
  <PropertyName>.NetTypeProperty</PropertyName>
  <ScriptBlock>ScriptToEvaluate</ScriptBlock>
</ItemSelectionCondition>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ItemSelectionCondition` element.

Attributes

None.

Child Elements

Element	Description
PropertyName Element for ItemSelectionCondition for Controls for Configuration	Optional element. Specifies the .NET property that triggers the condition.
ScriptBlock Element for ItemSelectionCondition for Controls for Configuration	Optional element. Specifies the script that triggers the condition.

Parent Elements

Element	Description
ExpressionBinding Element for CustomItem for Controls for Configuration	Defines the data that is displayed by the control.

Remarks

You can specify one property name or a script for this condition but cannot specify both.

See Also

PropertyName Element for ItemSelectionCondition for Controls for Configuration

ScriptBlock Element for ItemSelectionCondition for Controls for Configuration

ExpressionBinding Element for CustomItem for Controls for Configuration

Writing a PowerShell Formatting File

PropertyName Element for ItemSelectionCondition for Controls for Configuration

Article • 09/17/2021

Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the control is used. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- ItemSelectionCondition Element
- PropertyName Element

Syntax

XML

```
<PropertyName>.NetTypeProperty</PropertyName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `PropertyName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ItemSelectionCondition Element for ExpressionBinding for Controls for Configuration	Defines the condition that must exist for this control to be used.

Text Value

Specify the name of the .NET property that triggers the condition.

Remarks

If this element is used, you cannot specify the ScriptBlock element when defining the selection condition.

See Also

ScriptBlock Element for ItemSelectionCondition for Controls for Configuration

ItemSelectionCondition Element for ExpressionBinding for Controls for Configuration

Writing a PowerShell Formatting File

ScriptBlock Element for ItemSelectionCondition for Controls for Configuration

Article • 09/17/2021

Specifies the script that triggers the condition. When this script is evaluated to `true`, the condition is met, and the control is used. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- ItemSelectionCondition Element
- ScriptBlock Element

Syntax

XML

```
<ScriptBlock>ScriptToEvaluate</ScriptBlock>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ScriptBlock` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ItemSelectionCondition Element for ExpressionBinding for Controls for Configuration	Defines the condition that must exist for this control to be used.

Text Value

Specify the script that is evaluated.

Remarks

If this element is used, you cannot specify the PropertyName element when defining the selection condition.

See Also

PropertyName Element for ItemSelectionCondition for Controls for Configuration

ItemSelectionCondition Element for ExpressionBinding for Controls for Configuration

Writing a PowerShell Formatting File

PropertyName Element for ExpressionBinding for Controls for Configuration

Article • 09/17/2021

Specifies the .NET property whose value is displayed by the common control. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding
- PropertyName Element

Syntax

XML

```
<PropertyName>.NetTypeProperty</PropertyName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `PropertyName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ExpressionBinding Element for CustomItem for Controls for Configuration	Defines the data that is displayed by the control.

Text Value

Specify the name of the .NET property whose value is displayed by the control.

Remarks

See Also

ExpressionBinding Element for CustomItem for Controls for Configuration

Writing a PowerShell Formatting File

ScriptBlock Element for ExpressionBinding for Controls for Configuration

Article • 09/17/2021

Specifies the script whose value is displayed by the common control. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- ScriptBlock Element

Syntax

XML

```
<ScriptBlock>ScriptToEvaluate</ScriptBlock>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ScriptBlock` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ExpressionBinding Element for CustomItem for Controls for Configuration	Defines the data that is displayed by the common control.

Text Value

Specify the script whose value is displayed by the control.

Remarks

See Also

ExpressionBinding Element for CustomItem for Controls for Configuration

Writing a PowerShell Formatting File

Frame Element for CustomItem for Controls for Configuration

Article • 09/17/2021

Defines how the data is displayed, such as shifting the data to the left or right. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Frame Element

Syntax

XML

```
<Frame>
  <LeftIndent>NumberOfCharactersToShift</LeftIndent>
  <RightIndent>NumberOfCharactersToShift</RightIndent>
  <FirstLineHanging>NumberOfCharactersToShift</FirstLineHanging>
  <FirstLineIndent>NumberOfCharactersToShift</FirstLineIndent>
  <CustomItem>...</CustomItem>
</Frame>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `Frame` element.

Attributes

None.

Child Elements

Element	Description
`CustomItem Element`	Required Element
FirstLineHanging Element for Frame for Controls for Configuration	Optional element. Specifies how many characters the first line of data is shifted to the left.
FirstLineIndent Element for Frame for Controls for Configuration	Optional element. Specifies how many characters the first line of data is shifted to the right.
LeftIndent Element for Frame for Controls for Configuration	Optional element. Specifies how many characters the data is shifted away from the left margin.
RightIndent Element for Frame for Controls for Configuration	Optional element. Specifies how many characters the data is shifted away from the right margin.

Parent Elements

Element	Description
CustomItem Element for CustomEntry for Controls for Configuration	Defines what data is displayed by the control and how it is displayed.

Remarks

You cannot specify the FirstLineHanging and the FirstLineIndent elements in the same `Frame` element.

See Also

FirstLineHanging Element for Frame for Controls for Configuration

FirstLineIndent Element for Frame for Controls for Configuration

LeftIndent Element for Frame for Controls for Configuration

RightIndent Element for Frame for Controls for Configuration

CustomItem Element for CustomEntry for Controls for Configuration

Writing a PowerShell Formatting File

FirstLineHanging Element for Frame for Controls for Configuration

Article • 09/17/2021

Specifies how many characters the first line of data is shifted to the left. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Frame Element
- FirstLineHanging Element

Syntax

XML

```
<FirstLineHanging>NumberOfCharactersToShift</FirstLineHanging>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `FirstLineHanging` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
Frame Element for CustomItem for Controls for Configuration	Defines how the data is displayed, such as shifting the data to the left or right.

Text Value

Specify the number of characters that you want to shift the first line of the data.

Remarks

If this element is specified, you cannot specify the `FirstLineIndent` element.

See Also

Frame Element for CustomItem for Controls for Configuration

Writing a PowerShell Formatting File

FirstLineIndent Element for Frame for Controls for Configuration

Article • 09/17/2021

Specifies how many characters the first line of data is shifted to the right. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Frame Element
- FirstLineIndent Element

Syntax

XML

```
<FirstLineIndent>NumberOfCharactersToShift</FirstLineIndent>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `FirstLineIndent` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
Frame Element for CustomItem for Controls for Configuration	Defines how the data is displayed, such as shifting the data to the left or right.

Text Value

Specify the number of characters that you want to shift the first line of the data.

Remarks

If this element is specified, you cannot specify the FirstLineHanging element.

See Also

FirstLineHanging Element for Frame for Controls for Configuration

Frame Element for CustomItem for Controls for Configuration

Writing a PowerShell Formatting File

LeftIndent Element for Frame for Controls for Configuration

Article • 09/17/2021

Specifies how many characters the data is shifted away from the left margin. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Frame Element
- LeftIndent Element

Syntax

XML

```
<LeftIndent>CharactersToShift</LeftIndent>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `LeftIndent` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
Frame Element for CustomItem for Controls for Configuration	Defines how the data is displayed, such as shifting the data to the left or right.

Text Value

Specify the number of characters that you want to shift the data to the left.

Remarks

See Also

Frame Element for CustomItem for Controls for Configuration

Writing a PowerShell Formatting File

RightIndent Element for Frame for Controls for Configuration

Article • 09/17/2021

Specifies how many characters the data is shifted away from the right margin. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Frame Element
- RightIndent Element

Syntax

XML

```
<RightIndent>CharactersToShift</RightIndent>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `RightIndent` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
Frame Element for CustomItem for Controls for Configuration	Defines how the data is displayed, such as shifting the data to the left or right.

Text Value

Specify the number of characters that you want to shift the data to the right.

Remarks

See Also

Frame Element for CustomItem for Controls for Configuration

Writing a PowerShell Formatting File

NewLine Element for CustomItem for Controls for Configuration

Article • 09/17/2021

Adds a blank line to the display of the control. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- NewLine Element

Syntax

XML

```
<NewLine/>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `NewLine` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
CustomItem Element for CustomEntry for Controls for Configuration	Defines a control for the custom control view.

Remarks

See Also

CustomItem Element for CustomEntry for Controls for Configuration

Writing a PowerShell Formatting File

Text Element for CustomItem for Controls for Configuration

Article • 09/17/2021

Specifies text that is added to the data that is displayed by the control, such as a label, brackets to enclose the data, and spaces to indent the data. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Text Element

Syntax

XML

```
<Text>TextToDisplay</Text>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `Text` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
CustomItem Element for CustomEntry for Controls for Configuration	Defines what data is displayed by the control and how it is displayed.

Text Value

Specify the text of a control for data that you want to display.

Remarks

See Also

CustomItem Element for CustomEntry for Controls for Configuration

Writing a PowerShell Formatting File

EntrySelectedBy Element for CustomEntry for Controls

Article • 09/17/2021

Defines the .NET types that use the definition of the common control or the condition that must exist for this control to be used. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element

Syntax

XML

```
<EntrySelectedBy>
  <TypeName>Nameof.NetType</TypeName>
  <SelectionSetName>SelectionSet</SelectionSetName>
  <SelectionCondition>...</SelectionCondition>
</EntrySelectedBy>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `EntrySelectedBy` element.

Attributes

None.

Child Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for Controls for Configuration	Optional element. Defines the condition that must exist for the common control definition to be used.
SelectionSetName Element for EntrySelectedBy for Controls for Configuration	Optional element. Specifies a set of .NET types that use this definition of the common control.
TypeName Element for EntrySelectedBy for Controls for Configuration	Optional element. Specifies a .NET type that uses this definition of the common control.

Parent Elements

Element	Description
CustomEntry Element for CustomControl for Controls for Configuration	Provides a definition of the common control.

Remarks

At a minimum, each definition must have at least one .NET type, selection set, or selection condition specified. There is no maximum limit to the number of types, selection sets, or selection conditions that you can specify.

See Also

SelectionCondition Element for EntrySelectedBy for Controls for Configuration

SelectionSetName Element for EntrySelectedBy for Controls for Configuration

CustomEntry Element for CustomControl for Controls for Configuration

TypeName Element for EntrySelectedBy for Controls for Configuration

Writing a PowerShell Formatting File

SelectionCondition Element for EntrySelectedBy for Controls for Configuration

Article • 09/17/2021

Defines a condition that must exist for a common control definition to be used. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element
- SelectionCondition Element

Syntax

XML

```
<SelectionCondition>
  <TypeName>Nameof.NetType</TypeName>
  <SelectionSetName>NameofSelectionSet</SelectionSetName>
  <PropertyName>.NetTypeProperty</PropertyName>
  <ScriptBlock>ScriptToEvaluate</ScriptBlock>
</SelectionCondition>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `SelectionCondition` element.

Attributes

None.

Child Elements

Element	Description
PropertyName Element for SelectionCondition for Controls for Configuration	Optional element. Specifies a .NET property that triggers the condition.
ScriptBlock Element for SelectionCondition for Controls for Configuration	Optional element. Specifies the script that triggers the condition.
SelectionSetName Element for SelectionCondition for Controls for Configuration	Optional element. Specifies the set of .NET types that triggers the condition.
TypeName Element for SelectionCondition for Controls for Configuration	Optional element. Specifies a .NET type that triggers the condition.

Parent Elements

Element	Description
EntrySelectedBy Element for CustomEntry for Controls for Configuration	Defines the .NET types that use this entry of the common control definition.

Remarks

The following guidelines must be followed when defining a selection condition:

- The selection condition must specify a least one property name or a script block, but cannot specify both.
- The selection condition can specify any number of .NET types or selection sets, but cannot specify both.

For more information about how selection conditions can be used, see Defining Conditions for when Data is Displayed.

See Also

PropertyName Element for SelectionCondition for Controls for Configuration

ScriptBlock Element for SelectionCondition for Controls for Configuration

SelectionSetName Element for SelectionCondition for Controls for Configuration

TypeName Element for SelectionCondition for Controls for Configuration

EntrySelectedBy Element for CustomEntry for Controls for Configuration

Writing a Windows PowerShell Formatting and Types File

PropertyName Element for SelectionCondition for Controls for Configuration

Article • 09/17/2021

Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the entry is used. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element
- SelectionCondition Element
- PropertyName Element

Syntax

XML

```
<PropertyName>.NetTypeProperty</PropertyName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `PropertyName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for Controls for Configuration	Defines a condition that must exist for a common control definition to be used.

Text Value

Specify the .NET property name.

Remarks

The selection condition must specify a least one property name or a script, but cannot specify both. For more information about how selection conditions can be used, see Defining Conditions for Displaying Data.

See Also

SelectionCondition Element for EntrySelectedBy for Controls for Configuration

Writing a PowerShell Formatting File

ScriptBlock Element for SelectionCondition for Controls for Configuration

Article • 09/17/2021

Specifies the script that triggers the condition. When this script is evaluated to `true`, the condition is met, and the definition is used. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element
- SelectionCondition Element
- ScriptBlock Element

Syntax

XML

```
<ScriptBlock>ScriptToEvaluate</ScriptBlock>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ScriptBlock` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for Controls for Configuration	Defines a condition that must exist for the common control definition to be used.

Text Value

Specify the script that is evaluated.

Remarks

The selection condition must specify a least one script or property name to evaluate, but cannot specify both. For more information about how selection conditions can be used, see Defining Conditions for Displaying Data.

See Also

SelectionCondition Element for EntrySelectedBy for Controls for Configuration

Writing a PowerShell Formatting File

SelectionSetName Element for SelectionCondition for Controls for Configuration

Article • 09/17/2021

Specifies the set of .NET types that trigger the condition. When any of the types in this set are present, the condition is met, and the object is displayed by using this control. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element
- SelectionCondition Element
- SelectionSetName Element

Syntax

XML

```
<SelectionSetName>NameofSelectionSet</SelectionSetName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `SelectionSetName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for Controls for Configuration	Defines a condition that must exist for the control definition to be used.

Text Value

Specify the name of the selection set.

Remarks

Selection sets are common groups of .NET objects that can be used by any view that the formatting file defines. For more information about creating and referencing selection sets, see Defining Sets of Objects.

The selection condition can specify a selection set or .NET type, but cannot specify both. For more information about how to use selection conditions, see Defining Conditions for Displaying Data.

See Also

SelectionCondition Element for EntrySelectedBy for Controls for Configuration

Defining Conditions for When Data Is Displayed

Defining Selection Sets

Writing a PowerShell Formatting File

TypeName Element for SelectionCondition for Controls for Configuration

Article • 09/17/2021

Specifies a .NET type that triggers the condition. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element
- SelectionCondition Element
- TypeName Element

Syntax

XML

```
<TypeName>Nameof.NetType</TypeName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `TypeName` Element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for CustomEntry for Configuration	Defines a condition that must exist for the control definition to be used.

Text Value

Specify the fully qualified name of the .NET type, such as `System.IO.DirectoryInfo`.

Remarks

See Also

SelectionCondition Element for EntrySelectedBy for CustomEntry for Configuration

Writing a PowerShell Formatting File

SelectionSetName Element for EntrySelectedBy for Controls for Configuration

Article • 09/17/2021

Specifies a set of .NET types that use this definition of the control. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element of Configuration
- Control Element for Controls for Configuration
- CustomControl Element for Control for Configuration
- CustomEntries Element for CustomControl for Configuration
- CustomEntry Element for CustomControl for Controls for Configuration
- EntrySelectedBy Element for CustomEntry for Controls for Configuration
- SelectionSetName Element for EntrySelectedBy for Controls for Configuration

Syntax

XML

```
<SelectionSetName>NameofSelectionSet</SelectionSetName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `SelectionSetName` element.

Attributes

None

Child Elements

None.

Parent Elements

Element	Description
EntrySelectedBy Element for CustomEntry for Controls for Configuration	Defines the .NET types that use this control definition or the condition that must exist for this definition to be used.

Text Value

Specify the name of the selection set.

Remarks

Each control definition must have at least one type name, selection set, or selection condition defined.

Selection sets are typically used when you want to define a group of objects that are used in multiple views. For more information about defining selection sets, see Defining Selection Sets.

See Also

EntrySelectedBy Element for CustomEntry for Controls for Configuration

Writing a PowerShell Formatting File

TypeName Element for EntrySelectedBy for Controls for Configuration

Article • 09/17/2021

Specifies a .NET type that uses this definition of the control. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element
- TypeName Element

Syntax

XML

```
<TypeName>Nameof.NetType</TypeName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `TypeName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
EntrySelectedBy Element for CustomEntry for Controls for Configuration	Defines the .NET types that use this control definition or the condition that must exist for this definition to be used.

Text Value

Specify the fully qualified name of the .NET type, such as `System.IO.DirectoryInfo`.

Remarks

See Also

EntrySelectedBy Element for CustomEntry for Controls for Configuration

Writing a PowerShell Formatting File

Name Element for Control for Controls for Configuration

Article • 09/17/2021

Specifies the name of the control. This element is used when defining a common control that can be used by all the views in the formatting file.

Schema

- Configuration Element
- Controls Element
- Control Element
- Name Element

Syntax

XML

```
<Name>NameOfControl</Name>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `Name` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description

Element	Description
Control Element for Controls for Configuration	Defines a common control that can be used by all the views of the formatting file and the name that is used to reference the control.

Text Value

Specify the name that is used to reference this control.

Remarks

The name specified here can be used in the following elements to reference this control.

- When creating a table, list, wide or custom control view, the control can be specified by the following element: GroupBy Element for View
- When creating another common control, this control can be specified by the following element: ExpressionBinding Element for CustomItem for Controls for Configuration
- When creating a control that can be used by a view, this control can be specified by the following element: ExpressionBinding Element for CustomItem for Controls for View

See Also

Control Element for Controls for Configuration

ExpressionBinding Element for CustomItem for Controls for Configuration

ExpressionBinding Element for CustomItem for Controls for View

GroupBy Element for View

Writing a PowerShell Formatting File

DefaultSettings Element

Article • 09/17/2021

Defines common settings that apply to all the views of the formatting file. Common settings include displaying errors, wrapping text in tables, defining how collections are expanded, and more.

Schema

- Configuration Element
- DefaultSettings Element

Syntax

XML

```
<DefaultSettings>
  <ShowError/>
  <DisplayError/>
 <PropertyCountForTable>NumberOfProperties</PropertyCountFortable>
  <WrapTables/>
  <EnumerableExpansions>...</EnumerableExpansions>
</DefaultSettings>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `DefaultSettings` element.

Attributes

None.

Child Elements

Element	Description

Element	Description
DisplayError Element	Optional element. Specifies that the string #ERR is displayed when an error occurs while displaying a piece of data.
EnumerableExpansions Element	Optional element. Defines the different ways that .NET objects are expanded when they are displayed in a view.
PropertyCountForTable	Optional element. Specifies the minimum number of properties that an object must have to display the object in a table view.
ShowError Element	Optional element. Specifies that the full error record is displayed when an error occurs while displaying a piece of data.
WrapTables Element	Optional element. Specifies that data in a table is moved to the next line if it does not fit into the width of the column.

Parent Elements

Element	Description
Configuration Element	Represents the top-level element of a formatting file.

Remarks

See Also

Configuration Element

DisplayError Element

EnumerableExpansions Element

PropertyCountForTable

ShowError Element

WrapTables Element

Writing a PowerShell Formatting File

DisplayError Element

Article • 09/17/2021

Specifies that the string #ERR is displayed when an error occurs displaying a piece of data.

Schema

- Configuration Element
- DefaultSettings Element
- DisplayError Element

Syntax

```
XML

<DisplayError/>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `DisplayError` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
DefaultSettings Element	Defines common settings that apply to all the views of the formatting file.

Remarks

By default, when an error occurs while trying to display a piece of data, the location of the data is left blank. When this element is set to true, the #ERR string will be displayed.

See Also

DefaultSettings Element

Writing a PowerShell Formatting File

EnumerableExpansions Element

Article • 09/17/2021

Defines how .NET collection objects are expanded when they are displayed in a view.

Schema

- Configuration Element
- DefaultSettings Element
- EnumerableExpansions Element

Syntax

XML

```
<EnumerableExpansions>
  <EnumerableExpansion>...</EnumerableExpansion>
</EnumerableExpansions>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `EnumerableExpansions` element. There is no limit to the number of child elements that you can use.

Attributes

None.

Child Elements

Element	Description
EnumerableExpansion Element	Optional element. Defines the specific .NET collection objects that are expanded when they are displayed in a view.

Parent Elements

Element	Description
DefaultSettings Element	Defines common settings that apply to all the views of the formatting file.

Remarks

This element is used to define how collection objects and the objects in the collection are displayed. In this case, a collection object refers to any object that supports the **System.Collections.ICollection** interface.

See Also

Writing a PowerShell Formatting File

EnumerableExpansion Element

Article • 09/17/2021

Defines how specific .NET collection objects are expanded when they are displayed in a view.

Schema

- Configuration Element
- DefaultSettings Element
- EnumerableExpansions Element
- EnumerableExpansion Element

Syntax

XML

```
<EnumerableExpansion>
  <EntrySelectedBy>...</EntrySelectedBy>
  <Expand>EnumOnly, CoreOnly, Both</Expand>
</EnumerableExpansion>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `EnumerableExpansion` element.

Attributes

None.

Child Elements

Element	Description
EntrySelectedBy Element for EnumerableExpansion	Optional element. Defines which .NET collection objects are expanded by this definition.

Element	Description
Expand Element	Specifies how the collection object is expanded for this definition.

Parent Elements

Element	Description
EnumerableExpansions Element	Defines the different ways that .NET collection objects are expanded when they are displayed in a view.

Remarks

This element is used to define how collection objects and the objects in the collection are displayed. In this case, a collection object refers to any object that supports the **System.Collections.ICollection** interface.

The default behavior is to display only the properties of the objects in the collection.

See Also

Writing a PowerShell Formatting File

EntrySelectedBy Element for EnumerableExpansion

Article • 09/17/2021

Defines the .NET types that use this definition or the condition that must exist for this definition to be used.

Schema

- Configuration Element
- DefaultSettings Element
- EnumerableExpansions Element
- EnumerableExpansion Element
- EntrySelectedBy Element for EnumerableExpansion

Syntax

XML

```
<EntrySelectedBy>
  <TypeName>Nameof.NetType</TypeName>
  <SelectionSetName>NameofSelectionSet</SelectionSetName>
  <SelectionCondition>...</SelectionCondition>
</EntrySelectedBy>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `EntrySelectedBy` element.

Attributes

None.

Child Elements

Element	Description

Element	Description
SelectionCondition Element for EntrySelectedBy for EnumerableExpansion	Optional element. Defines the condition that must exist to expand the collection objects of this definition.
SelectionSetName Element for EntrySelectedBy for EnumerableExpansion	Optional element. Specifies a set of .NET types that use this definition of how collection objects are expanded.
TypeName Element for EntrySelectedBy for EnumerableExpansion	Optional element. Specifies a .NET type that uses this definition of how collection objects are expanded.

Parent Elements

Element	Description
EnumerableExpansion Element	Defines how specific .NET collection objects are expanded when they are displayed in a view.

Remarks

You must specify at least one type, selection set, or selection condition for a definition entry. There is no maximum limit to the number of child elements that you can use.

Selection conditions are used to define a condition that must exist for the definition to be used, such as when an object has a specific property or that a specific property value or script evaluates to `true`. For more information about selection conditions, see Defining Conditions for Displaying Data.

See Also

Defining Conditions for Displaying Data

EnumerableExpansion Element

SelectionCondition Element for EntrySelectedBy for EnumerableExpansion

SelectionSetName Element for EntrySelectedBy for EnumerableExpansion

TypeName Element for EntrySelectedBy for EnumerableExpansion

Writing a PowerShell Formatting File

SelectionCondition Element for EntrySelectedBy for EnumerableExpansion

Article • 09/17/2021

Defines the condition that must exist to expand the collection objects of this definition.

Schema

- Configuration Element
- DefaultSettings Element
- EnumerableExpansions Element
- EnumerableExpansion Element
- EntrySelectedBy Element
- SelectionCondition Element

Syntax

XML

```
<SelectionCondition>
  <TypeName>Nameof.NetType</TypeName>
  <SelectionSetName>NameofSelectionSet</SelectionSetName>
  <PropertyName>.NetTypeProperty</PropertyName>
  <ScriptBlock>ScriptToEvaluate</ScriptBlock>
</SelectionCondition>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `SelectionCondition` element. You must specify a single `PropertyName` or `ScriptBlock` element. The `SelectionSetName` and `TypeName` elements are optional. You can specify one of either element.

Attributes

None.

Child Elements

Element	Description
PropertyName Element for SelectionCondition for EntrySelectedBy for EnumerableExpansion	Optional element. Specifies the .NET property that triggers the condition.
ScriptBlock Element for SelectionCondition for EntrySelectedBy for EnumerableExpansion	Optional element. Specifies the script that triggers the condition.
SelectionSetName Element for SelectionCondition for EntrySelectedBy for EnumerableExpansion	Optional element. Specifies the set of .NET types that triggers the condition.
TypeName Element for SelectionCondition for EntrySelectedBy for EnumerableExpansion	Optional element. Specifies a .NET type that triggers the condition.

Parent Elements

Element	Description
EntrySelectedBy Element for EnumerableExpansion	Defines which .NET collection objects are expanded by this definition.

Remarks

Each definition must have at least one type name, selection set, or selection condition defined.

When you are defining a selection condition, the following requirements apply:

- The selection condition must specify a least one property name or a script block, but cannot specify both.
- The selection condition can specify any number of .NET types or selection sets, but cannot specify both.

For more information about how to use selection conditions, see Defining Conditions for Diplaying Data.

For more information about other components of a wide view, see Wide View.

See Also

Defining Conditions for When Data Is Displayed

Writing a PowerShell Formatting File

PropertyName Element for SelectionCondition for Controls for View

Article • 09/17/2021

Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the entry is used. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element for Controls for View
- CustomControl Element for Control for Controls for View
- CustomEntries Element for CustomControl for Controls for View
- CustomEntry Element for CustomEntries for Controls for View
- EntrySelectedBy Element for CustomEntry for Controls for View
- SelectionCondition Element for EntrySelectedBy for Controls for View
- PropertyName Element for SelectionCondition for Controls for View

Syntax

XML

```
<PropertyName>.NetTypeProperty</PropertyName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `PropertyName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for Controls for View	Defines a condition that must exist for the control definition to be used.

Text Value

Specify the .NET property name.

Remarks

The selection condition must specify a least one property name or a script, but cannot specify both. For more information about how selection conditions can be used, see Defining Conditions for Displaying Data.

See Also

SelectionCondition Element for EntrySelectedBy for Controls for View

Writing a PowerShell Formatting File

ScriptBlock Element for SelectionCondition for Controls for View

Article • 09/17/2021

Specifies the script that triggers the condition. When this script is evaluated to `true`, the condition is met, and the definition is used. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element
- SelectionCondition Element
- ScriptBlock Element

Syntax

XML

```
<ScriptBlock>ScriptToEvaluate</ScriptBlock>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ScriptBlock` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for Controls for View	Defines a condition that must exist for the control definition to be used.

Text Value

Specify the script that is evaluated.

Remarks

The selection condition must specify a least one script or property name to evaluate, but cannot specify both. For more information about how selection conditions can be used, see Defining Conditions for Displaying Data.

See Also

SelectionCondition Element for EntrySelectedBy for Controls for View

Writing a PowerShell Formatting File

SelectionSetName Element for SelectionCondition for EntrySelectedBy for EnumerableExpansion

Article • 09/17/2021

Specifies the set of .NET types that trigger the condition. When any of the types in this set are present, the condition is met.

Schema

- Configuration Element
- DefaultSettings Element
- EnumerableExpansions Element
- EnumerableExpansions Element
- EntrySelectedBy Element
- SelectionCondition Element
- SelectionSetName Element

Syntax

XML

```
<SelectionSetName>NameofSelectionSet</SelectionSetName>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `SelectionSetName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for EnumerableExpansion	Defines the condition that must exist to expand the collection objects of this definition.

Text Value

Specify the name of the selection set.

Remarks

The selection condition can specify a selection set or .NET type, but cannot specify both. For more information about how to use selection conditions, see Defining Conditions for Displaying Data.

Selection sets are common groups of .NET objects that can be used by any view that the formatting file defines. For more information about creating and referencing selection sets, see Defining Selection Sets.

See Also

Defining Selection Sets

SelectionCondition Element for EntrySelectedBy for EnumerableExpansion

Writing a PowerShell Formatting File

TypeName Element for SelectionCondition for EntrySelectedBy for EnumerableExpansion

Article • 09/17/2021

Specifies a .NET type that triggers the condition.

Schema

- Configuration Element
- DefaultSettings Element
- EnumerableExpansions Element
- EnumerableExpansions Element
- EntrySelectedBy Element
- SelectionCondition Element
- TypeName Element

Syntax

```xml
<TypeName>Nameof.NetType</TypeName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `TypeName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for EnumerableExpansion	Defines the condition that must exist to expand the collection objects of this definition.

Text Value

Specify the fully qualified name of the .NET type, such as `System.IO.DirectoryInfo`.

Remarks

See Also

SelectionCondition Element for EntrySelectedBy for EnumerableExpansion

Writing a PowerShell Formatting File

SelectionSetName Element for EntrySelectedBy for EnumerableExpansion

Article • 09/17/2021

Specifies the set of .NET types that are expanded by this definition.

Schema

- Configuration Element
- DefaultSettings Element
- EnumerableExpansions Element
- EnumerableExpansion Element
- EntrySelectedBy Element
- SelectionSetName Element

Syntax

XML

```
<SelectionSetName>NameofSelectionSet</SelectionSetName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `SelectionSetName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
EntrySelectedBy Element for EnumerableExpansion	Defines the .NET collection objects that are expanded by this definition.

Text Value

Specify the name of the selection set.

Remarks

Each definition must specify one or more type names, a selection set, or a selection condition.

Selection sets are typically used when you want to define a group of objects that are used in multiple views. For example, you might want to create a table view and a list view for the same set of objects. For more information about defining selection sets, see Defining Sets of Objects for a View.

See Also

Defining Selection Sets

EntrySelectedBy Element for EnumerableExpansion

Writing a PowerShell Formatting File

TypeName Element for EntrySelectedBy for EnumerableExpansion

Article • 09/17/2021

Specifies a .NET type that is expanded by this definition. This element is used when defining a default settings.

Schema

- Configuration Element
- DefaultSettings Element
- EnumerableExpansions Element
- EnumerableExpansion Element
- EntrySelectedBy Element
- TypeName Element

Syntax

XML

```
<TypeName>Nameof.NetType</TypeName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `TypeName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
EntrySelectedBy Element for EnumerableExpansion	Defines the .NET types that use this definition or the condition that must exist for this definition to be used.

Text Value

Specify the fully qualified name of the .NET type, such as `System.IO.DirectoryInfo`.

Remarks

See Also

EntrySelectedBy Element for EnumerableExpansion

Writing a PowerShell Formatting File

Expand Element

Article • 09/17/2021

Specifies how the collection object is expanded for this definition.

Schema

- Configuration Element
- DefaultSettings Element
- EnumerableExpansions Element
- EnumerableExpansion Element
- Expand Element

Syntax

XML

```
<Expand>EnumOnly, CoreOnly, Both</Expand>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `Expand` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
EnumerableExpansion Element	Defines how specific .NET collection objects are expanded when they are displayed in a view.

Text Value

Specify one of the following values:

- EnumOnly: Displays only the properties of the objects in the collection.
- CoreOnly: Displays only the properties of the collection object.
- Both: Displays the properties of the objects in the collection and the properties of the collection object.

Remarks

This element is used to define how collection objects and the objects in the collection are displayed. In this case, a collection object refers to any object that supports the **System.Collections.ICollection** interface.

The default behavior is to display only the properties of the objects in the collection.

See Also

Writing a PowerShell Formatting File

PropertyCountForTable Element

Article • 09/17/2021

Optional element. Specifies the minimum number of properties that an object must have to display the object in a table view.

Schema

- DefaultSettings Element
- PropertyCountForTable Element

Syntax

XML

```
<PropertyCountForTable>NumberOfProperties</PropertyCountFortable>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `PropertyCountForTable` element. The default value for this element is `4`.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
DefaultSettings Element	Defines common settings that apply to all the views of the formatting file.

Remarks

See Also

Writing a PowerShell Formatting File

ShowError Element

Article • 09/17/2021

Specifies that the full error record is displayed when an error occurs while displaying a piece of data.

Schema

- Configuration Element
- DefaultSettings Element
- ShowError Element

Syntax

```
scr
```

```
<ShowError/>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ShowError` element. The default value for this element is `false`.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
DefaultSettings Element	Defines common settings that apply to all the views of the formatting file.

Remarks

See Also

Writing a PowerShell Formatting File

WrapTables Element

Article • 09/17/2021

Specifies that data in a table cell is moved to the next line if the data is longer than the width of the column.

Schema

- Configuration Element
- DefaultSettings Element
- WrapTables Element

Syntax

XML

```
<WrapTables/>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `WrapTables` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
DefaultSettings Element	Defines common settings that apply to all the views of the formatting file.

Remarks

See Also

Writing a PowerShell Formatting File

SelectionSets Element

Article • 09/17/2021

Defines the common sets of .NET objects that can be used by all views of the formatting file. The views and controls of the formatting file can reference the complete set of objects by using only the name of the selection set.

Schema

- Configuration Element
- SelectionSets Element

Syntax

```XML
<SelectionSets>
  <SelectionSet>...</SelectionSet>
</SelectionSets>
```

Attributes and Elements

The following sections describe the attributes, child elements, and parent element of the `SelectionSets` element. Each child element defines a set of objects that can be referenced by the name of the set. The order of the child elements is not significant.

Attributes

None.

Child Elements

Element	Description
SelectionSet Element	Required element. Defines a single set of .NET objects that can be referenced by the name of the set.

Parent Elements

Element	Description
Configuration Element	Represents the top-level element of a formatting file.

Remarks

You can use selection sets when you have a set of related objects that you want to reference by using a single name, such as a set of objects that are related through inheritance. When defining your views, you can specify the set of objects by using the name of the selection set instead of listing all the objects within each view.

Common selection sets are specified by their name when defining the views of the formatting file or the definitions of the views. In these cases, the `SelectionSetName` child element of the `ViewSelectedBy` and `EntrySelectedBy` elements specifies the set to be used. For more information about selection sets, see Defining Sets of Objects.

See Also

Configuration Element

Defining Selection Sets

SelectionSet Element

Writing a PowerShell Formatting File

SelectionSet Element

Article • 09/17/2021

Defines a set of .NET objects that can be referenced by the name of the set.

Schema

- Configuration Element
- SelectionSets Element
- SelectionSet Element

Syntax

XML

```
<SelectionSet>
  <Name>SelectionSetName</Name>
  <Types>...</Types>
</SelectionSet>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `SelectionSet` element. Each selection set must have a name, and it must specify the .NET objects of the set.

Attributes

None.

Child Elements

Element	Description
Name Element for SelectionSet	Required element. Specifies the name used to reference the selection set.

Element	Description
Types Element	Required element. Defines the .NET objects that are in the selection set.

Parent Elements

Element	Description
SelectionSets Element Format	Defines the common sets of .NET objects that can be used by all views of the formatting file.

Remarks

You can use selection sets when you have a set of related objects that you want to reference by using a single name, such as a set of objects that are related through inheritance. When defining your views, you can specify the set of objects by using the name of the selection set instead of listing all the objects within each view.

Common selection sets are specified by their name when defining the views of the formatting file or the definitions of the views. In these cases, the `SelectionSetName` child element of the `ViewSelectedBy` and `EntrySelectedBy` elements specifies the set to be used. For more information about selection sets, see Defining Sets of Objects.

Example

The following example shows a `SelectionSet` element that defines four .NET types.

XML

```
<SelectionSets>
  <SelectionSet>
    <Name>FileSystemTypes</Name>
    <Types>
     <TypeName>System.IO.DirectoryInfo</TypeName>
     <TypeName>System.IO.FileInfo</TypeName>
     <TypeName>Deserialized.System.IO.DirectoryInfo</TypeName>
     <TypeName>Deserialized.System.IO.FileInfo</TypeName>
    </Types>
  </SelectionSet>
</SelectionSets>
```

See Also

Defining Selection Sets

Name Element of SelectionSet

SelectionSets Element

Types Element

Writing a PowerShell Formatting File

Name Element for SelectionSet

Article • 09/17/2021

Specifies the name used to reference the selection set.

Schema

- Configuration Element
- SelectionSets Element
- SelectionSet Element
- Name Element

Syntax

XML

```
<Name>Name of selection set</Name>
```

Attributes and Elements

The following sections describe the attributes, child elements, and parent element of the `Name` Element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionSet Element	Defines a single set of .NET objects that can be referenced by the name of the set.

Text Value

Specify the name to reference the selection set. There are no restrictions as to what characters can be used.

Remarks

The name specified here is used in the `SelectionSetName` element. The selection set that can be used by a view, by a definition of a view (views can have multiple definitions), or when specifying a selection condition. For more information about selection sets, see Defining Sets of Objects.

Example

This example shows a `SelectionSet` element that defines four .NET types. The name of the selection set is "FileSystemTypes".

XML

```
<SelectionSets>
  <SelectionSet>
    <Name>FileSystemTypes</Name>
    <Types>
     <TypeName>System.IO.DirectoryInfo</TypeName>
     <TypeName>System.IO.FileInfo</TypeName>
     <TypeName>Deserialized.System.IO.DirectoryInfo</TypeName>
     <TypeName>Deserialized.System.IO.FileInfo</TypeName>
    </Types>
  </SelectionSet>
</SelectionSets>
```

See Also

Defining Selection Sets

SelectionSet Element

Writing a PowerShell Formatting File

Types Element for SelectionSet

Article • 09/17/2021

Defines the .NET objects that are in the selection set.

Schema

- Configuration Element
- SelectionSets Element
- SelectionSet Element
- Types Element

Syntax

XML

```
<Types>
  <TypeName>Nameof.NetType</TypeName>
</Types>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `Types` element. There must be at least one child element, but there is no maximum limit to the number of child elements that can be added.

Attributes

None.

Child Elements

Element	Description
TypeName Element of Types	Required element. Specifies the .NET object that belongs to the selection set.

Parent Elements

Element	Description
SelectionSet Element	Defines a set of .NET objects that can be referenced by the name of the set.

Remarks

The objects defined by this element make up a selection set that can be used by a view, by a definition of a view (views can have multiple definitions), or when specifying a selection condition. For more information about selection sets, see Defining Sets of Objects.

Example

This example shows a `SelectionSet` element that defines four .NET types.

XML

```
<SelectionSets>
  <SelectionSet>
    <Name>FileSystemTypes</Name>
    <Types>
     <TypeName>System.IO.DirectoryInfo</TypeName>
     <TypeName>System.IO.FileInfo</TypeName>
     <TypeName>Deserialized.System.IO.DirectoryInfo</TypeName>
     <TypeName>Deserialized.System.IO.FileInfo</TypeName>
    </Types>
  </SelectionSet>
</SelectionSets>
```

See Also

Defining Sets of Objects

SelectionSet Element

TypeName Element of Types

Writing a PowerShell Formatting File

TypeName Element for Types

Article • 09/17/2021

Specifies the .NET type of an object that belongs to the selection set.

Schema

- Configuration Element
- SelectionSets Element
- SelectionSet Element
- Types Element
- TypeName Element

Syntax

```xml
<TypeName>Nameof.NetType</Name>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `TypeName` element. At least one `TypeName` element must be included in the selection set.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
Types Element	Defines the .NET objects that are in the selection set.

Text Value

Specify the fully qualified name for the .NET type.

Remarks

You can use selection sets when you have a set of related objects that you want to reference by using a single name, such as a set of objects that are related through inheritance. When defining your views, you can specify the set of objects by using the name of the selection set instead of listing all the objects within each view.

Common selection sets are specified by their name when defining the views of the formatting file. In these cases, the `SelectionSetName` child element of the `ViewSelectedBy` element for the view specifies the set. However, different entries of a view can also specify a selection set that applies to only that entry of the view. For more information about selection sets, see Defining Sets of Objects.

Example

The following example shows a `SelectionSet` element that defines four .NET types.

```
<SelectionSets>
  <SelectionSet>
    <Name>FileSystemTypes</Name>
    <Types>
     <TypeName>System.IO.DirectoryInfo</TypeName>
     <TypeName>System.IO.FileInfo</TypeName>
     <TypeName>Deserialized.System.IO.DirectoryInfo</TypeName>
     <TypeName>Deserialized.System.IO.FileInfo</TypeName>
    </Types>
  </SelectionSet>
</SelectionSets>
```

See Also

Defining Selection Sets

SelectionSet Element

SelectionSets Element

Types Element

Writing a Windows PowerShell Formatting File

ViewDefinitions Element

Article • 09/17/2021

Defines the views used to display .NET objects. These views can display the properties and script values of an object in a table format, list format, wide format, and custom control format.

Schema

- Configuration Element
- ViewDefinitions

Syntax

XML

```
<ViewDefinitions>
  <View>...</View>
</ViewDefinitions>
```

Attributes and Elements

The following sections describe the attributes, child elements, and parent element of the `ViewDefinitions` element. There is no limit to the number of views that can be defined in a formatting file, and they can be added in any order.

Attributes

None.

Child Elements

Element	Description
View Element	Defines a view that is used to display one or more .NET objects.

Parent Elements

Element	Description
Configuration Element	Represents the top-level element of a formatting file.

Remarks

For more information about the components of the different types of views, see the following topics:

- Creating a Table View
- Creating a List View
- Creating a Wide View
- Custom Controls

Example

This example shows a `ViewDefinitions` element that contains the parent elements for a table view and a list view.

XML

```
<Configuration>
  <ViewDefinitions>
    <View>
      <TableControl>...</TableControl>
    </View>
    <View>
      <ListControl>...</ListControl>
    </View>
  </ViewDefinitions>
</Configuration>
```

See Also

Configuration Element

View Element

Creating a Table View

Creating a List View

Creating a Wide View

Custom Controls

Writing a PowerShell Formatting File

View Element

Article • 09/17/2021

Defines a view that displays one or more .NET objects. There is no limit to the number of views that can be defined in a formatting file.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element

Syntax

XML

```
<View>
  <Name>Friendly name of view.</Name>
  <OutOfBand />
  <ViewSelectedBy>...</ViewSelectedBy>
  <Controls>...</Controls>
  <GroupBy>...</GroupBy>
  <TableControl>...</TableControl>
  <ListControl>...</ListControl>
  <WideControl>...</WideControl>
  <CustomControl>...</CustomControl>
</View>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `View` element. You must specify one and only one of the control child elements, and you must specify the name of the view and the objects that use the view. Defining custom controls, how to group objects, and specifying if the view is out-of-band are optional.

Attributes

None.

Child Elements

Element	Description
Controls Element for View	Optional element. Defines a set of controls that can be referenced by their name from within the view.
CustomControl Element	Optional element. Defines a custom control format for the view.
GroupBy Element for View	Optional element. Defines how the members of the .NET objects are grouped.
ListControl Element	Optional element. Defines a list format for the view.
Name Element for View	Required element. Specifies the name used to reference the view.
OutOfBand	Optional element When OutOfBand is true, the view applies regardless of previous objects that may have selected a different view.
TableControl Element	Optional element. Defines a table format for the view.
ViewSelectedBy Element for View	Required element. Defines the .NET objects that this view displays.
WideControl Element	Optional element. Defines a wide (single value) list format for the view.

Parent Elements

Element	Description
ViewDefinitions Element	Defines the views used to display objects.

Remarks

For more information about the components of different views and custom controls, see the following topics:

- Table View Components
- List View Components
- Wide View Components
- Custom Controls

Example

This example shows a `View` element that defines a table view for the System.Serviceprocess.Servicecontroller object.

XML

```
<ViewDefinitions>
  <View>
    <Name>service</Name>
    <ViewSelectedBy>
      <TypeName>System.ServiceProcess.ServiceController</TypeName>
    </ViewSelectedBy>
    <TableControl>...</TableControl>
  </View>
</ViewDefinitions>
```

See Also

ViewDefinitions Element

Name Element for View

ViewSelectedBy Element

Controls Element for View

GroupBy Element for View

TableControl Element

ListControl Element

WideControl Element

CustomControl Element

Writing a PowerShell Formatting File

Controls Element for View

Article • 09/17/2021

Defines the view controls that can be used by a specific view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element

Syntax

XML

```
<Controls>
  <Control>...</Control>
</Controls>
```

Attributes and Elements

The following sections describe the attributes, child elements, and parent elements of the `Controls` element. This element must have at least one child element. There is no maximum number of child elements, nor is their order significant.

Attributes

None.

Child Elements

Element	Description
Control Element for Controls for View	Defines a control that can be used by the view.

Parent Elements

Element	Description
View Element	Defines a view that is used to display the members of one or more .NET objects.

Remarks

See Also

Control Element

View Element

Writing a PowerShell Formatting File

Control Element for Controls for View

Article • 09/17/2021

Defines a control that can be used by the view and the name that is used to reference the control.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element

Syntax

XML

```
<Control>
  <Name>NameOfControl</Name>
  <CustomControl>...</CustomControl>
</Control>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `Control` element.

Attributes

None.

Child Elements

Element	Description
Name Element for Control for View	Required element. Specifies the name of the control.

Element	Description
CustomControl Element for Control for Controls for View	Required element. Defines the control used by this view.

Parent Elements

Element	Description
Controls Element	Defines the view controls that can be used by a specific view.

Remarks

This control can be specified by the following elements:

- CustomControlName Element for ExpressionBinding for Controls for View
- CustomControlName Element for ExpressionBinding for CustomControl for View
- CustomControlName Element for ExpressionBinding for GroupBy
- CustomControlName Element for GroupBy

See Also

CustomControl Element for Control for Controls for View

CustomControlName Element for ExpressionBinding for Controls for View

CustomControlName Element for ExpressionBinding for CustomControl for View

CustomControlName Element for ExpressionBinding for GroupBy

CustomControlName Element for ExpressionBinding for GroupBy

Controls Element

Name Element for Control for Controls for View

Writing a PowerShell Formatting File

CustomControl Element for Control for Controls for View

Article • 09/17/2021

Defines a control that is used by the view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element

Syntax

XML

```
<CustomControl>
  <CustomEntries>...</CustomEntries>
</CustomControl>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `CustomControl` element. You must specify only one child element.

Attributes

None.

Child Elements

Element	Description

Element	Description
CustomEntries Element for CustomControl for Controls for View	Required element. Provides the definitions for the control.

Parent Elements

Element	Description
Control Element for Controls for View	Defines a control that can be used by the view and the name that is used to reference the control.

Remarks

See Also

CustomEntries Element for CustomControl for View

Control Element for Controls for View

Writing a PowerShell Formatting File

CustomEntries Element for CustomControl for Controls for View

Article • 09/17/2021

Provides the definitions for the control. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element

Syntax

XML

```
<CustomEntries>
  <CustomEntry>...</CustomEntry>
</CustomEntries>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent elements of the `CustomEntries` element. There is no maximum limit to the number of child elements that can be specified.

Attributes

None.

Child Elements

Element	Description
CustomEntry Element for CustomEntries for Controls for View	Required element. Provides a definition of the control.

Parent Elements

Element	Description
CustomControl Element for Control for Controls for View	Defines the control used by the view.

Remarks

In most cases, a control has only one definition, which is specified in a single `CustomEntry` element. However, it is possible to provide multiple definitions if you want to use the same control to display different .NET objects. In those cases, you can define a `CustomEntry` element for each object or set of objects.

See Also

CustomEntry Element for CustomEntries for Controls for View

CustomControl Element for Control for Controls for View

Writing a PowerShell Formatting File

CustomEntry Element for CustomEntries for Controls for View

Article • 09/17/2021

Provides a definition of the control. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element

Syntax

XML

```
<CustomEntry>
  <EntrySelectedBy>...</EntrySelectedBy>
  <CustomItem>...</CustomItem>
</CustomEntry>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent elements of the `CustomEntry` element.

Attributes

None.

Child Elements

Element	Description
EntrySelectedBy Element for CustomEntry for Controls for View	Optional element. Defines the .NET types that use this control definition or the condition that must exist for this definition to be used.
CustomItem Element for CustomEntry for Controls for View	Required element. Defines how the control displays the data.

Parent Elements

Element	Description
CustomEntries Element for CustomControl for View	Provides the definitions for the control.

Remarks

See Also

CustomEntries Element for CustomControl for View

Writing a PowerShell Formatting File

CustomItem Element for CustomEntry for Controls for View

Article • 09/17/2021

Defines what data is displayed by the control and how it is displayed. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element

Syntax

XML

```
<CustomItem>
  <ExpressionBinding>...</ExpressionBinding>
  <NewLine/>
  <Text>TextToDisplay</Text>
  <Frame>...<Frame>
</CustomItem>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `CustomItem` element. For more information, see Remarks.

Attributes

None.

Child Elements

Element	Description
ExpressionBinding Element for CustomItem for Controls for View	Optional element. Defines the data that is displayed by the control.
Frame Element for CustomItem for Controls for View	Optional element. Defines how the data is displayed, such as shifting the data to the left or right.
NewLine Element for CustomItem for Controls for View	Optional element. Adds a blank line to the display of the control.
Text Element for CustomItem for Controls for View	Optional element. Adds text, such as parentheses or brackets, to the display of the control.

Parent Elements

Element	Description
CustomEntry Element for CustomEntries for Controls for View	Provides a definition of the control.

Remarks

When specifying the child elements of the `CustomItem` element, keep the following in mind:

- The child elements must be added in the following sequence: `ExpressionBinding`, `NewLine`, `Text`, and `Frame`.
- There is no maximum limit to the number of sequences that you can specify.
- In each sequence, there is no maximum limit to the number of `ExpressionBinding` elements that you can use.

See Also

ExpressionBinding Element for CustomItem for Controls for View

Frame Element for CustomItem for Controls for View

NewLine Element for CustomItem for Controls for View

Text Element for CustomItem for Controls for View

Writing a PowerShell Formatting File

ExpressionBinding Element for CustomItem for Controls for View

Article • 09/17/2021

Defines the data that is displayed by the control. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element

Syntax

XML

```
<ExpressionBinding>
  <CustomControl>...</CustomControl>
  <CustomControlName>NameofCommonCustomControl</CustomControlName>
  <EnumerateCollection/>
  <ItemSelectionCondition>...</ItemSelectionCondition>
  <PropertyName>Nameof.NetTypeProperty</PropertyName>
  <ScriptBlock>ScriptToEvaluate></ScriptBlock>
</ExpressionBinding>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ExpressionBinding` element.

Attributes

None.

Child Elements

Element	Description
`CustomControl Element`	Optional element. Defines a control that is used by this control.
CustomControlName Element for ExpressionBinding for Controls for View	Optional element. Specifies the name of a common control or a view control.
EnumerateCollection Element for ExpressionBinding for Controls for View	Optional element. Specifies that the elements of collections are displayed.
ItemSelectionCondition Element of ExpressionBinding for Controls for View	Optional element. Defines the condition that must exist for this control to be used.
PropertyName Element for ExpressionBinding for Controls for View	Optional element. Specifies the .NET property whose value is displayed by the control.
ScriptBlock Element for ExpressionBinding for Controls for View	Optional element. Specifies the script whose value is displayed by the control.

Parent Elements

Element	Description
CustomItem Element for CustomEntry for Controls for View	Defines what data is displayed by the control and how it is displayed.

Remarks

See Also

CustomItem Element for CustomEntry for Controls for View

CustomControlName Element for ExpressionBinding for Controls for View

EnumerateCollection Element for ExpressionBinding for Controls for View

ItemSelectionCondition Element of ExpressionBinding for Controls for View

PropertyName Element for ExpressionBinding for Controls for View

ScriptBlock Element for ExpressionBinding for Controls for View

Writing a PowerShell Formatting File

CustomControlName Element for ExpressionBinding for Controls for View

Article • 09/17/2021

Specifies the name of a common control or a view control. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- CustomControlName Element

Syntax

XML

```
<CustomControlName>NameofCustomControl</CustomControlName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `CustomControlName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ExpressionBinding Element for CustomItem for Controls for View	Defines the data that is displayed by the control.

Text Value

Specify the name of the control.

Remarks

You can create common controls that can be used by all the views of a formatting file, and you can create view controls that can be used by a specific view. The following elements specify the names of these controls:

- Name Element for Control for Controls for Configuration
- Name Element for Control for Controls for View

See Also

Name Element for Control for Controls for Configuration

Name Element for Control for Controls for View

ExpressionBinding Element for CustomItem for Controls for View

Writing a PowerShell Formatting File

EnumerateCollection Element for ExpressionBinding for Controls for View

Article • 09/17/2021

Specified that the elements of collections are displayed. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- EnumerateCollection Element

Syntax

XML

```
<EnumerateCollection/>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `EnumerateCollection` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ExpressionBinding Element for CustomItem for Controls for View	Defines the data that is displayed by the control.

Remarks

See Also

ExpressionBinding Element for CustomItem for Controls for View

Writing a PowerShell Formatting File

ItemSelectionCondition Element for ExpressionBinding for Controls for View

Article • 09/17/2021

Defines the condition that must exist for this control to be used. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- ItemSelectionCondition Element

Syntax

XML

```
<ItemSelectionCondition>
  <PropertyName>.NetTypeProperty</PropertyName>
  <ScriptBlock>ScriptToEvaluate</ScriptBlock>
</ItemSelectionCondition>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ItemSelectionCondition` element.

Attributes

None.

Child Elements

Element	Description
PropertyName Element for ItemSelectionCondition for Controls for View	Optional element. Specifies the .NET property that triggers the condition.
ScriptBlock Element for ItemSelectionCondition for Controls for View	Optional element. Specifies the script that triggers the condition.

Parent Elements

Element	Description
ExpressionBinding Element for CustomItem for Controls for View	Defines the data that is displayed by the control.

Remarks

You can specify one property name or a script for this condition but cannot specify both.

See Also

PropertyName Element for ItemSelectionCondition for Controls for View

ScriptBlock Element for ItemSelectionCondition for Controls for View

ExpressionBinding Element for CustomItem for Controls for View

Writing a PowerShell Formatting File

PropertyName Element for ItemSelectionCondition for Controls for View

Article • 09/17/2021

Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the control is used. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- ItemSelectionCondition Element
- PropertyName Element

Syntax

XML

```
<PropertyName>.NetTypeProperty</PropertyName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `PropertyName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ItemSelectionCondition Element of ExpressionBinding for Controls for View	Defines the condition that must exist for this control to be used.

Text Value

Specify the name of the .NET property that triggers the condition.

Remarks

If this element is used, you cannot specify the ScriptBlock element when defining the selection condition.

See Also

ScriptBlock Element for ItemSelectionCondition for Controls for View

ItemSelectionCondition Element of ExpressionBinding for Controls for View

Writing a PowerShell Formatting File

ScriptBlock Element for ItemSelectionCondition for Controls for View

Article • 09/17/2021

Specifies the script that triggers the condition. When this script is evaluated to `true`, the condition is met, and the control is used. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- ItemSelectionCondition Element
- ScriptBlock Element

Syntax

XML

```
<ScriptBlock>ScriptToEvaluate</ScriptBlock>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ScriptBlock` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ItemSelectionCondition Element of ExpressionBinding for Controls for View	Defines the condition that must exist for this control to be used.

Text Value

Specify the script that is evaluated.

Remarks

If this element is used, you cannot specify the PropertyName element when defining the selection condition.

See Also

PropertyName Element for ItemSelectionCondition for Controls for View

ItemSelectionCondition Element of ExpressionBinding for Controls for View

Writing a PowerShell Formatting File

PropertyName Element for ExpressionBinding for Controls for View

Article • 09/17/2021

Specifies the .NET property whose value is displayed by the control. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding
- PropertyName Element

Syntax

XML

```
<PropertyName>.NetTypeProperty</PropertyName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `PropertyName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ExpressionBinding Element for CustomItem for Controls for View	Defines the data that is displayed by the control.

Text Value

Specify the name of the .NET property whose value is displayed by the control.

Remarks

See Also

ExpressionBinding Element for CustomItem for Controls for View

Writing a PowerShell Formatting File

ScriptBlock Element for ExpressionBinding for Controls for View

Article • 09/17/2021

Specifies the script whose value is displayed by the control. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- ScriptBlock Element

Syntax

XML

```
<ScriptBlock>ScriptToEvaluate</ScriptBlock>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ScriptBlock` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ExpressionBinding Element for CustomItem for Controls for View	Defines the data that is displayed by the control.

Text Value

Specify the script whose value is displayed by the control.

Remarks

See Also

ExpressionBinding Element for CustomItem for Controls for View

Writing a PowerShell Formatting File

Frame Element for CustomItem for Controls for View

Article • 09/17/2021

Defines how the data is displayed, such as shifting the data to the left or right. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Frame Element

Syntax

XML

```
<Frame>
  <LeftIndent>NumberOfCharactersToShift</LeftIndent>
  <RightIndent>NumberOfCharactersToShift</RightIndent>
  <FirstLineHanging>NumberOfCharactersToShift</FirstLineHanging>
  <FirstLineIndent>NumberOfCharactersToShift</FirstLineIndent>
  <CustomItem>...</CustomItem>
</Frame>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `Frame` element.

Attributes

None.

Child Elements

Element	Description
`CustomItem Element`	Required Element
FirstLineHanging Element of Frame of Controls of View	Optional element. Specifies how many characters the first line is shifted to the left.
FirstLineIndent Element of Frame of Controls of View	Optional element. Specifies how many characters the first line is shifted to the right.
LeftIndent Element of Frame of Controls of View	Optional element. Specifies how many characters the data is shifted away from the left margin.
RightIndent Element of Frame of Controls of View	Optional element. Specifies how many characters the data is shifted away from the right margin.

Parent Elements

Element	Description
CustomItem Element for CustomEntry for Controls for View	Defines what data is displayed by the control and how it is displayed.

Remarks

You cannot specify the FirstLineHanging and the FirstLineIndent elements in the same `Frame` element.

See Also

FirstLineHanging Element of Frame of Controls of View

FirstLineIndent Element of Frame of Controls of View

LeftIndent Element of Frame of Controls of View

RightIndent Element of Frame of Controls of View

CustomItem Element for CustomEntry for Controls for View

Writing a PowerShell Formatting File

FirstLineHanging Element for Frame for Controls for View

Article • 09/17/2021

Specifies how many characters the first line of data is shifted to the left. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Frame Element
- FirstLineHanging Element

Syntax

XML

```
<FirstLineHanging>NumberOfCharactersToShift</FirstLineHanging>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `FirstLineHanging` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
Frame Element for CustomItem for Controls for View	Defines how the data is displayed, such as shifting the data to the left or right.

Text Value

Specify the number of characters that you want to shift the first line of the data.

Remarks

If this element is specified, you cannot specify the FirstLineIndent element.

See Also

FirstLineIndent Element for Frame for Controls for View

Frame Element for CustomItem for Controls for View

Writing a PowerShell Formatting File

FirstLineIndent Element for Frame for Controls for View

Article • 09/17/2021

Specifies how many characters the first line of data is shifted to the right. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Frame Element
- FirstLineIndent Element

Syntax

XML

```
<FirstLineIndent>NumberOfCharactersToShift</FirstLineIndent>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `FirstLineIndent` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
Frame Element for CustomItem for Controls for View	Defines how the data is displayed, such as shifting the data to the left or right.

Text Value

Specify the number of characters that you want to shift the first line of the data.

Remarks

If this element is specified, you cannot specify the FirstLineHanging element.

See Also

FirstLineHanging Element for Frame for Controls for View

Frame Element for CustomItem for Controls for View

Writing a PowerShell Formatting File

LeftIndent Element for Frame for Controls for View

Article • 09/17/2021

Specifies how many characters the data is shifted away from the left margin. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Frame Element
- LeftIndent Element

Syntax

XML

```
<LeftIndent>CharactersToShift</LeftIndent>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `LeftIndent` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
Frame Element for CustomItem for Controls for View	Defines how the data is displayed, such as shifting the data to the left or right.

Text Value

Specify the number of characters that you want to shift the data to the left.

Remarks

See Also

Frame Element for CustomItem for Controls for View

Writing a PowerShell Formatting File

RightIndent Element for Frame for Controls for View

Article • 09/17/2021

Specifies how many characters the data is shifted away from the right margin. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Frame Element
- RightIndent Element

Syntax

XML

```
<RightIndent>CharactersToShift</RightIndent>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `RightIndent` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
Frame Element for CustomItem for Controls for View	Defines how the data is displayed, such as shifting the data to the left or right.

Text Value

Specify the number of characters that you want to shift the data to the right.

Remarks

See Also

Frame Element for CustomItem for Controls for View

Writing a PowerShell Formatting File

NewLine Element for CustomItem for Controls for View

Article • 09/17/2021

Adds a blank line to the display of the control. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- NewLine Element

Syntax

XML

```
<NewLine/>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `NewLine` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
CustomItem Element for CustomEntry for Controls for View	Defines what data is displayed by the control and how it is displayed.

Remarks

See Also

CustomItem Element for CustomEntry for Controls for View

Writing a PowerShell Formatting File

Text Element for CustomItem for Controls for View

Article • 09/17/2021

Specifies text that is added to the data that is displayed by the control, such as a label, brackets to enclose the data, and spaces to indent the data. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element

Syntax

XML

```
<Text>TextToDisplay</Text>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `Text` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
CustomItem Element for CustomEntry for Controls for View	Defines what data is displayed by the control and how it is displayed.

Text Value

Specify the text of a control for data that you want to display.

Remarks

See Also

CustomItem Element for CustomEntry for Controls for View

Writing a PowerShell Formatting File

EntrySelectedBy Element for CustomEntry for Controls for View

Article • 09/17/2021

Defines the .NET types that use this control definition or the condition that must exist for this definition to be used. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element

Syntax

XML

```
<EntrySelectedBy>
  <TypeName>Nameof.NetType</TypeName>
  <SelectionSetName>NameofSelectionSet</SelectionSetName>
  <SelectionCondition>...</SelectionCondition>
</EntrySelectedBy>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `EntrySelectedBy` element. You must specify at least one type, selection set, or selection condition for a definition. There is no maximum limit to the number of child elements that you can use.

Attributes

None.

Child Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for Controls for View	Optional element. Defines the condition that must exist for this definition to be used.
SelectionSetName Element for EntrySelectedBy for Controls for View	Optional element. Specifies a set of .NET types that use this definition of the control.
TypeName Element for EntrySelectedBy for Controls for View	Optional element. Specifies a .NET type that uses this definition of the control.

Parent Elements

Element	Description
CustomEntry Element for CustomEntries for Controls for View	Provides a definition of the control.

Remarks

Selection conditions are used to define a condition that must exist for the definition to be used, such as when an object has a specific property or when a specific property value or script evaluates to `true`. For more information about selection conditions, see Defining Conditions for when a View Entry or Item is Used.

See Also

CustomEntry Element for CustomEntries for Controls for View

Writing a PowerShell Formatting File

SelectionCondition Element for EntrySelectedBy for Controls for View

Article • 09/17/2021

Defines a condition that must exist for the control definition to be used. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element
- SelectionCondition Element

Syntax

XML

```
<SelectionCondition>
  <TypeName>Nameof.NetType</TypeName>
  <SelectionSetName>NameofSelectionSet</SelectionSetName>
  <PropertyName>.NetTypeProperty</PropertyName>
  <ScriptBlock>ScriptToEvaluate</ScriptBlock>
</SelectionCondition>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `SelectionCondition` element.

Attributes

None.

Child Elements

Element	Description
PropertyName Element for SelectionCondition for Controls for View	Optional element. Specifies a .NET property that triggers the condition.
ScriptBlock Element for SelectionCondition for Controls for View	Optional element. Specifies the script that triggers the condition.
SelectionSetName Element for SelectionCondition for Controls for View	Optional element. Specifies the set of .NET types that triggers the condition.
TypeName Element for SelectionCondition for Controls for View	Optional element. Specifies a .NET type that triggers the condition.

Parent Elements

Element	Description
EntrySelectedBy Element for CustomEntry for Controls for View	Defines the .NET types that use this control definition or the condition that must exist for this definition to be used.

Remarks

When you are defining a selection condition, the following requirements apply:

- The selection condition must specify a least one property name or a script block, but cannot specify both.
- The selection condition can specify any number of .NET types or selection sets, but cannot specify both.

For more information about how to use selection conditions, see Defining Conditions for when Data is Displayed.

See Also

PropertyName Element for SelectionCondition for Controls for View

ScriptBlock Element for SelectionCondition for Controls for View

SelectionSetName Element for SelectionCondition for Controls for View

TypeName Element for SelectionCondition for Controls for View

EntrySelectedBy Element for CustomEntry for Controls for View

Writing a PowerShell Formatting File

PropertyName Element for SelectionCondition for CustomControl for View

Article • 09/17/2021

Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the definition is used. This element is used when defining a custom control view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- EntrySelectedBy Element
- SelectionCondition Element
- PropertyName Element

Syntax

XML

```
<PropertyName>.NetTypeProperty</PropertyName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `PropertyName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for CustomControl for View	Defines a condition that must exist for the control definition to be used.

Text Value

Specify the .NET property name.

Remarks

The selection condition must specify a least one property name or a script, but cannot specify both. For more information about how selection conditions can be used, see Defining Conditions for Displaying Data.

See Also

SelectionCondition Element for EntrySelectedBy for CustomControl for View

Writing a PowerShell Formatting File

ScriptBlock Element for SelectionCondition for CustomControl for View

Article • 09/17/2021

Specifies the script that triggers the condition. When this script is evaluated to `true`, the condition is met, and the definition is used. This element is used when defining a custom control view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- SelectionCondition Element
- ScriptBlock Element

Syntax

XML

```
<ScriptBlock>ScriptToEvaluate</ScriptBlock>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ScriptBlock` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for CustomControl for View	Defines a condition that must exist for the control definition to be used.

Text Value

Specify the script that is evaluated.

Remarks

The selection condition must specify a least one script or property name to evaluate, but cannot specify both. For more information about how selection conditions can be used, see Defining Conditions for Displaying Data.

See Also

SelectionCondition Element for EntrySelectedBy for CustomControl for View

Writing a PowerShell Formatting File

SelectionSetName Element for SelectionCondition for Controls for View

Article • 09/17/2021

Specifies the set of .NET types that trigger the condition. When any of the types in this set are present, the condition is met and the object is displayed using this control. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element
- SelectionCondition Element
- SelectionSetName Element

Syntax

XML

```
<SelectionSetName>NameofSelectionSet</SelectionSetName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `SelectionSetName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for Controls for View	Defines a condition that must exist for the control definition to be used.

Text Value

Specify the name of the selection set.

Remarks

Selection sets are common groups of .NET objects that can be used by any view that the formatting file defines. For more information about creating and referencing selection sets, see Defining Selection Sets.

The selection condition can specify a selection set or .NET type, but cannot specify both. For more information about how to use selection conditions, see Defining Conditions for Displaying Data.

See Also

SelectionCondition Element for EntrySelectedBy for Controls for View

Defining Conditions for When Data Is Displayed

Defining Selection Sets

Writing a PowerShell Formatting File

TypeName Element for SelectionCondition for Controls for View

Article • 09/17/2021

Specifies a .NET type that triggers the condition. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element
- SelectionCondition Element
- TypeName Element

Syntax

XML

```
<TypeName>Nameof.NetType</TypeName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `TypeName` Element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for Controls for View	Defines a condition that must exist for the control definition to be used.

Text Value

Specify the fully qualified name of the .NET type, such as `System.IO.DirectoryInfo`.

Remarks

See Also

SelectionCondition Element for EntrySelectedBy for Controls for View

Writing a PowerShell Formatting File

SelectionSetName Element for EntrySelectedBy for Controls for View

Article • 09/17/2021

Specifies a set of .NET types that use this definition of the control. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element
- SelectionSetName Element

Syntax

XML

```
<SelectionSetName>NameofSelectionSet</SelectionSetName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `SelectionSetName` element.

Attributes

None

Child Elements

None.

Parent Elements

Element	Description
EntrySelectedBy Element for CustomEntry for Controls for View	Defines the .NET types that use this control definition or the condition that must exist for this definition to be used.

Text Value

Specify the name of the selection set.

Remarks

Each control definition must have at least one type name, selection set, or selection condition defined.

Selection sets are typically used when you want to define a group of objects that are used in multiple views. For more information about defining selection sets, see Defining Selection Sets.

See Also

EntrySelectedBy Element for CustomEntry for Controls for View

Writing a PowerShell Formatting File

TypeName Element for EntrySelectedBy for Controls for View

Article • 09/17/2021

Specifies a .NET type that uses this definition of the control. This element is used when defining controls that can be used by a view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- TypeName Element

Syntax

XML

```
<TypeName>Nameof.NetType</TypeName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `TypeName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
EntrySelectedBy Element for CustomEntry for Controls for View	Defines the .NET types that use this control definition or the condition that must exist for this definition to be used.

Text Value

Specify the fully qualified name of the .NET type, such as `System.IO.DirectoryInfo`.

Remarks

See Also

EntrySelectedBy Element for CustomEntry for Controls for View

Writing a PowerShell Formatting File

Name Element for Control for Controls for View

Article • 09/17/2021

Specifies the name of the control.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Controls Element
- Control Element
- Name Element

Syntax

XML

```
<Name>ControlName</Name>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `Name` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description

Element	Description
Control Element for Controls for View	Defines a control that can be used by the view and the name that is used to reference the control.

Text Value

Specify the name that is used to reference the control.

Remarks

The name specified here can be used in the following elements to reference this control.

- When creating a table, list, wide or custom control view, the control can be specified by the following element: GroupBy Element for View
- When creating another control that can be used by a view, this control can be specified by the following element: ExpressionBinding Element for CustomItem for Controls for View

See Also

GroupBy Element for View

ExpressionBinding Element for CustomItem for Controls for View

Control Element for Controls for View

Writing a PowerShell Formatting File

CustomControl Element for View

Article • 09/17/2021

Defines a custom control format for the view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element

Syntax

XML

```
<CustomControl>
  <CustomEntries>...</CustomEntries>
</CustomControl>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `CustomControl` element. You must specify one child element.

Attributes

None.

Child Elements

Element	Description
CustomEntries Element for CustomControl for View	Required element. Provides the definitions of the custom control view.

Parent Elements

Element	Description
View Element	Defines a view that is used to display one or more .NET objects.

Remarks

In most cases, only one definition is required for each control view, but it is possible to provide multiple definitions if you want to use the same view to display different .NET objects. In those cases, you can provide a separate definition for each object or set of objects.

See Also

CustomEntries Element for CustomControl for View

View Element

Writing a PowerShell Formatting File

CustomEntries Element for CustomControl for View

Article • 09/17/2021

Provides the definitions of the custom control view. The custom control view must specify one or more definitions.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element

Syntax

XML

```
<CustomEntries>
  <CustomEntry>...</CustomEntry>
</CustomEntries>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `CustomControlEntries` element. You must specify one or more child elements.

Attributes

None.

Child Elements

Element	Description

Element	Description
CustomEntry Element for CustomEntries for View	Required element. Provides a definition of the custom control view.

Parent Elements

Element	Description
CustomControl Element for View	Required element. Defines a custom control format for the view.

Remarks

In most cases, a control has only one definition, which is defined in a single `CustomEntry` element. However it is possible to have multiple definitions if you want to use the same control to display different .NET objects. In those cases, you can define a `CustomEntry` element for each object or set of objects.

See Also

CustomControl Element for View

CustomEntry Element for CustomEntries for View

Writing a PowerShell Formatting File

CustomEntry Element for CustomEntries for CustomControl for View

Article • 09/17/2021

Provides a definition of the custom control view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element

Syntax

XML

```
<CustomEntry>
  <EntrySelectedBy>...</EntrySelectedBy>
  <CustomItem>...</CustomItem>
</CustomEntry>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `CustomEntry` element. You must specify the items displayed by the definition.

Attributes

None.

Child Elements

Element	Description

Element	Description
EntrySelectedBy Element for CustomEntry for View	Optional element. Defines the .NET types that use the definition of the custom control view or the condition that must exist for this definition to be used.
CustomItem Element for CustomEntry for View	Defines a control for the custom control definition.

Parent Elements

Element	Description
CustomEntries Element for CustomControl for View	Provides the definitions of the custom control view. The custom control view must specify one or more definitions.

Remarks

In most cases, only one definition is required for each custom control view, but it is possible to have multiple definitions if you want to use the same view to display different .NET objects. In those cases, you can provide a separate definition for each object or set of objects.

See Also

CustomControl Element for View

CustomItem Element for CustomEntry for View

EntrySelectedBy Element for CustomEntry for View

Writing a PowerShell Formatting File

CustomItem Element for CustomEntry for CustomControl for View

Article • 09/17/2021

Defines what data is displayed by the custom control view and how it is displayed. This element is used when defining a custom control view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element

Syntax

XML

```
<CustomItem>
  <ExpressionBinding>...</ExpressionBinding>
  <Frame>...</Frame>
  <NewLine/>
  <Text>TextToDisplay</Text>
</CustomItem>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `CustomItem` element.

Attributes

None.

Child Elements

Element	Description
ExpressionBinding Element for CustomItem for CustomControl for View	Optional element. Defines the data that is displayed by the control.
Frame Element for CustomItem for CustomControl for View	Optional element. Defines what data is displayed by the custom control view and how it is displayed.
NewLine Element for CustomItem for Custom Control for View	Optional element. Adds a blank line to the display of the control.
Text Element for CustomItem for CustomControl for View	Optional element. Specifies additional text to the data displayed by the control.

Parent Elements

Element	Description
CustomEntry Element for CustomEntries for CustomControl for View	Provides a definition of the custom control view.

Remarks

See Also

CustomEntry Element for CustomEntries for View

ExpressionBinding Element for CustomItem for CustomControl for View

Frame Element for CustomItem for CustomControl for View

NewLine Element for CustomItem for CustomControl for View

Text Element for CustomItem for CustomControl for View

Writing a PowerShell Formatting File

ExpressionBinding Element for CustomItem for CustomControl for View

Article • 02/06/2023

Defines the data that is displayed by the control. This element is used when defining a custom control view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element

Syntax

XML

```
<ExpressionBinding>
  <CustomControl>...</CustomControl>
  <CustomControlName>NameofCommonCustomControl</CustomControlName>
  <EnumerateCollection/>
  <ItemSelectionCondition>...</ItemSelectionCondition>
  <PropertyName>Nameof.NetTypeProperty</PropertyName>
  <ScriptBlock>ScriptToEvaluate</ScriptBlock>
</ExpressionBinding>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ExpressionBinding` element.

Attributes

None.

Child Elements

Element	Description
`CustomControl Element`	Optional element. Defines a control that is used by this control.
CustomControlName Element for ExpressionBinding for CustomControl for View	Optional element. Specifies the name of a common control or a view control.
EnumerateCollection Element for ExpressionBinding for CustomControl for View	Optional element. Specified that the elements of collections are displayed.
ItemSelectionCondition Element for ExpressionBinding for CustomControl for View	Optional element. Defines the condition that must exist for this control to be used.
PropertyName Element for ExpressionBinding for CustomControl for View	Optional element. Specifies the .NET property whose value is displayed by the control.
ScriptBlock Element for ExpressionBinding for CustomCustomControl for View	Optional element. Specifies the script whose value is displayed by the control.

Parent Elements

Element	Description
CustomItem Element for CustomEntry for CustomControl for View	Defines what data is displayed by the custom control view and how it is displayed.

Remarks

See Also

CustomControlName Element for ExpressionBinding for CustomControl for View

EnumerateCollection Element for ExpressionBinding for CustomControl for View

ItemSelectionCondition Element for ExpressionBinding for CustomControl for View

PropertyName Element for ExpressionBinding for CustomControl for View

ScriptBlock Element for ExpressionBinding for CustomControl for View

CustomItem Element for CustomEntry for CustomControl for View

Writing a PowerShell Formatting File

CustomControlName Element for ExpressionBinding for CustomControl for View

Article • 09/17/2021

Specifies the name of a common control or a view control. This element is used when defining a custom control view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- CustomControlName Element

Syntax

XML

```
<CustomControlName>NameofCustomControl</CustomControlName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `CustomControlName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ExpressionBinding Element for CustomItem	Defines the data that is displayed by the control.

Text Value

Specify the name of the control.

Remarks

You can create common controls that can be used by all the views of a formatting file and you can create view controls that can be used by a specific view. The names of these controls are specified by the following elements.

- Name Element for Control for Controls for Configuration
- Name Element for Control for Controls for View

See Also

Name Element for Control for Controls for Configuration

Name Element for Control for Controls for View

ExpressionBinding Element for CustomItem

Writing a PowerShell Formatting File

EnumerateCollection Element for ExpressionBinding for CustomControl for View

Article • 09/17/2021

Specifies that the elements of collections are displayed. This element is used when defining a custom control view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- EnumerateCollection Element

Syntax

```
XML
```

```
<EnumerateCollection/>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `EnumerateCollection` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ExpressionBinding Element for CustomItem	Defines the data that is displayed by the control.

Remarks

See Also

ExpressionBinding Element for CustomItem

Writing a PowerShell Formatting File

ItemSelectionCondition Element for ExpressionBinding for CustomControl

Article • 09/17/2021

Defines the condition that must exist for this control to be used. There is no limit to the number of selection conditions that can be specified for a control item. This element is used when defining a custom control view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- ItemSelectionCondition Element

Syntax

XML

```
<ItemSelectionCondition>
  <PropertyName>.NetTypeProperty</PropertyName>
  <ScriptBlock>ScriptToEvaluate</ScriptBlock>
</ItemSelectionCondition>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ItemSelectionCondition` element.

Attributes

None.

Child Elements

Element	Description
PropertyName Element for ItemSelectionCondition for CustomControl for View (Format	Optional element. Specifies the .NET property that triggers the condition.
ScriptBlock Element for ItemSelectionCondition for CustomControl for View	Optional element. Specifies the script that triggers the condition.

Parent Elements

Element	Description
ExpressionBinding Element for CustomItem for CustomControl for View	Defines the data that is displayed by the control.

Remarks

You can specify one property name or a script for this condition but cannot specify both.

See Also

Writing a PowerShell Formatting File

ExpressionBinding Element for CustomItem for CustomControl for View

PropertyName Element for ItemSelectionCondition for CustomControl for View

Article • 09/17/2021

Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the control is used. This element is used when defining a custom control view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element for CustomControl for View
- CustomEntry Element for CustomEntries for View
- CustomItem Element for CustomEntry for View
- ExpressionBinding Element for CustomItem for CustomControl for View
- ItemSelectionCondition Element for Expression Binding for CustomControl for View
- PropertyName Element for ItemSelectionCondition for CustomControl for View (Format

Syntax

XML

```
<PropertyName>.NetTypeProperty</PropertyName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `PropertyName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ItemSelectionCondition Element for Expression Binding for CustomControl for View	Defines the condition that must exist for this control to be used.

Text Value

Specify the name of the .NET property that triggers the condition.

Remarks

If this element is used, you cannot specify the ScriptBlock element when defining the selection condition.

See Also

ScriptBlock Element for ItemSelectionCondition for CustomControl for View

ItemSelectionCondition Element for Expression Binding for CustomControl for View

Writing a PowerShell Formatting File

ScriptBlock Element for ItemSelectionCondition for CustomControl for View

Article • 09/17/2021

Specifies the script that triggers the condition. When this script is evaluated to `true`, the condition is met, and the control is used. This element is used when defining a custom control view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- ItemSelectionCondition Element
- ScriptBlock Element

Syntax

XML

```
<ScriptBlock>ScriptToEvaluate</ScriptBlock>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ScriptBlock` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ItemSelectionCondition Element for Expression Binding for CustomControl for View	Defines the condition that must exist for this control to be used.

Text Value

Specify the script that is evaluated.

Remarks

If this element is used, you cannot specify the PropertyName element when defining the selection condition.

See Also

PropertyName Element for ItemSelectionCondition for CustomControl for View

ItemSelectionCondition Element for Expression Binding for CustomControl for View

Writing a PowerShell Formatting File

PropertyName Element for ExpressionBinding for CustomControl for View

Article • 09/17/2021

Specifies the .NET property whose value is displayed by the control. This element is used when defining a custom control view

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- PropertyName Element

Syntax

XML

```
<PropertyName>.NetTypeProperty</PropertyName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `PropertyName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ExpressionBinding Element for CustomItem for CustomControl for View	Defines the data that is displayed by the control.

Text Value

Specify the name of the .NET property whose value is displayed by the control.

Remarks

See Also

ExpressionBinding Element for CustomItem for CustomControl for View

Writing a PowerShell Formatting File

ScriptBlock Element for ExpressionBinding for CustomControl for View

Article • 09/17/2021

Specifies the script whose value is displayed by the control. This element is used when defining a custom control view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- ScriptBlock Element

Syntax

XML

```
<ScriptBlock>ScriptToEvaluate</ScriptBlock>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ScriptBlock` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ExpressionBinding Element for CustomItem for CustomControl for View	Defines the data that is displayed by the control.

Text Value

Specify the script whose value is displayed by the control.

Remarks

See Also

ExpressionBinding Element for CustomItem for CustomControl for View

Writing a PowerShell Formatting File

Frame Element for CustomItem for CustomControl for View

Article • 09/17/2021

Defines how the data is displayed, such as shifting the data to the left or right. This element is used when defining a custom control view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Frame Element

Syntax

XML

```
<Frame>
  <LeftIndent>NumberOfCharactersToShift</LeftIndent>
  <RightIndent>NumberOfCharactersToShift</RightIndent>
  <FirstLineHanging>NumberOfCharactersToShift</FirstLineHanging>
  <FirstLineIndent>NumberOfCharactersToShift</FirstLineIndent>
  <CustomItem>...</CustomItem>
</Frame>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `Frame` element.

Attributes

None.

Child Elements

Element	Description
`CustomItem Element`	Required Element
FirstLineHanging Element	Optional element. Specifies how many characters the first line of data is shifted to the left.
FirstLineIndent Element	Optional element. Specifies how many characters the first line of data is shifted to the right.
LeftIndent Element	Optional element. Specifies how many characters the data is shifted away from the left margin.
RightIndent Element	Optional element. Specifies how many characters the data is shifted away from the right margin.

Parent Elements

Element	Description
CustomItem Element for CustomEntry for View	Defines what data is displayed by the control and how it is displayed.

Remarks

You cannot specify the FirstLineHanging and the FirstLineIndent elements in the same `Frame` element.

See Also

FirstLineHanging Element

FirstLineIndent Element

LeftIndent Element

RightIndent Element

CustomItem Element for CustomEntry for View

Writing a PowerShell Formatting File

FirstLineHanging Element for Frame for CustomControl

Article • 09/17/2021

Specifies how many characters the first line of data is shifted to the left. This element is used when defining a custom control view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Frame Element
- FirstLineHanging Element

Syntax

XML

```
<FirstLineHanging>NumberOfCharactersToShift</FirstLineHanging>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `FirstLineHanging` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
Frame Element for CustomItem for CustomControl for View	Defines how the data is displayed, such as shifting the data to the left or right.

Text Value

Specify the number of characters that you want to shift the first line of the data.

Remarks

If this element is specified, you cannot specify the FirstLineIndent element.

See Also

FirstLineIndent Element for Frame for CustomControl for View

Frame Element for CustomItem for CustomControl for View

Writing a PowerShell Formatting File

FirstLineIndent Element for Frame for CustomControl for View

Article • 09/17/2021

Specifies how many characters the first line of data is shifted to the right. This element is used when defining a custom control view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Frame Element
- FirstLineIndent Element

Syntax

XML

```
<FirstLineIndent>NumberOfCharactersToShift</FirstLineIndent>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `FirstLineIndent` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
Frame Element for CustomItem for CustomControl for View	Defines how the data is displayed, such as shifting the data to the left or right.

Text Value

Specify the number of characters that you want to shift the first line of the data.

Remarks

If this element is specified, you cannot specify the FirstLineHanging element.

See Also

FirstLineHanging Element for Frame for CustomControl for View

Frame Element for CustomItem for CustomControl for View

Writing a PowerShell Formatting File

LeftIndent Element for Frame for CustomControl for View

Article • 09/17/2021

Specifies how many characters the data is shifted away from the left margin. This element is used when defining a custom control view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Frame Element
- LeftIndent Element

Syntax

XML

```
<LeftIndent>CharactersToShift</LeftIndent>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `LeftIndent` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
Frame Element for CustomItem for CustomControl for View	Defines how the data is displayed, such as shifting the data to the left or right.

Text Value

Specify the number of characters that you want to shift the data to the left.

Remarks

See Also

Frame Element for CustomItem for CustomControl for View

Writing a PowerShell Formatting File

RightIndent Element for Frame for CustomControl for View

Article • 09/17/2021

Specifies how many characters the data is shifted away from the right margin. This element is used when defining a custom control view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Frame Element
- RightIndent Element

Syntax

XML

```
<RightIndent>CharactersToShift</RightIndent>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `RightIndent` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
Frame Element for CustomItem for CustomControl for View	Defines how the data is displayed, such as shifting the data to the left or right.

Text Value

Specify the number of characters that you want to shift the data to the right.

Remarks

See Also

Frame Element for CustomItem for CustomControl for View

Writing a PowerShell Formatting File

NewLine Element for CustomItem for CustomControl for View

Article • 09/17/2021

Adds a blank line to the display of the control. This element is used when defining a custom control view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- NewLine Element

Syntax

XML

```
<NewLine/>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `NewLine` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
CustomItem Element for CustomEntry for View	Defines a control for the custom control view.

Remarks

See Also

CustomItem Element for CustomEntry for View

Writing a PowerShell Formatting File

Text Element for CustomItem for CustomView for View

Article • 09/17/2021

Specifies text that is added to the data that is displayed by the control, such as a label, brackets to enclose the data, and spaces to indent the data. This element is used when defining a custom control view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Text Element

Syntax

XML

```
<Text>TextToDisplay</Text>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `Text` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
CustomItem Element for CustomEntry for View	Defines a control for the custom control view.

Text Value

Specify the text of a control for data that you want to display.

Remarks

See Also

CustomItem Element for CustomEntry for View

Writing a PowerShell Formatting File

EntrySelectedBy Element for CustomEntry for CustomControl for View

Article • 09/17/2021

Defines the .NET types that use this custom entry or the condition that must exist for this entry to be used.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element

Syntax

XML

```
<EntrySelectedBy>
  <TypeName>Nameof.NetType</TypeName>
  <SelectionSetName>NameofSelectionSet</SelectionSetName>
  <SelectionCondition>...</SelectionCondition>
</EntrySelectedBy>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `EntrySelectedBy` element.

Attributes

None.

Child Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for CustomEntry	Optional element. Defines the condition that must exist for this definition to be used.
SelectionSetName Element for EntrySelectedBy for CustomEntry	Optional element. Specifies a set of .NET types that use this definition of the control view.
TypeName Element for EntrySelectedBy for CustomEntry	Optional element. Specifies a .NET type that uses this definition of the control view.

Parent Elements

Element	Description
CustomEntry Element for CustomEntries for View	Defines the controls used by specific .NET objects.

Remarks

You must specify at least one type, selection set, or selection condition for an entry. There is no maximum limit to the number of child elements that you can use.

Selection conditions are used to define a condition that must exist for the entry to be used, such as when an object has a specific property or when a specific property value or script evaluates to `true`. For more information about selection conditions, see Defining Conditions for when a View Entry or Item is Used.

For more information about the components of a custom control view, see Custom Control View.

See Also

SelectionCondition Element for EntrySelectedBy for CustomEntry

SelectionSetName Element for EntrySelectedBy for CustomEntry

TypeName Element for EntrySelectedBy for CustomEntry

CustomEntry Element for CustomEntries for View

Custom Control View

Writing a PowerShell Formatting File

SelectionCondition Element for EntrySelectedBy for CustomControl

Article • 02/06/2023

Defines a condition that must exist for a control definition to be used. This element is used when defining a custom control view.

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- EntrySelectedBy Element
- SelectionCondition Element

Syntax

XML

```
<SelectionCondition>
  <TypeName>Nameof.NetType</TypeName>
  <SelectionSetName>NameofSelectionSet</SelectionSetName>
  <PropertyName>.NetTypeProperty</PropertyName>
  <ScriptBlock>ScriptToEvaluate</ScriptBlock>
</SelectionCondition>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `SelectionCondition` element.

Attributes

None.

Child Elements

Element	Description
PropertyName Element for SelectionCondition for CustomControl for View	Optional element. Specifies a .NET property that triggers the condition.
ScriptBlock Element for SelectionCondition for CustomControl for View	Optional element. Specifies the script that triggers the condition.
SelectionSetName Element for SelectionCondition for Custom Control for View	Optional element. Specifies the set of .NET types that triggers the condition.
TypeName Element for SelectionCondition for CustomControl for View	Optional element. Specifies a .NET type that triggers the condition.

Parent Elements

Element	Description
EntrySelectedBy Element for CustomEntry for CustomControl for View	Defines the .NET types that use this control definition or the condition that must exist for this definition to be used.

Remarks

When you are defining a selection condition, the following requirements apply:

- The selection condition must specify a least one property name or a script block, but cannot specify both.
- The selection condition can specify any number of .NET types or selection sets, but cannot specify both.

For more information about how to use selection conditions, see Defining Conditions for when Data is Displayed.

See Also

PropertyName Element for SelectionCondition for CustomControl for View

ScriptBlock Element for SelectionCondition for CustomControl for View

SelectionSetName Element for SelectionCondition for Custom Control for View

TypeName Element for SelectionCondition for CustomControl for View

EntrySelectedBy Element for CustomEntry for CustomControl for View

Writing a PowerShell Formatting File

PropertyName Element for SelectionCondition for EntrySelectedBy for EnumerableExpansion

Article • 09/17/2021

Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the definition is used.

Schema

- Configuration Element
- DefaultSettings Element
- EnumerableExpansions Element
- EnumerableExpansion Element
- EntrySelectedBy Element
- SelectionCondition Element
- PropertyName Element

Syntax

XML

```
<PropertyName>.NetTypeProperty</PropertyName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `PropertyName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for EnumerableExpansion	Defines the condition that must exist to expand the collection objects of this definition.

Text Value

Specify the .NET property name.

Remarks

The selection condition must specify at least one property name or a script to evaluate, but cannot specify both. For more information about how to use selection conditions, see Defining Conditions for when Data is Displayed.

See Also

Defining Conditions for When Data is Displayed

ScriptBlock Element for SelectionCondition for EntrySelectedBy for EnumerableExpansion

SelectionCondition Element for EntrySelectedBy for EnumerableExpansion

Writing a PowerShell Formatting File

ScriptBlock Element for SelectionCondition for EntrySelectedBy for EnumerableExpansion

Article • 09/17/2021

Specifies the script that triggers the condition.

Schema

- Configuration Element
- DefaultSettings Element
- EnumerableExpansions Element
- EnumerableExpansion Element
- EntrySelectedBy Element
- SelectionCondition Element
- ScriptBlock Element

Syntax

XML

```
<ScriptBlock>ScriptToEvaluate</ScriptBlock>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ScriptBlock` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for EnumerableExpansion	Defines the condition that must exist to expand the collection objects of this definition.

Text Value

Specify the script that is evaluated.

Remarks

The selection condition must specify at least one script or property name to evaluate, but cannot specify both. For more information about how to use selection conditions, see Defining Conditions for when Data is Displayed.

See Also

Defining Conditions for When Data Is Displayed

PropertyName Element for SelectionCondition for EntrySelectedBy for EnumerableExpansion

SelectionCondition Element for EntrySelectedBy for EnumerableExpansion

Writing a PowerShell Formatting File

SelectionSetName Element for SelectionCondition for CustomControl for View

Article • 09/17/2021

Specifies the set of .NET types that trigger the condition. When any of the types in this set are present, the condition is met and the object is displayed using this control. This element is used when defining a custom control view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element

Syntax

XML

```
<SelectionSetName>NameofSelectionSet</SelectionSetName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `SelectionSetName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for CustomControl for View	Defines a condition that must exist for the control definition to be used.

Text Value

Specify the name of the selection set.

Remarks

Selection sets are common groups of .NET objects that can be used by any view that the formatting file defines. For more information about creating and referencing selection sets, see Defining Sets of Objects.

The selection condition can specify a selection set or .NET type, but cannot specify both. For more information about how to use selection conditions, see Defining Conditions for when Data is Displayed.

See Also

SelectionCondition Element for EntrySelectedBy for CustomControl for View

Defining Conditions for When Data Is Displayed

Defining Selection Sets

Writing a PowerShell Formatting File

TypeName Element for SelectionCondition for CustomControl for View

Article • 09/17/2021

Specifies a .NET type that triggers the condition. This element is used when defining a custom control view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- SelectionCondition Element
- TypeName Element

Syntax

XML

```
<TypeName>Nameof.NetType</TypeName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `TypeName` Element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for CustomControl for View	Defines a condition that must exist for the control definition to be used.

Text Value

Specify the fully qualified name of the .NET type, such as `System.IO.DirectoryInfo`.

Remarks

See Also

SelectionCondition Element for EntrySelectedBy for CustomControl for View

Writing a PowerShell Formatting File

SelectionSetName Element for EntrySelectedBy for CustomControl for View

Article • 09/17/2021

Specifies a set of .NET objects for the list entry. There is no limit to the number of selection sets that can be specified for an entry.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element
- SelectionSetName Element

Syntax

XML

```
<SelectionSetName>NameofSelectionSet</SelectionSetName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `SelectionSetName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
EntrySelectedBy Element for CustomEntry for View	Defines the .NET types that use this custom entry or the condition that must exist for this entry to be used.

Text Value

Specify the name of the selection set.

Remarks

Each custom control entry must have at least one type name, selection set, or selection condition defined.

Selection sets are typically used when you want to define a group of objects that are used in multiple views. For example, you might want to create a table view and a list view for the same set of objects. For more information about defining selection sets, see Defining Selection Sets.

For more information about the components of a custom control view, see Creating Custom Controls.

See Also

EntrySelectedBy Element for CustomEntry for View

Custom Control View

Writing a PowerShell Formatting File

TypeName Element for EntrySelectedBy for CustomEntry for View

Article • 09/17/2021

Specifies a .NET type that uses this definition of the custom control view. There is no limit to the number of types that can be specified for a definition.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element
- TypeName Element

Syntax

XML

```
<TypeName>Nameof.NetType</TypeName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `TypeName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
EntrySelectedBy Element for CustomEntry for View	Defines the .NET types that use this custom control view definition or the condition that must exist for this definition to be used.

Text Value

Specify the fully qualified name of the .NET type, such as `System.IO.DirectoryInfo`.

Remarks

Each custom control view definition must have at least one type name, selection set, or selection condition defined.

For more information about the components of a custom control view, see Creating Custom Controls.

See Also

Creating Custom Controls

EntrySelectedBy Element for CustomEntry for View

Writing a PowerShell Formatting File

GroupBy Element for View

Article • 09/17/2021

Defines how a new group of objects is displayed. This element is used when defining a table, list, wide, or custom control view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element

Syntax

XML

```
<GroupBy>
  <PropertyName>.NetTypeProperty</PropertyName>
  <ScriptBlock>ScriptToEvaluate</ScriptBlock>
  <Label>TextToDisplay</Label>
  <CustomControl>...</CustomControl>
  <CustomControlName>NameOfControl</CustomControlName>
</GroupBy>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent elements.

Attributes

None.

Child Elements

Element	Description
CustomControl Element for GroupBy	Optional element. Defines the custom control that display new groups.

Element	Description
CustomControlName Element for GroupBy	Optional element. Specifies the name of a control that is used to display the new group.
Label Element for GroupBy	Optional element. Specifies a label that is displayed when a new group is encountered.
PropertyName Element for GroupBy	Optional element. Specifies the .NET property the starts a new group whenever its value changes.
ScriptBlock Element for GroupBy	Optional element. Specifies the script that starts a new group whenever its value changes.

Parent Elements

Element	Description
View Element	Defines a view that displays one or more .NET objects.

Remarks

When defining how a new group of objects is displayed, you must specify the property or script that will start the new group; however, you cannot specify both.

See Also

CustomControlName Element for GroupBy

Label Element for GroupBy

PropertyName Element for GroupBy

ScriptBlock Element for GroupBy

View Element

CustomControl Element for GroupBy

Article • 09/17/2021

Defines the custom control that displays the new group.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element

Syntax

XML

```
<CustomControl>
  <CustomEntries>...</CustomEntries>
<CustomControl>
```

Attributes and Elements

The following sections describe the attributes, child elements, and parent element of the `CustomControl` element. You can specify any number of child elements and list them in any order.

Attributes

None.

Child Elements

Element	Description
CustomEntries Element for CustomControl for GroupBy	Required element. Provides the definitions for the control.

Parent Elements

Element	Description
GroupBy Element for View	Defines how Windows PowerShell displays a new group of objects.

Remarks

See Also

CustomEntries Element for CustomControl for GroupBy

GroupBy Element for View

Writing a PowerShell Formatting File

CustomEntries Element for CustomControl for GroupBy

Article • 09/17/2021

Provides the definitions for the control. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element

Syntax

XML

```
<CustomEntries>
  <CustomEntry>...</CustomEntry>
</CustomEntries>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent elements of the `CustomEntries` element. There is no maximum limit to the number of child elements that can be specified.

Attributes

None.

Child Elements

Element	Description

Element	Description
CustomEntry Element for CustomControl for GroupBy	Required element. Provides a definition of the control.

Parent Elements

Element	Description
CustomControl Element for GroupBy	Defines the custom control that displays the new group.

Remarks

In most cases, a control has only one definition, which is specified in a single `CustomEntry` element. However, it is possible to provide multiple definitions if you want to use the same control to display different groups. In those cases, you can define a `CustomEntry` element for a group.

See Also

CustomEntry Element for CustomEntries for Controls for View

CustomControl Element for GroupBy

Writing a PowerShell Formatting File

CustomEntry Element for CustomControl for GroupBy

Article • 09/17/2021

Provides a definition of the control. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element

Syntax

XML

```
<CustomEntry>
  <EntrySelectedBy>...</EntrySelectedBy>
  <CustomItem>...</CustomItem>
</CustomEntry>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent elements of the `CustomEntry` element.

Attributes

None.

Child Elements

Element	Description
EntrySelectedBy Element for CustomEntry for GroupBy	Optional element. Defines the .NET types that use this control definition or the condition that must exist for this definition to be used.
CustomItem Element for CustomEntry for GroupBy	Required element. Defines how the control displays the data.

Parent Elements

Element	Description
CustomEntries Element for CustomControl for GroupBy	Provides the definitions for the control.

Remarks

See Also

EntrySelectedBy Element for CustomEntry for GroupBy

CustomItem Element for CustomEntry for GroupBy

CustomEntries Element for CustomControl for GroupBy

Writing a PowerShell Formatting File

CustomItem Element for CustomEntry for GroupBy

Article • 09/17/2021

Defines what data is displayed by the custom control view and how it is displayed. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element
- CustomItem Element

Syntax

XML

```
<CustomItem>
  <ExpressionBinding>...</ExpressionBinding>
  <Frame>...</Frame>
  <NewLine/>
  <Text>TextToDisplay</Text>
</CustomItem>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `CustomItem` element.

Attributes

None.

Child Elements

Element	Description
ExpressionBinding Element for CustomItem for GroupBy	Optional element. Defines the data that is displayed by the control.
Frame Element for CustomItem for GroupBy	Optional element. Defines what data is displayed by the custom control view and how it is displayed.
NewLine Element for CustomItem for GroupBy	Optional element. Adds a blank line to the display of the control.
Text Element for CustomItem for GroupBy	Optional element. Specifies additional text to the data displayed by the control.

Parent Elements

Element	Description
CustomEntry Element for CustomControl for GroupBy	Provides a definition of the custom control view.

Remarks

See Also

CustomEntry Element for CustomControl for GroupBy

ExpressionBinding Element for CustomItem for GroupBy

Frame Element for CustomItem for GroupBy

NewLine Element for CustomItem for GroupBy

Text Element for CustomItem for GroupBy

Writing a PowerShell Formatting File

ExpressionBinding Element for CustomItem for GroupBy

Article • 09/17/2021

Defines the data that is displayed by the control. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element

Syntax

XML

```
<ExpressionBinding>
  <CustomControl>...</CustomControl>
  <CustomControlName>NameofCommonCustomControl</CustomControlName>
  <EnumerateCollection/>
  <ItemSelectionCondition>...</ItemSelectionCondition>
  <PropertyName>Nameof.NetTypeProperty</PropertyName>
  <ScriptBlock>ScriptToEvaluate></ScriptBlock>
</ExpressionBinding>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ExpressionBinding` element.

Attributes

None.

Child Elements

Element	Description
`CustomControl Element`	Optional element. Defines a control that is used by this control.
CustomControlName Element for ExpressionBinding for GroupBy	Optional element. Specifies the name of a common control or a view control.
EnumerateCollection Element for ExpressionBinding for GroupByEnumerateCollection Element for ExpressionBinding for GroupBy	Optional element. Specified that the elements of collections are displayed.
ItemSelectionCondition Element for ExpressionBinding for GroupBy	Optional element. Defines the condition that must exist for this control to be used.
PropertyName Element for ExpressionBinding for GroupBy	Optional element. Specifies the .NET property whose value is displayed by the control.
ScriptBlock Element for ExpressionBinding for GroupBy	Optional element. Specifies the script whose value is displayed by the control.

Parent Elements

Element	Description
CustomItem Element for CustomEntry for GroupBy	Defines what data is displayed by the custom control view and how it is displayed.

See Also

CustomControlName Element for ExpressionBinding for GroupBy

EnumerateCollection Element for ExpressionBinding for GroupBy

ItemSelectionCondition Element for ExpressionBinding for GroupBy

PropertyName Element for ExpressionBinding for GroupBy

ScriptBlock Element for ExpressionBinding for GroupBy

CustomItem Element for CustomEntry for GroupBy

Writing a PowerShell Formatting File

CustomControlName Element for ExpressionBinding for GroupBy

Article • 09/17/2021

Specifies the name of a common control or a view control. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- CustomControlName Element

Syntax

XML

```
<CustomControlName>NameofCustomControl</CustomControlName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `CustomControlName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ExpressionBinding Element for CustomItem for GroupBy	Defines the data that is displayed by the control.

Text Value

Specify the name of the control.

Remarks

You can create common controls that can be used by all the views of a formatting file, and you can create view controls that can be used by a specific view. The following elements specify the names of these controls:

- Name Element for Control for Controls for Configuration
- Name Element for Control for Controls for View

See Also

Name Element for Control for Controls for Configuration

Name Element for Control for Controls for View

ExpressionBinding Element for CustomItem for GroupBy

Writing a PowerShell Formatting File

EnumerateCollection Element for ExpressionBinding for GroupBy

Article • 09/17/2021

Specifies that the elements of collections are displayed. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- EnumerateCollection Element

Syntax

XML

```
<EnumerateCollection/>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `EnumerateCollection` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ExpressionBinding Element for CustomItem for GroupBy	Defines the data that is displayed by the control.

Remarks

See Also

ExpressionBinding Element for CustomItem for GroupBy

Writing a PowerShell Formatting File

ItemSelectionCondition Element for ExpressionBinding for GroupBy

Article • 09/17/2021

Defines the condition that must exist for this control to be used. There is no limit to the number of selection conditions that can be specified for a control item. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- ItemSelectionCondition Element

Syntax

XML

```
<ItemSelectionCondition>
  <PropertyName>.NetTypeProperty</PropertyName>
  <ScriptBlock>ScriptToEvaluate</ScriptBlock>
</ItemSelectionCondition>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ItemSelectionCondition` element.

Attributes

None.

Child Elements

Element	Description
PropertyName Element for ItemSelectionCondition for GroupBy	Optional element. Specifies the .NET property that triggers the condition.
ScriptBlock Element for ItemSelectionCondition for GroupBy	Optional element. Specifies the script that triggers the condition.

Parent Elements

Element	Description
ExpressionBinding Element for CustomItem for GroupBy	Defines the data that is displayed by the control.

Remarks

You can specify one property name or a script for this condition but cannot specify both.

See Also

Writing a PowerShell Formatting File

ExpressionBinding Element for CustomItem for GroupBy

PropertyName Element for ItemSelectionCondition for GroupBy

Article • 09/17/2021

Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the control is used. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- ItemSelectionCondition Element
- PropertyName Element

Syntax

XML

```
<PropertyName>.NetTypeProperty</PropertyName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `PropertyName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ItemSelectionCondition Element for ExpressionBinding for GroupBy	Defines the condition that must exist for this control to be used.

Text Value

Specify the name of the .NET property that triggers the condition.

Remarks

If this element is used, you cannot specify the ScriptBlock element when defining the selection condition.

See Also

ScriptBlock Element for ItemSelectionCondition for GroupBy

ItemSelectionCondition Element for ExpressionBinding for GroupBy

Writing a PowerShell Formatting File

ScriptBlock Element for ItemSelectionCondition for GroupBy

Article • 09/17/2021

Specifies the script that triggers the condition. When this script is evaluated to `true`, the condition is met, and the control is used. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- ItemSelectionCondition Element
- ScriptBlock Element

Syntax

XML

```
<ScriptBlock>ScriptToEvaluate</ScriptBlock>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ScriptBlock` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ItemSelectionCondition Element for ExpressionBinding for GroupBy	Defines the condition that must exist for this control to be used.

Text Value

Specify the script that is evaluated.

Remarks

If this element is used, you cannot specify the PropertyName element when defining the selection condition.

See Also

ItemSelectionCondition Element for ExpressionBinding for GroupBy

PropertyName Element for ItemSelectionCondition for GroupBy

Writing a PowerShell Formatting File

PropertyName Element for ExpressionBinding for GroupBy

Article • 09/17/2021

Specifies the .NET property whose value is displayed by the control. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- PropertyName Element

Syntax

XML

```
<PropertyName>.NetTypeProperty</PropertyName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `PropertyName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ExpressionBinding Element for CustomItem for GroupBy	Defines the data that is displayed by the control.

Text Value

Specify the name of the .NET property whose value is displayed by the control.

Remarks

See Also

ExpressionBinding Element for CustomItem for GroupBy

Writing a PowerShell Formatting File

ScriptBlock Element for ExpressionBinding for GroupBy

Article • 09/17/2021

Specifies the script whose value is displayed by the control. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- ExpressionBinding Element
- ScriptBlock Element

Syntax

XML

```
<ScriptBlock>ScriptToEvaluate</ScriptBlock>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ScriptBlock` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ExpressionBinding Element for CustomItem for GroupBy	Defines the data that is displayed by the control.

Text Value

Specify the script whose value is displayed by the control.

Remarks

See Also

ExpressionBinding Element for CustomItem for GroupBy

Writing a PowerShell Formatting File

Frame Element for CustomItem for GroupBy

Article • 09/17/2021

Defines how the data is displayed, such as shifting the data to the left or right. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Frame Element

Syntax

XML

```
<Frame>
  <LeftIndent>NumberOfCharactersToShift</LeftIndent>
  <RightIndent>NumberOfCharactersToShift</RightIndent>
  <FirstLineHanging>NumberOfCharactersToShift</FirstLineHanging>
  <FirstLineIndent>NumberOfCharactersToShift</FirstLineIndent>
  <CustomItem>...</CustomItem>
</Frame>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `Frame` element.

Attributes

None.

Child Elements

Element	Description
`CustomItem Element`	Required Element
FirstLineHanging Element for Frame for GroupBy	Optional element. Specifies how many characters the first line of data is shifted to the left.
FirstLineIndent Element for Frame for GroupBy	Optional element. Specifies how many characters the first line of data is shifted to the right.
LeftIndent Element for Frame for GroupBy	Optional element. Specifies how many characters the data is shifted away from the left margin.
RightIndent Element for Frame for GroupByRightIndent Element	Optional element. Specifies how many characters the data is shifted away from the right margin.

Parent Elements

Element	Description
CustomItem Element for CustomEntry for GroupBy	Defines what data is displayed by the control and how it is displayed.

Remarks

You cannot specify the FirstLineHanging and the FirstLineIndent elements in the same `Frame` element.

See Also

FirstLineHanging Element for Frame for GroupBy

FirstLineIndent Element for Frame for GroupBy

LeftIndent Element for Frame for GroupBy

RightIndent Element for Frame for GroupBy

CustomItem Element for CustomEntry for GroupBy

Writing a PowerShell Formatting File

FirstLineHanging Element for Frame for GroupBy

Article • 09/17/2021

Specifies how many characters the first line of data is shifted to the left. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Frame Element
- FirstLineHanging Element

Syntax

XML

```
<FirstLineHanging>NumberOfCharactersToShift</FirstLineHanging>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `FirstLineHanging` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
Frame Element for CustomItem for GroupBy	Defines how the data is displayed, such as shifting the data to the left or right.

Text Value

Specify the number of characters that you want to shift the first line of the data.

Remarks

If this element is specified, you cannot specify the FirstLineIndent element.

See Also

FirstLineIndent Element for Frame for GroupBy

Frame Element for CustomItem for GroupBy

Writing a PowerShell Formatting File

FirstLineIndent Element for Frame for GroupBy

Article • 09/17/2021

Specifies how many characters the first line of data is shifted to the right. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element for View
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Frame Element
- FirstLineIndent Element

Syntax

XML

```
<FirstLineIndent>NumberOfCharactersToShift</FirstLineIndent>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `FirstLineIndent` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
Frame Element for CustomItem for GroupBy	Defines how the data is displayed, such as shifting the data to the left or right.

Text Value

Specify the number of characters that you want to shift the first line of the data.

Remarks

If this element is specified, you cannot specify the FirstLineHanging element.

See Also

FirstLineHanging Element for Frame for GroupBy

Frame Element for CustomItem for GroupBy

Writing a PowerShell Formatting File

LeftIndent Element for Frame

Article • 09/17/2021

Specifies how many characters the data is shifted away from the left margin. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Frame Element
- LeftIndent Element

Syntax

XML

```
<LeftIndent>CharactersToShift</LeftIndent>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `LeftIndent` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
Frame Element for CustomItem for GroupBy	Defines how the data is displayed, such as shifting the data to the left or right.

Text Value

Specify the number of characters that you want to shift the data to the left.

Remarks

See Also

Frame Element for CustomItem for GroupBy

Writing a PowerShell Formatting File

RightIndent Element for Frame for GroupBy

Article • 09/17/2021

Specifies how many characters the data is shifted away from the right margin. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Frame Element
- RightIndent Element

Syntax

XML

```
<RightIndent>CharactersToShift</RightIndent>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `RightIndent` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
Frame Element for CustomItem for GroupBy	Defines how the data is displayed, such as shifting the data to the left or right.

Text Value

Specify the number of characters that you want to shift the data to the right.

Remarks

See Also

Frame Element for CustomItem for GroupBy

Writing a PowerShell Formatting File

NewLine Element for CustomItem for GroupBy

Article • 09/17/2021

Adds a blank line to the display of the control. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- NewLine Element

Syntax

XML

```
<NewLine/>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `NewLine` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
CustomItem Element for CustomEntry for GroupBy	Defines a control for the custom control view.

Remarks

See Also

CustomItem Element for CustomEntry for GroupBy

Writing a PowerShell Formatting File

Text Element for CustomItem for GroupBy

Article • 09/17/2021

Specifies text that is added to the data that is displayed by the control, such as a label, brackets to enclose the data, and spaces to indent the data. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- CustomItem Element
- Text Element

Syntax

XML

```
<Text>TextToDisplay</Text>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `Text` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
CustomItem Element for CustomEntry for GroupBy	Defines a control for the custom control view.

Text Value

Specify the text of a control for data that you want to display.

Remarks

See Also

CustomItem Element for CustomEntry for GroupBy

Writing a PowerShell Formatting File

EntrySelectedBy Element for CustomEntry for GroupBy

Article • 09/17/2021

Defines the .NET types that use this control definition or the condition that must exist for this definition to be used. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element for View
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element

Syntax

XML

```
<EntrySelectedBy>
  <TypeName>Nameof.NetType</TypeName>
  <SelectionSetName>NameofSelectionSet</SelectionSetName>
  <SelectionCondition>...</SelectionCondition>
</EntrySelectedBy>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `EntrySelectedBy` element. You must specify at least one type, selection set, or selection condition for a definition. There is no maximum limit to the number of child elements that you can use.

Attributes

None.

Child Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for GroupBy	Optional element. Defines the condition that must exist for this definition to be used.
SelectionSetName Element for EntrySelectedBy for GroupBy	Optional element. Specifies a set of .NET types that use this definition of the control.
TypeName Element for EntrySelectedBy for GroupBy	Optional element. Specifies a .NET type that uses this definition of the control.

Parent Elements

Element	Description
CustomEntry Element for CustomControl for GroupBy	Provides a definition of the control.

Remarks

Selection conditions are used to define a condition that must exist for the definition to be used, such as when an object has a specific property or when a specific property value or script evaluates to `true`. For more information about selection conditions, see Defining Conditions for when a View Entry or Item is Used.

See Also

SelectionCondition Element for EntrySelectedBy for GroupBy

SelectionSetName Element for EntrySelectedBy for GroupBy

TypeName Element for EntrySelectedBy for GroupBy

CustomEntry Element for CustomEntries for Controls for View

SelectionCondition Element for EntrySelectedBy for GroupBy

Article • 09/17/2021

Defines a condition that must exist for a control definition to be used. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element for View
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element
- SelectionCondition Element

Syntax

XML

```
<SelectionCondition>
  <TypeName>Nameof.NetType</TypeName>
  <SelectionSetName>NameofSelectionSet</SelectionSetName>
  <PropertyName>.NetTypeProperty</PropertyName>
  <ScriptBlock>ScriptToEvaluate</ScriptBlock>
</SelectionCondition>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `SelectionCondition` element.

Attributes

None.

Child Elements

Element	Description
PropertyName Element for SelectionCondition for GroupBy	Optional element. Specifies a .NET property that triggers the condition.
ScriptBlock Element for SelectionCondition for GroupBy	Optional element. Specifies the script that triggers the condition.
SelectionSetName Element for SelectionCondition for GroupBy	Optional element. Specifies the set of .NET types that triggers the condition.
TypeName Element for SelectionCondition for GroupBy	Optional element. Specifies a .NET type that triggers the condition.

Parent Elements

Element	Description
EntrySelectedBy Element for CustomEntry for GroupBy	Defines the .NET types that use this control definition or the condition that must exist for this definition to be used.

Remarks

When you are defining a selection condition, the following requirements apply:

- The selection condition must specify a least one property name or a script block, but cannot specify both.
- The selection condition can specify any number of .NET types or selection sets, but cannot specify

  both. For more information about how to use selection conditions, see Defining Conditions for when Data is Displayed.

See Also

PropertyName Element for SelectionCondition for CustomControl for View

ScriptBlock Element for SelectionCondition for CustomControl for View

SelectionSetName Element for SelectionCondition for Custom Control for View

TypeName Element for SelectionCondition for GroupBy

EntrySelectedBy Element for CustomEntry for GroupBy

Writing a PowerShell Formatting File

PropertyName Element for SelectionCondition for GroupBy

Article • 09/17/2021

Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the definition is used. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element
- SelectionCondition Element
- PropertyName Element

Syntax

XML

```
<PropertyName>.NetTypeProperty</PropertyName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `PropertyName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for GroupBy	Defines a condition that must exist for the control definition to be used.

Text Value

Specify the .NET property name.

Remarks

The selection condition must specify a least one property name or a script, but cannot specify both. For more information about how selection conditions can be used, see Defining Conditions for Displaying Data.

See Also

SelectionCondition Element for EntrySelectedBy for GroupBy

Writing a PowerShell Formatting File

ScriptBlock Element for SelectionCondition for EntrySelectedBy for GroupBy

Article • 09/17/2021

Specifies the script that triggers the condition. When this script is evaluated to `true`, the condition is met, and the definition is used. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element
- SelectionCondition Element
- ScriptBlock Element

Syntax

XML

```
<ScriptBlock>ScriptToEvaluate</ScriptBlock>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ScriptBlock` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for GroupBy	Defines a condition that must exist for the control definition to be used.

Text Value

Specify the script that is evaluated.

Remarks

The selection condition must specify a least one script or property name to evaluate, but cannot specify both. For more information about how selection conditions can be used, see Defining Conditions for Displaying Data.

See Also

SelectionCondition Element for EntrySelectedBy for GroupBy

Writing a PowerShell Formatting File

SelectionSetName Element for SelectionCondition for GroupBy

Article • 09/17/2021

Specifies the set of .NET types that trigger the condition. When any of the types in this set are present, the condition is met, and the object is displayed by using this control. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element
- SelectionCondition Element
- SelectionSetName Element

Syntax

XML

```
<SelectionSetName>NameofSelectionSet</SelectionSetName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `SelectionSetName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for GroupBy	Defines a condition that must exist for the control definition to be used.

Text Value

Specify the name of the selection set.

Remarks

Selection sets are common groups of .NET objects that can be used by any view that the formatting file defines. For more information about creating and referencing selection sets, see Defining Selection Sets.

When this element is specified, you cannot specify the TypeName element. For more information about defining selection conditions, see Defining Conditions for Displaying Data.

See Also

TypeName Element for SelectionCondition for GroupBy

SelectionCondition Element for EntrySelectedBy for GroupBy

Defining Conditions for When Data Is Displayed

Defining Selection Sets

Writing a PowerShell Formatting File

TypeName Element for SelectionCondition for GroupBy

Article • 09/17/2021

Specifies a .NET type that triggers the condition. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element
- SelectionCondition Element
- TypeName Element

Syntax

XML

```
<TypeName>Nameof.NetType</TypeName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `TypeName` Element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for GroupBy	Defines a condition that must exist for the control definition to be used.

Text Value

Specify the fully qualified name of the .NET type, such as `System.IO.DirectoryInfo`.

Remarks

When this element is specified, you cannot specify the `SelectionSetName` element. For more information about defining selection conditions, see Defining Conditions for Displaying Data.

See Also

SelectionCondition Element for EntrySelectedBy for GroupBy

Writing a PowerShell Formatting File

SelectionSetName Element for EntrySelectedBy for GroupBy

Article • 09/17/2021

Specifies a set of .NET objects for the list entry. There is no limit to the number of selection sets that can be specified for an entry. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element
- SelectionSetName Element

Syntax

XML

```
<SelectionSetName>NameofSelectionSet</SelectionSetName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `SelectionSetName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
EntrySelectedBy Element for CustomEntry for GroupBy	Defines the .NET types that use this custom entry or the condition that must exist for this entry to be used.

Text Value

Specify the name of the selection set.

Remarks

Each custom control definition must have at least one type name, selection set, or selection condition defined.

Selection sets are typically used when you want to define a group of objects that are used in multiple views. For example, you may want to create a table view and a list view for the same set of objects. For more information about defining selection sets, see Defining Selection Sets.

For more information about the components of a custom control view, see Creating Custom Controls.

See Also

EntrySelectedBy Element for CustomEntry for GroupBy

Creating Custom Controls

Writing a PowerShell Formatting File

TypeName Element for EntrySelectedBy for GroupBy

Article • 09/17/2021

Specifies a .NET type that uses this definition of the custom control. This element is used when defining how a new group of objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControl Element
- CustomEntries Element
- CustomEntry Element
- EntrySelectedBy Element
- TypeName Element

Syntax

XML

```
<TypeName>Nameof.NetType</TypeName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `TypeName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
EntrySelectedBy Element for CustomEntry for GroupBy	Defines the .NET types that use this control definition or the condition that must exist for this definition to be used.

Text Value

Specify the fully qualified name of the .NET type, such as `System.IO.DirectoryInfo`.

Remarks

Each control definition must have at least one type name, selection set, or selection condition defined.

For more information about the components of a custom control view, see Creating Custom Controls.

See Also

Creating Custom Controls

EntrySelectedBy Element for CustomEntry for GroupBy

Writing a PowerShell Formatting File

CustomControlName Element for GroupBy

Article • 09/17/2021

Specifies the name of a custom control that is used to display the new group. This element is used when defining a table, list, wide or custom control view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- CustomControlName Element

Syntax

XML

```
<CustomControlName>ControlName</CustomControlName>
```

Attributes and Elements

The following sections describe the attributes, child elements, and parent elements of the `CustomControlName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description

Element	Description
GroupBy Element for View	Defines how Windows PowerShell displays a new group of objects.

Text Value

Specify the name of the custom control that is used to display a new group.

Remarks

You can create common controls that can be used by all the views of a formatting file, and you can create view controls that can be used by a specific view. The following elements specify the names of these custom controls:

- Name Element for Control for Controls for Configuration
- Name Element for Control for Controls for View

See Also

GroupBy Element for View

Name Element for Control for Controls for Configuration

Name Element for Control for Controls for View

Writing a PowerShell Formatting File

Label Element for GroupBy

Article • 09/17/2021

Specifies a label that is displayed when a new group is encountered.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- Label Element

Syntax

```
XML

<Label>DisplayedLabel</Label>
```

Attributes and Elements

The following sections describe the attributes, child elements, and parent element of the `Label` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
GroupBy Element for View	Defines how a new group of objects is displayed.

Text Value

Specify the text that is displayed whenever Windows PowerShell encounters a new property or script value.

Remarks

In addition to the text specified by this element, Windows PowerShell displays the new value that starts the group, and adds a blank line before and after the group.

Example

The following example shows the label for a new group. The displayed label would look similar to this: `Service Type: NewValueofProperty`

XML

```
<GroupBy>
  <Label>Service Type</Label>
  <PropertyName>ServiceType</PropertyName>
</GroupBy>
```

For an example of a complete formatting file that includes this element, see Wide View (GroupBy).

See Also

GroupBy Element for View

Writing a PowerShell Formatting File

PropertyName Element for GroupBy

Article • 09/17/2021

Specifies the .NET property that starts a new group whenever its value changes.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- PropertyName Element

Syntax

XML

```
<PropertyName>.NetTypeProperty</PropertyName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `PropertyName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
GroupBy Element for View	Defines how a group of .NET objects is displayed.

Text Value

Specify the .NET property name.

Remarks

Windows PowerShell starts a new group whenever the value of this property changes.

When this element is specified, you cannot specify the ScriptBlock element to start a new group.

Example

The following example shows how to start a new group when the value of a property changes.

XML

```
<GroupBy>
  <Label>Service Type</Label>
  <PropertyName>ServiceType</PropertyName>
</GroupBy>
```

For an example of a complete formatting file that includes this element, see Wide View (GroupBy).

See Also

GroupBy Element for View

ScriptBlock Element for GroupBy

Writing a PowerShell Formatting File

ScriptBlock Element for GroupBy

Article • 09/17/2021

Specifies the script that starts a new group whenever its value changes.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- GroupBy Element
- ScriptBlock Element

Syntax

```XML
<ScriptBlock>ScriptToEvaluate</ScriptBlock>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ScriptBlock` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
GroupBy Element for View	Defines how a group of .NET objects is displayed.

Text Value

Specify the script that is evaluated.

Remarks

PowerShell starts a new group whenever the value of this script changes.

When this element is specified, you cannot specify the PropertyName element to start a new group.

See Also

PropertyName Element for GroupBy

GroupBy Element for View

Writing a PowerShell Formatting File

ListControl Element

Article • 09/17/2021

Defines a list format for the view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- ListControl Element

Syntax

XML

```
<ListControl>
  <ListEntries>...</ListEntries>
</ListControl>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `ListControl` element. This element must contain only a single child element.

Attributes

None.

Child Elements

Element	Description
ListEntries Element	Required element. Provides the definitions of the list view.

Parent Elements

Element	Description
View Element	Defines a view that is used to display the members of one or more objects.

Remarks

For more information about creating a list view, see Creating a List View.

Example

This example shows a list view for the System.Serviceprocess.Servicecontroller object.

```
<View>
  <Name>System.ServiceProcess.ServiceController</Name>
  <ViewSelectedBy>
    <TypeName>System.ServiceProcess.ServiceController</TypeName>
  </ViewSelectedBy>
  <ListControl>
    <ListEntries>
      <ListEntry>...</ListEntry>
    </ListEntries>
  </ListControl>
</View>
```

See Also

View Element

ListEntries Element

Creating a List View

Writing a Windows PowerShell Formatting and Types File

ListEntries Element

Article • 09/17/2021

Provides the definitions of the list view. The list view must specify one or more definitions.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- ListControl Element
- ListEntries Element

Syntax

XML

```
<ListEntries>
  <ListEntry>...</ListEntry>
</ListEntries>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `ListEntries` element. At least one child element must be specified.

Attributes

None.

Child Elements

Element	Description
ListEntry Element	Provides a definition of the list view.

Parent Elements

Element	Description
ListControl Element	Defines a list format for the view.

Remarks

For more information about list views, see List View.

Example

This example shows the XML elements that define the list view for the System.Serviceprocess.Servicecontroller object.

XML

```
<View>
  <Name>System.ServiceProcess.ServiceController</Name>
  <ViewSelectedBy>
    <TypeName>System.ServiceProcess.ServiceController</TypeName>
  </ViewSelectedBy>
  <ListControl>
    <ListEntries>
      <ListEntry>
        <ListItems>...</ListItems>
      </ListEntry>
    </ListEntries>
  </ListControl>
</View>
```

See Also

ListControl Element

ListEntry Element

List View

Writing a Windows PowerShell Formatting and Types File

ListEntry Element

Article • 09/17/2021

Provides a definition of the list view.

- Configuration Element
- ViewDefinitions Element
- View Element
- ListControl Element
- ListEntries Element
- ListEntry Element

Syntax

XML

```
<ListEntry>
  <EntrySelectedBy>...</EntrySelectedBy>
  <ListItems>...</ListItems>
</ListEntry>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `ListEntry` element.

Attributes

None.

Child Elements

Element	Description
EntrySelectedBy Element for ListEntry	Optional element. Defines the .NET objects that use this list view definition or the condition that must exist for this definition to be used.

Element	Description
ListItems Element	Required element. Defines the properties and scripts whose values are displayed by the list view.

Parent Elements

Element	Description
ListEntries Element	Provides the definitions of the list view.

Remarks

A list view is a list format that displays property values or script values for each object. For more information about list views, see Creating a List View.

Example

This example shows the XML elements that define the list view for the System.Serviceprocess.Servicecontroller object.

XML

```
<View>
  <Name>System.ServiceProcess.ServiceController</Name>
  <ViewSelectedBy>
    <TypeName>System.ServiceProcess.ServiceController</TypeName>
  </ViewSelectedBy>
  <ListControl>
    <ListEntries>
      <ListEntry>
        <ListItems>...</ListItems>
      </ListEntry>
    </ListEntries>
  </ListControl>
</View>
```

See Also

Creating a List View

EntrySelectedBy Element for ListEntry

ListEntries Element

ListItems Element

Writing a Windows PowerShell Formatting and Types File

EntrySelectedBy Element for ListEntry

Article • 09/17/2021

Defines the .NET types that use this list view definition or the condition that must exist for this definition to be used. In most cases only one definition is needed for a list view. However, you can provide multiple definitions for the list view if you want to use the same list view to display different data for different objects.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- ListControl Element
- ListEntries Element
- ListEntry Element
- EntrySelectedBy Element

Syntax

XML

```
<EntrySelectedBy>
  <TypeName>Nameof.NetType</TypeName>
  <SelectionSetName>NameofSelectionSet</SelectionSetName>
  <SelectionCondition>...</SelectionCondition>
</EntrySelectedBy>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `EntrySelectedBy` element.

Attributes

None.

Child Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for ListControl	Optional element. Defines the condition that must exist for this list view definition to be used.
SelectionSetName Element for EntrySelectedBy for ListControl	Optional element. Specifies a set of .NET types that use this list view definition.
TypeName Element for EntrySelectedBy for ListControl	Optional element. Specifies a .NET type that uses this list view definition.

Parent Elements

Element	Description
ListEntry Element for ListControl	Defines how the rows of the list are displayed.

Remarks

You must specify at least one type, selection set, or selection condition for a list view definition. There is no maximum limit to the number of child elements that you can use.

Selection conditions are used to define a condition that must exist for the definition to be used, such as when an object has a specific property or that a specific property value or script evaluates to `true`. For more information about selection conditions, see Defining Conditions for when Data is displayed.

For more information about the components of a list view, see Creating a List View.

Example

The following example shows how to define the objects for a list view using their .NET type name.

XML

```
<ListEntry>
  <EntrySelectedBy>
```

```
    <TypeName>NameofDotNetType</TypeName>>
  </EntrySelectedBy>
</ListEntry>
```

See Also

ListEntry Element for ListControl

SelectionCondition Element for EntrySelectedBy for ListControl

SelectionSetName Element for EntrySelectedBy for ListControl

TypeName Element for EntrySelectedBy for ListControl

Creating a List View

Defining Conditions for when Data is Displayed

Writing a PowerShell Formatting File

SelectionCondition Element for EntrySelectedBy for ListControl

Article • 09/17/2021

Defines the condition that must exist to use this definition of the list view. There is no limit to the number of selection conditions that can be specified for a list definition.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- ListControl Element
- ListEntries Element
- ListEntry Element
- EntrySelectedBy Element
- SelectionCondition Element

Syntax

XML

```
<SelectionCondition>
  <TypeName>Nameof.NetType</TypeName>
  <SelectionSetName>NameofSelectionSet</SelectionSetName>
  <PropertyName>.NetTypeProperty</PropertyName>
  <ScriptBlock>ScriptToEvaluate</ScriptBlock>
</SelectionCondition>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `SelectionCondition` element.

Attributes

None.

Child Elements

Element	Description
PropertyName Element for SelectionCondition for EntrySelectedBy for ListEntry	Optional element. Specifies the .NET property that triggers the condition.
ScriptBlock Element for SelectionCondition for EntrySelectedBy for ListEntry	Optional element. Specifies the script that triggers the condition.
SelectionSetName Element for SelectionCondition for EntrySelectedBy for ListEntry	Optional element. Specifies the set of .NET types that trigger the condition.
TypeName Element for SelectionCondition for EntrySelectedBy for ListEntry	Optional element. Specifies a .NET type that triggers the condition.

Parent Elements

Element	Description
EntrySelectedBy Element for TableRowEntry	Defines the .NET types that use this table entry or the condition that must exist for this entry to be used.

Remarks

lWhen you are defining a selection condition, the following requirements apply:

- The selection condition must specify a least one property name or a script block, but cannot specify both.
- The selection condition can specify any number of .NET types or selection sets, but cannot specify both.

For more information about how to use selection conditions, see Defining Conditions for when Data is Displayed.

For more information about other components of a list view, see Creating a List View.

See Also

Creating a List View

Defining Conditions for When Data Is Displayed

ListEntry Element

SelectionSetName Element for EntrySelectedBy for ListEntry

TypeName Element for EntrySelectedBy for ListEntry

Writing a PowerShell Formatting File

PropertyName Element for SelectionCondition for EntrySelectedBy for ListControl

Article • 09/17/2021

Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the list entry is used.

- Configuration Element
- ViewDefinitions Element
- View Element
- ListControl Element
- ListEntries Element
- ListEntry Element
- EntrySelectedBy Element
- SelectionCondition Element
- PropertyName Element

Syntax

XML

```
<PropertyName>.NetTypeProperty</PropertyName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `PropertyName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for ListEntry	Defines the condition that must exist for this list entry to be used.

Text Value

Specify the .NET property name.

Remarks

The selection condition must specify at least one property name or a script block, but cannot specify both. For more information about how to use selection conditions, see Defining Conditions for when a View Entry or Item is Used.

For more information about other components of a list view, see Creating List View.

See Also

Creating a List View

Defining Conditions for When Data is Displayed

ListEntry Element

ScriptBlock Element for SelectionCondition for EntrySelectedBy for ListEntry

Writing a PowerShell Formatting File

ScriptBlock Element for SelectionCondition for EntrySelectedBy for ListControl

Article • 09/17/2021

Specifies the script that triggers the condition. When this script is evaluated to `true`, the condition is met, and the list entry is used.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- ListControl Element
- ListEntries Element
- ListEntry Element
- EntrySelectedBy Element
- SelectionCondition Element
- ScriptBlock Element

Syntax

XML

```
<ScriptBlock>ScriptToEvaluate</ScriptBlock>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ScriptBlock` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for ListEntry	Defines the condition that must exist for this list entry to be used.

Text Value

Specify the script that is evaluated.

Remarks

The selection condition must specify a least one script or property name to evaluate, but cannot specify both. (For more information about how selection conditions can be used, see Defining Conditions for when a View Entry or Item is Used.)

For more information about the other components of a list view, see List View.

See Also

ListEntry Element

PropertyName Element for SelectionCondition for EntrySelectedBy for ListEntry

SelectionCondition Element for EntrySelectedBy for ListEntry

List View

Defining Conditions for when a View Entry or Item is Used

Writing a Windows PowerShell Formatting and Types File

SelectionSetName Element for SelectionCondition for EntrySelectedBy for ListEntry

Article • 09/17/2021

Specifies the set of .NET types that trigger the condition. When any of the types in this set are present, the condition is met, and the object is displayed by using this definition of the list view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- ListControl Element
- ListEntries Element
- ListEntry Element
- EntrySelectedBy Element
- SelectionCondition Element
- SelectionSetName Element

Syntax

XML

```
<SelectionSetName>NameofSelectionSet</SelectionSetName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `SelectionSetName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for ListEntry	Defines the condition that must exist to use this definition of the list view.

Text Value

Specify the name of the selection set.

Remarks

The selection condition can specify a selection set or .NET type, but cannot specify both. For more information about how to use selection conditions, see Defining Conditions for when Data is Displayed.

Selection sets are common groups of .NET objects that can be used by any view that the formatting file defines. For more information about creating and referencing selection sets, see Defining Sets of Objects.

For more information about other components of a list view, see Creating a List View.

See Also

Creating a List View

Defining Conditions for When Data Is Displayed

SelectionCondition Element for EntrySelectedBy for ListEntry

Writing a PowerShell Formatting File

TypeName Element for SelectionCondition for EntrySelectedBy for ListControl

Article • 09/17/2021

Specifies a .NET type that triggers the condition. When this type is present, the list entry is used.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- ListControl Element
- ListEntries Element
- ListEntry Element
- EntrySelectedBy Element
- SelectionCondition Element
- TypeName Element

Syntax

XML

```
<TypeName>Nameof.NetType</TypeName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `TypeName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for ListControl	Defines the condition that must exist for this list entry to be used.

Text Value

Specify the fully qualified name of the .NET type, such as `System.IO.DirectoryInfo`.

Remarks

The selection condition can specify any number of .NET types or selection sets, but cannot specify both. For more information about how to use selection conditions, see Defining Conditions for when Data is Displayed.

For more information about other the components of a list view, see Creating a List View.

See Also

Creating a List View

Defining Conditions for When Data Is Displayed

SelectionCondition Element for EntrySelectedBy for ListControl

Writing a PowerShell Formatting File

SelectionSetName Element for EntrySelectedBy for ListControl

Article • 09/17/2021

Specifies a set of .NET objects for the list entry. There is no limit to the number of selection sets that can be specified for an entry.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- ListControl Element
- ListEntries Element
- ListEntry Element
- EntrySelectedBy Element
- SelectionSetName Element

Syntax

XML

```
<SelectionSetName>NameofSelectionSet</SelectionSetName>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `SelectionSetName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
EntrySelectedBy Element for ListEntry	Defines the .NET types that use this list entry or the condition that must exist for this entry to be used.

Text Value

Specify the name of the selection set.

Remarks

Each list entry must have at least one type name, selection set, or selection condition defined.

Selection sets are typically used when you want to define a group of objects that are used in multiple views. For example, you might want to create a table view and a list view for the same set of objects. For more information about defining selection sets, see Defining Sets of objects for a View.

For more information about the components of a list view, see Creating a List View.

Example

The following example shows how to specify a selection set for an entry of a list view.

XML

```
<ListEntry>
  <EntrySelectedBy>
    <SelectionSetName>NameofSelectionSet</SelectionSetName>
  </EntrySelectedBy>
  <ListItems>...</ListItems>
</ListEntry>
```

See Also

Creating a List View

EntrySelectedBy Element for ListEntry

TypeName Element for EntrySelectedBy for ListControl

Article • 09/17/2021

Specifies a .NET type that uses this entry of the list view. There is no limit to the number of types that can be specified for a list entry.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- ListControl Element
- ListEntries Element
- ListEntry Element
- EntrySelectedBy
- TypeName Element

Syntax

XML

```
<TypeName>Nameof.NetType</TypeName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `TypeName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
EntrySelectedBy Element for ListEntry	Defines the .NET types that use this list entry or the condition that must exist for this entry to be used.

Text Value

Specify the fully-qualified name of the .NET type, such as `System.IO.DirectoryInfo`.

Remarks

Each list entry must have at least one type name, selection set, or selection condition defined.

For more information about how this element is used in a list view, see List View.

Example

The following example shows how to specify a selection set for an entry of a list view.

XML

```
<ListEntry>
  <EntrySelectedBy>
    <TypeName>Nameof.NetType</TypeName>
  </EntrySelectedBy>
  <ListItems>...</ListItems>
</ListEntry>
```

See Also

Creating a List View

EntrySelectedBy Element for ListEntry

SelectionSetName Element for EntrySelectedBy for ListEntry

Writing a PowerShell Formatting File

ListItems Element

Article • 09/17/2021

Defines the properties and scripts whose values are displayed in the rows of the list view.

- Configuration Element
- ViewDefinitions Element
- View Element
- ListControl Element
- ListEntries Element
- ListEntry Element
- ListItems Element

Syntax

XML

```
<ListItems>
  <ListItem>...</ListItem>
</ListItems>
```

Attributes and Elements

The following sections describe the attributes, child elements, and parent element of the `ListItems` element. There is no limit to the number of child elements that can be specified. The order of the child elements defines the order that values are displayed in the list view.

Attributes

None.

Child Elements

Element	Description

Element	Description
ListItem Element for ListControl	Required element. Defines the property or script whose value is displayed by the list view.

Parent Elements

Element	Description
ListEntry Element for ListControl	Provides a definition of the list view.

Remarks

For more information about this type of view, see Creating a List View.

Example

This example shows the XML elements that define three rows of the list view.

XML

```
<ListEntry>
    <ListItems>
      <ListItem>
        <Label>Property1: </Label>
        <PropertyName>.NetTypeProperty1</PropertyName>
      </ListItem>
      <ListItem>
        <PropertyName>.NetTypeProperty2</PropertyName>
      </ListItem>
      <ListItem>
        <ScriptBlock>$_.ProcessName + ":" $_.Id</ScriptBlock>
      </ListItem>
  </ListEntry>
```

See Also

ListEntry Element for ListControl

ListItem Element for ListControl

Creating a List View

FormatString Element for ListItem for ListControl

Article • 01/18/2022

Specifies a format pattern that defines how the property or script value is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- ListControl Element
- ListEntries Element
- ListEntry Element
- ListItems Element
- ListItem Element
- FormatString Element

Syntax

XML

```
<FormatString>PropertyPattern</FormatString>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `FormatString` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ListItem Element	Defines the property or script whose value is displayed in a row of the list view.

Text Value

Specify the pattern that is used to format the data. For example, you can use this pattern to format the value of any property that is of type System.Timespan: {0:MMM}{0:dd} {0:HH}:{0:mm}.

Remarks

Format strings can be used when creating table views, list views, wide views, or custom views. For more information about formatting a value displayed in a view, see Formatting Displayed Data.

For more information about using format strings in list views, see Creating List View.

Example

The following example shows how to define a formatting string for the value of the `StartTime` property.

XML

```
<ListItem>
  <PropertyName>StartTime</PropertyName>
  <FormatString>{0:MMM} {0:DD} {0:HH}:{0:MM}</FormatString>
</ListItem>
```

See Also

Creating a List View

ListItem Element

Writing a Windows PowerShell Formatting and Types File

ItemSelectionCondition Element for ListItem for ListControl

Article • 09/17/2021

Defines the condition that must exist for this list item to be used.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- ListControl Element
- ListEntries Element
- ListEntry Element
- ListItems Element
- ListItem Element
- ItemSelectionCondition Element

Syntax

XML

```
<ItemSelectionCondition>
  <PropertyName>.NetTypeProperty</PropertyName>
  <ScriptBlock>ScriptToEvaluate</ScriptBlock>
</ItemSelectionCondition>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ItemSelectionCondition` element.

Attributes

None.

Child Elements

Element	Description
PropertyName Element for ItemSelectionCondition for ListControl	Optional element. Specifies the .NET property that triggers the condition.
ScriptBlock Element for ItemSelectionCondition for ListControl	Optional element. Specifies the script that triggers the condition.

Parent Elements

Element	Description
ListItem Element for ListItems for ListControl	Defines the property or script whose value is displayed in a row of the list view.

Remarks

You can specify one property name or a script for this condition but cannot specify both.

See Also

ListItem Element for ListItems for ListControl

PropertyName Element for ItemSelectionCondition for ListControl

ScriptBlock Element for ItemSelectionCondition for ListControl

Writing a PowerShell Formatting File

PropertyName Element for ItemSelectionCondition for ListControl

Article • 09/17/2021

Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the view is used. This element is used when defining a list view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- ListControl Element
- ListEntries Element
- ListEntry Element
- ListItems Element
- ListItem Element
- ItemSelectionCondition Element
- PropertyName Element

Syntax

XML

```
<PropertyName>.NetTypeProperty</PropertyName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent elements of the `PropertyName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ItemSelectionCondition Element for ListItem for ListControl	

Text Value

Specify the name of the property whose value is displayed.

Remarks

If this element is used, you cannot specify the ScriptBlock element when defining the selection condition.

See Also

ScriptBlock Element for ItemSelectionCondition for ListIControl

ItemSelectionCondition Element for ListItem for ListControl

Writing a PowerShell Formatting File

ScriptBlock Element for ItemSelectionCondition for ListControl

Article • 09/17/2021

Specifies the script that triggers the condition. When this script is evaluated to `true`, the condition is met, and the list item is used. This element is used when defining a list view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- ListControl Element
- ListEntries Element for ListControl
- ListEntry Element for ListEntries for ListControl
- ListItems Element for ListEntry for ListControl
- ListItem Element for ListItems for List Control
- ItemSelectionCondition Element for ListItem for ListControl
- ScriptBlock Element for ItemSelectionCondition for ListControl

Syntax

XML

```
<ScriptBlock>ScriptToEvaluate</ScriptBlock>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent elements of the `ScriptBlock` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ItemSelectionCondition Element for ListItem for ListControl	Defines the condition that must exist for this list item to be used.

Text Value

Specify the script that is evaluated.

Remarks

If this element is used, you cannot specify the `PropertyName` element when defining the selection condition.

See Also

Writing a PowerShell Formatting File

Label Element for ListItem for ListControl

Article • 09/17/2021

Specifies the label that is displayed to the left of the property or script value in the row.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- ListControl Element
- ListEntries Element
- ListEntry Element
- ListItems Element
- ListItem Element
- Label Element

Syntax

```
XML

<Label>Label for displayed value</Label>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `Label` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ListItem Element for ListItems for ListControl	Defines the property or script whose value is displayed in a row of the list view.

Text Value

Specify the label to be display to the left of the property or script value.

Remarks

If a label is not specified, the name of the property or the script is displayed. For more information about using labels in a list view, see Creating a List View.

Example

The following example shows how to add a label to a row.

XML

```
<ListItem>
  <Label>Property1: </Label>
  <PropertyName>DotNetProperty1</PropertyName>
</ListItem>
```

See Also

Creating a List View

ListItem Element

Writing a PowerShell Formatting File

ListItem Element

Article • 09/17/2021

Defines the property or script whose value is displayed in a row of the list view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- ListControl Element
- ListEntries Element
- ListEntry Element
- ListItems Element
- ListItem Element

Syntax

XML

```
<ListItem>
  <PropertyName>PropertyToDisplay</PropertyName>
  <ScriptBlock>ScriptToExecute</ScriptBlock>
  <Label>LabelToDisplay</Label>
  <FormatString>FormatPattern</FormatString>
  <ItemSelectionCondition>...</ItemSelectionCondition>
</ListItem>
```

Attributes and Elements

The following sections describe the attributes, child elements, and parent element of the `ListItem` element. Only one property or script can be specified.

Attributes

None

Child Elements

Element	Description
FormatString Element for ListItem for ListControl	Optional element. Specifies a format string that defines how the property or script value is displayed.
ItemSelectionCondition Element for ListItem for ListControl	Optional element. Defines the condition that must exist for this list item to be used.
Label Element for ListItem for ListControl	Optional element Specifies the label that is displayed to the left of the property or script value in the row.
PropertyName Element for ListItem for ListControl	Optional element. Specifies the .NET property whose value is displayed in the row.
ScriptBlock Element for ListItem for ListControl	Optional element. Specifies the script whose value is displayed in the row.

Parent Elements

Element	Description
ListItems Element for List Control	Defines the properties and scripts whose values are displayed in the list view.

Remarks

For more information about the components of a list view, see Creating a List View.

Example

This example shows the XML elements that define three rows of the list view. The first two rows display the value of a .NET property, and the last row displays a value generated by a script.

```
XML
```

```
<ListEntry>
    <ListItems>
      <ListItem>
        <Label>Property1: </Label>
        <PropertyName>DotNetProperty1</PropertyName>
      </ListItem>
      <ListItem>
        <PropertyName>DotNetProperty2</PropertyName>
      </ListItem>
      <ListItem>
        <ScriptBlock>$_.ProcessName + ":" $_.Id</ScriptBlock>
      </ListItem>
    </ListItems>
</ListEntry>
```

See Also

ListItems Element

FormatString Element for ListItem

Label Element for ListItem

PropertyName Element for ListItem

ScriptBlock Element for ListItem

Creating a List View

Writing a Windows PowerShell Formatting and Types File

PropertyName Element for ListItem for ListControl

Article • 09/17/2021

Specifies the .NET property whose value is displayed in the list.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- ListControl Element
- ListEntries Element
- ListEntry Element
- ListItems Element
- ListItem Element
- PropertyName Element

Syntax

XML

```
<PropertyName>.NetTypeProperty</PropertyName>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `PropertyName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ListItem Element	Defines the property or script whose value is displayed in the row of the list view.

Text Value

Specify the name of the property whose value is displayed.

Remarks

When this element is specified, you cannot specify the ScriptBlock element.

In addition to displaying the property value, you can also specify a label for the value or a format string that can be used to change the display of the value. For more information about specifying data in a list view, see Creating a List View.

Example

The following example shows how to specify the label and property whose value is displayed.

XML

```
ListItem>
  <Label>NameOfProperty</Label>
  <PropertyName>.NetTypeProperty</PropertyName>
</ListItem>
```

See Also

ScriptBlock Element for ListItem for ListControl

Creating a List View

ListItem Element for ListControl(Format)

Writing a PowerShell Formatting File

ScriptBlock Element for ListItem for ListControl

Article • 09/17/2021

Specifies the script whose value is displayed in the row.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- ListControl Element
- ListEntries Element
- ListEntry Element
- ListItems Element
- ListItem Element
- ScriptBlock Element

Syntax

XML

```
<ScriptBlock>ScriptToEvaluate</ScriptBlock>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `ScriptBlock` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ListItem Element	Defines the property or script whose value is displayed in a row of the list view.

Text Value

Specify the script whose value is displayed in the row.

Remarks

When this element is specified, you cannot specify the PropertyName element.

For more information about specifying scripts in a list view, see List View.

Example

The following example shows how to specify the property whose value is displayed.

XML

```
<ListItem>
  <ScriptBlock>$_.ProcessName + ":" $_.Id</ScriptBlock>
</ListItem>
```

See Also

PropertyName Element for ListItem for ListControl

Creating a List View

ListItem Element for ListItems for ListControl

Writing a PowerShell Formatting File

Name Element for View

Article • 09/17/2021

Specifies the name that is used to identify the view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- Name Element

Syntax

```
XML

<Name>ViewName</Name>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `Name` element. Only one `Name` element is allowed for each view.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
View Element	Defines a view that is used to display the members of one or more .NET objects.

Text Value

Specify a unique friendly name for the view. This name can include a reference to the type of the view (such as a table view or list view), which object or set of objects use the view, what command returns the objects, or a combination of these.

Remarks

For more information about the different types of views, see the following topics: Table View, List View, Wide View, and Custom View.

Example

The following example shows a `View` element that defines a table view for the System.Serviceprocess.Servicecontroller object. The name of the view is "service".

XML

```
<View>
  <Name>service</Name>
  <ViewSelectedBy>
    <TypeName>System.ServiceProcess.ServiceController</TypeName>
  </ViewSelectedBy>
  <TableControl>...</TableControl>
</View>
```

See Also

Creating a List View

Creating a Table View

Creating a Wide View

Creating Custom Controls

View Element

Writing a PowerShell Formatting File

OutOfBand Element

Article • 09/17/2021

In a pipeline, the first object emitted is chosen as the type to format the output of the pipeline. PowerShell attempts for format subsequent objects using the same view. If the object does not fit the view, it is not displayed. You can create OutOfBand views that can be used for format these other types.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- OutOfBand Element

Syntax

```
XML

<OutOfBand/>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `OutOfBand` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description

Element	Description
View Element	Defines a view that displays one or more .NET objects.

Remarks

When the "shape" of formatting (view) has been determined by previous objects, you may want objects of different types to continue using that shape (table, list, or whatever) even if they specify their own views. Or sometimes you want your view to take over. When OutOfBand is true, the view applies regardless of previous objects that may have selected a different view.

See Also

View Element

Writing a PowerShell Formatting File

TableControl Element

Article • 09/17/2021

Defines a table format for a view.

Schema

- ViewDefinitions Element
- View Element
- TableControl Element

Syntax

XML

```
<TableControl>
  <AutoSize/>
  <HideTableHeaders/>
  <TableHeaders>...</TableHeaders>
  <TableRowEntries>...</TableRowEntries>
</TableControl>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `TableControl` element. You must specify the rows of the table. All other child elements are optional.

Attributes

None.

Child Elements

Element	Description

Element	Description
AutoSize Element for TableControl	Optional element. Specifies whether the column size and the number of columns are adjusted based on the size of the data.
HideTableHeaders Element for TableControl	Optional element. Indicates whether the header of the table is not displayed.
TableHeaders Element for TableControl	Required element. Defines the labels, the widths, and the alignment of the data for the columns of the table view.
TableRowEntries Element for TableControl	Optional element. Provides the definitions of the table view.

Parent Elements

Element	Description
View Element	Defines a view that is used to display the members of one or more objects.

Remarks

For more information about the components of a table view, see Creating a Table View.

Example

This example shows a `TableControl` element that is used to display the properties of the System.Serviceprocess.Servicecontroller object.

XML

```
<View>
  <Name>service</Name>
  <ViewSelectedBy>
    <TypeName>System.ServiceProcess.ServiceController</TypeName>
  </ViewSelectedBy>
  <TableControl>
    <TableHeaders>...</TableHeaders>
    <TableRowEntries>...</TableRowEntries>
  </TableControl>
```

```
</View>
```

See Also

Creating a Table View

View Element

AutoSize Element for TableControl

HideTableHeaders Element

TableHeaders Element

TableRowEntries Element

Writing a PowerShell Formatting File

AutoSize Element for TableControl

Article • 09/17/2021

Specifies whether the column size and the number of columns are adjusted based on the size of the data.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- TableControl Element
- AutoSize Element

Syntax

```
XML
```

```
<AutoSize/>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `AutoSize` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
TableControl Element	Defines a table format for a view.

Remarks

For more information about the components of a table view, see Creating a Table View.

See Also

Creating a Table View

TableControl Element

Writing a PowerShell Formatting File

HideTableHeaders Element

Article • 09/17/2021

Specifies that the headers of the table are not displayed.

Schema

- ViewDefinitions Element
- View Element
- TableControl Element
- HideTableHeaders Element

Syntax

```
VB

<HideTableHeaders/>
```

Attributes and Elements

The following sections describe the attributes, child elements, and parent element of the `HideTableHeaders` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
TableControl Element	Defines a table format for a view.

Text Value

Specify `true` to hide the headers of the table.

Remarks

For more information about the components of a table view, see Creating a Table View.

See Also

Creating a Table View

TableControl Element

TableHeaders Element

Article • 09/17/2021

Defines the headers for the columns of a table.

Schema

- ViewDefinitions Element
- View Element
- TableControl Element
- TableHeaders Element for TableControl

Syntax

XML

```
<TableHeaders>
  <TableColumnHeader>...</TableColumnHeader>
</TableHeaders>
```

Attributes and Elements

The following sections describe the attributes, child elements, and parent elements of the `TableHeaders` element. There must be a child element for each property of the object that is to be displayed. The column header information is displayed in the order that the child elements are specified.

Attributes

None.

Child Elements

Element	Description

Element	Description
TableColumnHeader Element	Optional element. Defines the label, the width, and the alignment of the data for a column of a table view.

Parent Elements

Element	Description
TableControl Element	Defines a table format for a view.

Remarks

For more information about the components of a table view, see Creating a Table View.

Example

This example shows a `TableHeaders` element that defines two column headers.

XML

```
<TableHeaders>
  <TableColumnHeader>
    <Label>Column 1</Label)
    <Width>16</Width>
    <Alignment>Left</Alignment>
  </TableColumnHeader>
  <TableColumnHeader>
    <Label>Column 2</Label)
    <Width>10</Width>
    <Alignment>Centered</Alignment>
  </TableColumnHeader>
</TableHeaders>
```

See Also

Creating a Table View

TableColumnHeader Element

TableControl Element

TableColumnHeader Element

Article • 09/17/2021

Defines the label, the width of the column, and the alignment of the label for a column of the table.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- TableControl Element
- TableHeaders Element
- TableColumnHeader Element

Syntax

XML

```
<TableColumnHeader>
  <Label>DisplayedLabel</Label>
  <Width>NumberOfCharacters</Width>
  <Alignment>Left, Right, or Centered</Alignment>
</TableColumnHeader>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `TableColumnHeader` element.

Attributes

None.

Child Elements

Element	Description

Element	Description
Label Element For TableColumnHeader for TableControl	Optional element. Defines the label that is displayed at the top of the column. If no label is specified, the name of the property whose value is displayed in the rows is used.
Width Element for TableColumnHeader for TableControl	Required element. Specifies the width (in characters) of the column.
Alignment Element for TableColumnHeader for TableControl	Optional element. Specifies how the label of the column is displayed. If no alignment is specified, the label is aligned on the left.

Parent Elements

Element	Description
TableHeaders Element	Defines the columns of a table view.

Remarks

Specify a header for each column of the table. The columns are displayed in the order in which the `TableColumnHeader` elements are defined.

A table must have the same number of `TableColumnHeader` elements as `TableRowEntry` elements. The column header defines how the text at the top of the table is displayed. The row entries define what data is displayed in the rows of the table.

For more information about the components of a table view, see Table View.

Example

The following example shows two `TableColumnHeader` elements. The first element defines a column whose label is "Column 1", has a width of 16 characters, and whose label is aligned on the left. The second element defines a column whose label is "Column 2", has a width of 10 characters, and whose label is centered in the column.

```
XML
```

```
<TableHeaders>
  <TableColumnHeader>
    <Label>Column 1</Label)
    <Width>16</Width>
    <Alignment>Left</Alignment>
  </TableColumnHeader>
    <TableColumnHeader>
    <Label>Column 2</Label)
    <Width>10</Width>
    <Alignment>Centered</Alignment>
  </TableColumnHeader>
</TableHeaders>
```

See Also

Alignment Element for TableColumnHeader for TableControl

Creating a Table View

Label Element for TableColumnHeader for TableControl

TableHeaders Element for TableControl

Width for TableColumnHeader for TableControl Element

Writing a PowerShell Formatting File

Alignment Element for TableColumnHeader

Article • 09/17/2021

Defines how the data in a column header is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- TableControl Element
- TableHeaders Element
- TableColumnHeader Element
- Alignment Element

Syntax

XML

```
<Alignment>AlignmentType</Alignment>
```

Attributes and Elements

The following sections describe the attributes, child elements, and parent element of the `Alignment` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
TableColumnHeader Element	Defines a label, the width, and the alignment of the data for a column of the table.

Text Value

Specify one of the following values. These values are not case-sensitive.

- Left - Aligns the data displayed in the column on the left This is the default if this element is not specified.
- Right - Aligns the data displayed in the column on the right.
- Center - Centers the data displayed in the column.

Remarks

For more information about the components of a table view, see Creating a Table View.

Example

This example shows a `TableColumnHeader` element whose data is aligned on the center.

XML

```
<TableColumnHeader>
  <Label>Column 1</Label)
  <Width>16</Width>
  <Alignment>Center</Alignment>
</TableColumnHeader>
```

See Also

Creating a Table View

TableColumnHeader Element

Writing a PowerShell Formatting File

Label Element for TableColumnHeader for TableControl

Article • 09/17/2021

Defines the label that is displayed at the top of a column. This element is used when defining a table view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- TableControl Element
- TableHeaders Element
- TableColumnHeader Element
- Label Element

Syntax

```XML
<Label>DisplayedLabel</Label>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `Label` element. Only one label is allowed for each column.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
TableColumnHeader Element for TableHeaders for TableControl	Defines a label, the width, and the alignment of the data for a column of the table.

Text Value

Specify the text that is displayed at the top of the column of the table. There are no restricted characters for the column label.

Remarks

If no label is specified, the name of the property whose value is displayed in the rows is used.

For more information about the components of a table view, see Creating a Table View.

Example

This example shows a `TableColumnHeader` element whose label is "Column 1".

XML

```
<TableColumnHeader>
  <Label>Column 1</Label)
  <Width>16</Width>
  <Alignment>Left</Alignment>
</TableColumnHeader>
```

See Also

Creating a Table View

TableColumnHeader Element

Writing a PowerShell Formatting File

Width Element for TableColumnHeader

Article • 09/17/2021

Defines the width (in characters) of a column.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- TableControl Element
- TableHeaders Element
- TableColumnHeader
- Width Element

Syntax

```
XML

<Width>NumberOfCharacters</Width>
```

Attributes and Elements

The following sections describe the attributes, child elements, and parent element of the `Width` element used when defining column headers.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description

Element	Description
TableColumnHeader Element for TableHeaders for TableControl	Defines a label, width, and alignment of the data for a column of the table.

Text Value

When at all possible, specify a width (in characters) that is greater than the length of the displayed property values.

Remarks

For more information about the components of a table view, see Creating a Table View.

Example

The following example shows a `TableColumnHeader` element whose width is 16 characters.

XML

```
<TableColumnHeader>
  <Label>Column 1</Label)
  <Width>16</Width>
  <Alignment>Left</Alignment>
</TableColumnHeader>
```

See Also

Creating a Table View

TableColumnHeader Element for TableHeader for TableControl

Writing a PowerShell Formatting File

TableRowEntries Element

Article • 09/17/2021

Defines the rows of the table.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- TableControl Element
- TableRowEntries Element

Syntax

XML

```
<TableRowEntries>
  <TableRowEntry>...</TableRowEntry>
</TableRowEntries>
```

Attributes and Elements

The following sections describe the attributes, child elements, and parent element of the `TableRowEntries` element.

Attributes

None.

Child Elements

Element	Description
TableRowEntry Element for TableRowEntries for TableControl	Required element. Defines the data that is displayed in a row of the table.

Parent Elements

Element	Description
TableControl Element	Defines a table format for a view.

Remarks

You must specify one or more `TableRowEntry` elements for the table view. There is no maximum limit to the number of `TableRowEntry` elements that can be added nor is their order significant.

For more information about the components of a table view, see Creating a Table View.

Example

The following example shows a `TableRowEntries` element that defines a row that displays the values of two properties of the System.Diagnostics.Process object.

XML

```
<TableRowEntries>
  <TableRowEntry>
    <EntrySelectedBy>
      <TypeName>System.Diagnostics.Process</TypeName>
    </EntrySelectedBy>
    <TableColumnItems>
      <TableColumnItem>
        <PropertyName> Property for first column</PropertyName>
      </TableColumnItem>
      <TableColumnItem>
        <PropertyName> Property for second column</PropertyName>
      </TableColumnItem>
    </TableColumnItems>
  </TableRowEntry>
</TableRowEntries>
```

See Also

Creating a Table View

TableControl Element

TableRowEntry Element

Writing a PowerShell Formatting File

TableColumnItems Element

Article • 02/03/2023

Defines the properties or scripts whose values are displayed in a row.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- TableControl Element
- TableRowEntries Element for TableControl
- TableRowEntry Element for TableRowEntries for TableControl
- TableColumnItems Element for TableControlEntry for TableControl

Syntax

XML

```
<TableColumnItems>
  <TableColumnItem>...</TableColumnItem>
</TableColumnItems>
```

Attributes and Elements

The following sections describe the attributes, child elements, and parent element of the `TableColumnItems` element.

Attributes

None.

Child Elements

Element	Description

Element	Description
TableColumnItem Element for TableColumnItems for TableControl	Required element. Defines the property or script whose value is displayed in a column of the row.

Parent Elements

Element	Description
TableRowEntry Element for TableRowEntries for TableControl	Defines the data that is displayed in a row of the table.

Remarks

A `TableColumnItem` element is required for each column of the row. The first entry is displayed in first column, the second entry in the second column, and so on.

For more information about the components of a table view, see Creating a Table View.

Example

The following example shows a `TableColumnItems` element that defines three properties of the System.Diagnostics.Process object.

XML

```
<TableColumnItems>
  <TableColumnItem>
    <PropertyName>Status</PropertyName>
  </TableColumnItem>
  <TableColumnItem>
    <PropertyName>Name</PropertyName>
  </TableColumnItem>
  <TableColumnItem>
    <PropertyName>DisplayName</PropertyName>
  </TableColumnItem>
</TableColumnItems>
```

See Also

Creating a Table View

TableColumnItem Element

TableRowEntry Element

Writing a PowerShell Formatting File

TableColumnItem Element

Article • 09/17/2021

Defines the property or script whose value is displayed in the column of the row.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- TableControl Element
- TableRowEntries Element
- TableRowEntry Element
- TableColumnItems Element
- TableColumnItem Element

Syntax

XML

```
<TableColumnItem>
  <Alignment>Left, Right, or Center</Alignment>
  <FormatString>FormatPattern</FormatString>
  <PropertyName>Nameof.NetProperty</PropertyName>
  <ScriptBlock>ScriptToEvaluate</ScriptBlock>
</TableColumnItem>
```

Attributes and Elements

The following sections describe the attributes, child elements, and parent element of the `TableColumnItem` element.

Attributes

None.

Child Elements

Element	Description

Element	Description
Alignment Element for TableColumnItem for TableControl	Optional element. Defines how the data in a column of the row is displayed.
FormatString Element for TableColumnItem for TableControl	Specifies a format pattern that is used to format the data in the column of the row.
PropertyName Element for TableColumnItem for TableControl	Optional element. Specifies the name of the property whose value is displayed.
ScriptBlock Element for TableColumnItem for TableControl	Optional element. Specifies the script whose value is displayed in the column of a row.

Parent Elements

Element	Description
TableColumnItems Element for TableControlEntry for TableControl	Defines the properties or scripts whose values are displayed in the row.

Remarks

You can specify a property of an object or a script in each column of the row. If no child elements are specified, the item is a placeholder, and no data is displayed.

For more information about the components of a table view, see Creating a Table View.

Example

This example shows a `TableColumnItem` element that displays the value of the `Status` property of the System.Diagnostics.Process object.

XML

```
<TableColumnItem>
   <Alignment>Centered</Alignment>
  <PropertyName>Status</PropertyName>
```

```
</TableColumnItem>
```

See Also

Creating a Table View

Alignment Element for TableColumnItem for TableControl

TableColumnItems Element

FormatString Element for TableColumnItem for TableControl

PropertyName Element for TableColumnItem for TableControl

ScriptBlock Element for TableColumnItem for TableControl

Writing a PowerShell Formatting File

Alignment Element for TableColumnItem

Article • 09/17/2021

Defines how the data in a column of the row is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- TableControl Element
- TableRowEntries Element
- TableRowEntry Element
- TableColumnItems Element
- TableColumnItem Element
- Alignment Element

Syntax

XML

```
<Alignment>AlignmentType</Alignment>
```

Attributes and Elements

The following sections describe the attributes, child elements, and parent element of the `Alignment` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
TableColumnItem Element	Defines a label, the width, and the alignment of the data for a column of the table.

Text Value

Specify one of the following values. (These values are not case-sensitive.)

- Left - Shifts the data displayed in the column to the left. (This is the default if this element is not specified.)
- Right - Shifts the data displayed in the column to the right.
- Center - Centers the data displayed in the column.

Remarks

For more information about the components of a table view, see Table View.

See Also

Table View

TableColumnItem Element

FormatString Element for TableColumnItem for TableControl

Article • 01/18/2022

Specifies a format pattern that defines how the property or script value of the table is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- TableControl Element
- TableRowEntries Element
- TableRowEntry Element
- TableColumnItems Element
- TableColumnItem Element
- FormatString Element

Syntax

XML

```
<FormatString>FormatPattern</FormatString>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `FormatString` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
TableColumnItem Element	Defines the property or script whose value is displayed in the column of the row.

Text Value

Specify the pattern that is used to format the data. For example, this pattern can be used to format the value of any property that is of type System.Timespan: {0:MMM} {0:dd}{0:HH}:{0:mm}.

Remarks

Format strings can be used when creating table views, list views, wide views, or custom views. For more information about formatting a value displayed in a view, see Formatting Displayed Data.

For more information about the components of a table view, see Table View.

Example

The following example shows how to define a formatting string for the value of the `StartTime` property.

XML

```
<TableColumnItem>
  <PropertyName>StartTime</PropertyName>
  <FormatString>{0:MMM} {0:DD} {0:HH}:{0:MM}</FormatString>
</TableColumnItem>
```

See Also

Creating a Table View

Formatting Displayed Data

TableColumnItem Element

Writing a PowerShell Formatting File

PropertyName Element for TableColumnItem for TableControl

Article • 09/17/2021

Specifies the property whose value is displayed in the column of the row.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- TableControl Element
- TableRowEntries Element
- TableRowEntry Element
- TableColumnItems Element
- TableColumnItem Element
- PropertyName Element

Syntax

```
XML

<PropertyName>.NetTypeProperty</PropertyName>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `PropertyName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
TableColumnItem Element	Defines the property or script whose value is displayed in the column of the row.

Text Value

Specify the name of the property whose value is displayed.

Remarks

For more information about the components of a table view, see Creating a Table View.

Example

This example shows a `TableColumnItem` element that specifies the `Status` property of the System.Diagnostics.Process object.

XML

```
<TableColumnItem>
   <Alignment>Centered</Alignment>
  <PropertyName>Status</PropertyName>
</TableColumnItem>
```

See Also

Creating a Table View

TableColumnItem Element

Writing a PowerShell Formatting File

ScriptBlock Element for TableColumnItem for TableControl

Article • 09/17/2021

Specifies the script whose value is displayed in the column of the row.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- TableControl Element
- TableRowEntries Element
- TableRowEntry Element
- TableColumnItems Element
- TableColumnItem Element
- ScriptBlock Element

Syntax

```
XML

<ScriptBlock>ScriptToEvaluate</ScriptBlock>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ScriptBlock` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
TableColumnItem Element	Defines the property or script whose value is displayed in the column of the row.

Text Value

Specify the script whose value is displayed.

Remarks

For more information about the components of a table view, see Creating a Table View.

See Also

Creating a Table View

TableColumnItem Element

Writing a PowerShell Formatting File

TableRowEntry Element

Article • 09/17/2021

Defines the data that is displayed in a row of the table.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- TableControl Element
- TableRowEntries Element for TableControl
- TableRowEntry Element for TableRowEntries

Syntax

XML

```
<TableRowEntry>
  <Wrap/>
  <EntrySelectedBy>...</EntrySelectedBy>
  <TableColumnItems>...</TableColumnItems>
</TableRowEntry>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent element of the `TableRowEntry` element.

Attributes

None.

Child Elements

Element	Description

Element	Description
EntrySelectedBy Element for TableRowEntry for TableControl	Required element. Defines the objects whose property values are displayed in the row.
TableColumnItems Element for TableRowEntry for TableControl	Required element. Defines the properties or scripts whose values are displayed.
Wrap Element for TableRowEntry for TableControl	Optional element. Specifies that text that exceeds the column width is displayed on the next line.

Parent Elements

Element	Description
TableRowEntries Element for TableControl	Defines the rows of the table.

Remarks

One `TableColumnItems` element and one `EntrySelectedBy` element must be specified.

For more information about the components of a table view, see Creating a Table View.

Example

The following example shows a `TableRowEntry` element that defines a row that displays the values of two properties of the System.Diagnostics.Process object.

XML

```
<TableRowEntry>
  <EntrySelectedBy>
    <TypeName>System.Diagnostics.Process</TypeName>
  </EntrySelectedBy>
  <TableColumnItems>
    <TableColumnItem>
      <PropertyName> Property for first column</PropertyName>
    </TableColumnItem>
    <TableColumnItem>
      <PropertyName> Property for second column</PropertyName>
```

```
    </TableColumnItem>
  </TableColumnItems>
</TableRowEntry>
```

See Also

Creating a Table View

EntrySelectedBy Element for TableRowEntry for TableControl

TableColumnItems Element for TableRowEntry for TableControl

TableRowEntries Element for TableControl

Wrap Element for TableRowEntry for TableControl

Writing a PowerShell Formatting File

EntrySelectedBy Element for TableRowEntry

Article • 09/17/2021

Defines the .NET types that use this definition of the table view or the condition that must exist for this definition to be used.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- TableControl Element
- TableRowEntries Element
- TableRowEntry Element
- EntrySelectedBy Element

Syntax

XML

```
<EntrySelectedBy>
  <TypeName>Nameof.NetType</TypeName>
  <SelectionSetName>NameofSelectionSet</SelectionSetName>
  <SelectionCondition>...</SelectionCondition>
</EntrySelectedBy>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `EntrySelectedBy` element.

Attributes

None.

Child Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for TableControl	Optional element. Defines the condition that must exist for this table view definition to be used.
SelectionSetName Element for EntrySelectedBy for TableControl	Optional element. Specifies a set of .NET types that use this table view definition.
TypeName Element for EntrySelectedBy for TableControl	Optional element. Specifies a .NET type that uses this table view definition.

Parent Elements

Element	Description
TableRowEntry Element for TableControl	Defines the data that is displayed in a row of the table.

Remarks

You must specify at least one type, selection set, or selection condition for a table view definition. There is no maximum limit to the number of child elements that you can use.

Selection conditions are used to define a condition that must exist for the definition to be used, such as when an object has a specific property or that a specific property value or script evaluates to `true`. For more information about selection conditions, see Defining Conditions for when a View Entry or Item is Used.

For more information about the components of a table view, see Creating a Table View.

Example

The following example shows a `TableRowEntry` element that is used to display the properties of the System.Diagnostics.Process object.

XML

```
<TableRowEntry>
  <EntrySelectedBy>
```

```
      <TypeName>System.Diagnostics.Process</TypeName>
    </EntrySelectedBy>
    <TableColumnItems>
      <TableColumnItem>
        <PropertyName>PropertyForFirstColumn</PropertyName>
      </TableColumnItem>
      <TableColumnItem>
        <PropertyName>PropertyForSecondColumn</PropertyName>
      </TableColumnItem>
    </TableColumnItems>
  </TableRowEntry>
```

See Also

Creating a Table View

SelectionCondition Element for EntrySelectedBy for TableControl

SelectionSetName Element for EntrySelectedBy for TableControl

TableRowEntry Element for TableControl

TypeName Element for EntrySelectedBy for TableControl

Writing a PowerShell Formatting File

SelectionCondition Element for EntrySelectedBy for TableControl

Article • 09/17/2021

Defines the condition that must exist to use for this definition of the table view. There is no limit to the number of selection conditions that can be specified for a table definition.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- TableControl Element
- TableRowEntries Element
- TableRowEntry Element
- EntrySelectedBy Element
- SelectionCondition Element

Syntax

XML

```
<SelectionCondition>
  <TypeName>Nameof.NetType</TypeName>
  <SelectionSetName>NameofSelectionSet</SelectionSetName>
  <PropertyName>.NetTypeProperty</PropertyName>
  <ScriptBlock>ScriptToEvaluate</ScriptBlock>
</SelectionCondition>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the SelectionCondition element.

Attributes

None.

Child Elements

Element	Description
PropertyName Element for SelectionCondition for EntrySelectedBy for TableRowEntry	Optional element. Specifies the .NET property that triggers the condition.
ScriptBlock Element for SelectionCondition for EntrySelectedBy for TableRowEntry	Optional element. Specifies the script that triggers the condition.
SelectionSetName Element for SelectionCondition for EntrySelectedBy for TableRowEntry	Optional element. Specifies the set of .NET types that trigger the condition.
TypeName Element for SelectionCondition for EntrySelectedBy for TableRowEntry	Optional element. Specifies a .NET type that triggers the condition.

Parent Elements

Element	Description
EntrySelectedBy Element for TableRowEntry	Defines the .NET types that use this table entry or the condition that must exist for this entry to be used.

Remarks

Each list entry must have at least one type name, selection set, or selection condition defined.

When you are defining a selection condition, the following requirements apply:

- The selection condition must specify a least one property name or a script block, but cannot specify both.
- The selection condition can specify any number of .NET types or selection sets, but cannot specify both.

For more information about how to use selection conditions, see Defining Conditions for when a View Entry or Item is Used.

For more information about the components of a table view, see Creating a Table View.

See Also

Creating a Table View

Defining Conditions for When Data Is Displayed

EntrySelectedBy Element

PropertyName Element for SelectionCondition for EntrySelectedBy for TableRowEntry

ScriptBlock Element for SelectionCondition for EntrySelectedBy for TableRowEntry

SelectionSetName Element for SelectionCondition for EntrySelectedBy for TableRowEntry

TypeName Element for SelectionCondition for EntrySelectedBy for TableRowEntry

Writing a Windows PowerShell Formatting and Types File

PropertyName Element for SelectionCondition for EntrySelectedBy for TableRowEntry

Article • 09/17/2021

Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the table entry is used.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- TableControl Element
- TableRowEntries Element
- TableRowEntry Element
- EntrySelectedBy Element
- SelectionCondition Element
- PropertyName Element

Syntax

XML

```
<PropertyName>.NetTypeProperty</PropertyName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `PropertyName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for TableRowEntry	Defines the condition that must exist for this table entry to be used.

Text Value

Specify the .NET property name.

Remarks

The selection condition must specify at least one property name or a script block, but cannot specify both. For more information about how selection conditions can be used, see Defining Conditions for when a View Entry or Item is Used.

For more information about the components of a table view, see Creating a Table View.

See Also

Creating a Table View

Defining Conditions for When Data Is Displayed

ScriptBlock Element for SelectionCondition for EntrySelectedBy for TableRowEntry

SelectionCondition Element for EntrySelectedBy for TableRowEntry

Writing a PowerShell Formatting File

ScriptBlock Element for SelectionCondition for EntrySelectedBy for TableControl

Article • 09/17/2021

Specifies the script block that triggers the condition. When this script is evaluated to `true`, the condition is met, and the table entry is used.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- TableControl Element
- TableRowEntries Element
- TableRowEntry Element
- EntrySelectedBy Element
- SelectionCondition Element
- ScriptBlock Element

Syntax

XML

```
<ScriptBlock>ScriptToEvaluate</ScriptBlock>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ScriptBlock` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for TableRowEntry	Defines the condition that must exist for this table entry to be used.

Text Value

Specify the script that is evaluated.

Remarks

The selection condition must specify at least one script block or property name, but cannot specify both. For more information about how to use selection conditions, see Defining Conditions for when a View Entry or Item is Used.

For more information about the components of a table view, see Creating a Table View.

See Also

Creating a Table View

Defining Conditions for When Data Is Displayed

PropertyName Element for SelectionCondition for EntrySelectedBy for TableRowEntry

SelectionCondition Element for EntrySelectedBy for TableRowEntry

Writing a PowerShell Formatting File

SelectionSetName Element for SelectionCondition for EntrySelectedBy for TableControl

Article • 09/17/2021

Specifies the set of .NET types that trigger the condition. When any of the types in this set are present, the condition is met, and the object is displayed by using this definition of the table view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- TableControl Element
- TableRowEntries Element
- TableRowEntry Element
- EntrySelectedBy Element
- SelectionCondition Element
- SelectionSetName Element

Syntax

XML

```
<SelectionSetName>NameofSelectionSet</SelectionSetName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `SelectionSetName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for TableRowEntry	Defines the condition that must exist to use for this definition of the table view.

Text Value

Specify the name of the selection set.

Remarks

The selection condition can specify a selection set or .NET type, but cannot specify both. For more information about how to use selection conditions, see Defining Conditions for when Data is Displayed.

Selection sets are common groups of .NET objects that can be used by any view that the formatting file defines. For more information about creating and referencing selection sets, see Defining Sets of Objects.

For more information about other components of a wide view, see Creating a Table View.

See Also

Creating a Table View

Defining Conditions for When Data Is Displayed

TypeName Element for SelectionCondition for EntrySelectedBy for TableRowEntry

SelectionCondition Element for EntrySelectedBy for TableRowEntry

Writing a PowerShell Formatting File

TypeName Element for SelectionCondition for EntrySelectedBy for TableControl

Article • 09/17/2021

Specifies a .NET type that triggers the condition. When this type is present, the condition is met, and the table row is used.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- TableControl Element
- TableRowEntries Element
- TableRowEntry Element
- EntrySelectedBy Element
- SelectionCondition Element
- TypeName Element

Syntax

XML

```
<TypeName>Nameof.NetType</TypeName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `TypeName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for TableRowEntry	Defines the condition that must exist for this table row to be used.

Text Value

Specify the fully qualified name of the .NET type, such as `System.IO.DirectoryInfo`.

Remarks

The selection condition can specify any number of .NET types or selection sets, but cannot specify both. For more information about how to use selection conditions, see Defining Conditions for when a View Entry or Item is Used.

For more information about the components of a table view, see Creating a Table View.

See Also

Creating a Table View

Defining Conditions for When Data Is Displayed

SelectionCondition Element for EntrySelectedBy for TableRowEntry

SelectionSetName Element for SelectionCondition for EntrySelectedBy for TableRowEntry

Writing a PowerShell Formatting File

SelectionSetName Element for EntrySelectedBy for TableControl

Article • 09/17/2021

Specifies a set of .NET types the use this entry of the table view. There is no limit to the number of selection sets that can be specified for an entry.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- TableControl Element
- TableRowEntries Element
- TableRowEntry Element
- EntrySelectedBy Element
- SelectionSetName Element

Syntax

XML

```
<SelectionSetName>NameofSelectionSet</SelectionSetName>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent elements.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
EntrySelectedBy Element	Defines the .NET types that use this entry or the condition that must exist for this entry to be used.

Text Value

Specify the name of the selection set.

Remarks

Selection sets are typically used when you want to define a group of objects that are used in multiple views. For example, you might want to create a table view and a list view for the same set of objects. For more information about defining selection sets, see Defining Sets of objects for a View.

If you specify a selection set for an entry, you cannot specify a type name. For more information about how to specify a .NET type, see TypeName Element for EntrySelectedBy for TableRowEntry.

For more information about the components of a table view, see Creating a Table View.

See Also

EntrySelectedBy Element

Defining Sets of objects for a View

Creating a Table View

Writing a PowerShell Formatting File

TypeName Element for EntrySelectedBy for TableControl

Article • 09/17/2021

Specifies a .NET type that uses this entry of the table view. There is no limit to the number of types that can be specified for a table entry.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- TableControl Element
- TableRowEntries Element
- TableRowEntry Element
- EntrySelectedBy Element
- TypeName Element

Syntax

XML

```
<TypeName>Nameof.NetType</TypeName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `TypeName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
EntrySelectedBy Element	Defines the .NET types that use this entry or the condition that must exist for this entry to be used.

Text Value

Specify the name of the .NET type.

Remarks

Each list entry must have at least one type name, selection set, or selection condition defined.

For more information about the components of a table view, see Creating a Table View.

See Also

Creating a Table View

EntrySelectedBy Element

Writing a PowerShell Formatting File

Wrap Element for TableRowEntry

Article • 09/17/2021

Specifies that text that exceeds the column width is displayed on the next line. By default, text that exceeds the column width is truncated.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- TableControl Element
- TableRowEntries Element for TableControl
- TableRowEntry Element for TableRowEntries for TableControl
- Wrap Element for TableRowEntry for TableControl

Syntax

```XML
<Wrap/>
```

Attributes and Elements

The following sections describe attributes, child elements, and parent elements of the `Wrap` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
TableRowEntry Element for TableRowEntries for TableControl	Defines the data that is displayed in a row of the table.

Remarks

For more information about the components of a table view, see Creating a Table View.

See Also

Creating a Table View

TableRowEntry Element for TableRowEntries for TableControl

Writing a PowerShell Formatting File

ViewSelectedBy Element

Article • 09/17/2021

Defines the .NET objects that are displayed by the view. Each view must specify at least one .NET object.

Schema

- ViewDefinitions Element
- View Element
- ViewSelectedBy Element

Syntax

XML

```
<ViewSelectedBy>
  <TypeName>Nameof.NetType</TypeName>
  <SelectionSetName>SelectionSet</SelectionSetName>
</ViewSelectedBy>
```

Attributes and Elements

The following sections describe the attributes, child elements, and parent element of the `ViewSelectedBy` element. This element must contain at least one `TypeName` or `SelectionSetName` child element. There is no limit to the number of child elements that can be specified nor is their order significant.

Attributes

None.

Child Elements

Element	Description
TypeName Element for ViewSelectedBy	Optional element. Specifies a .NET object that is displayed by the view.

Element	Description
SelectionSetName Element for ViewSelectedBy	Optional element. Specifies a set of .NET objects that are displayed by the view.

Parent Elements

Element	Description
View Element	Defines a view that displays one or more .NET objects.

Remarks

For more information about how this element is used in different views, see Table View Components, List View Components, Wide View Components, and Custom Control Components.

The `SelectionSetName` element is used when the formatting file defines a set of objects that are displayed by multiple views. For more information about how selection sets are defined and referenced, see Defining Sets of Objects.

Example

The following example shows how to specify the System.Serviceprocess.Servicecontroller object for a list view. The same schema is used for table, wide, and custom views.

XML

```
<View>
  <Name>System.ServiceProcess.ServiceController</Name>
  <ViewSelectedBy>
    <TypeName>System.ServiceProcess.ServiceController</TypeName>
  </ViewSelectedBy>
  <ListControl>...</ListControl>
</View>
```

See Also

Creating a List View

Creating a Table View

Creating a Wide View

Creating Custom Controls

Defining Selection Sets

SelectionSetName Element for ViewSelectedBy

TypeName Element

Writing a PowerShell Formatting File

SelectionSetName Element for ViewSelectedBy

Article • 09/17/2021

Specifies a set of .NET objects that are displayed by the view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- ViewSelectedBy Element
- SelectionSetName Element

Syntax

XML

```
<SelectionSetName>Name of selection set<SelectionSetName>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `SelectionSetName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description

Element	Description
ViewSelectedBy Element	Defines the .NET objects that are displayed by the view.

Text Value

Specify the name of the selection set that is defined by the `Name` element for the selection set.

Remarks

You can use selection sets when you have a set of related objects that you want to reference by using a single name, such as a set of objects that are related through inheritance. For more information about defining and referencing selection sets, see Defining Sets of Objects.

Example

The following example shows how to specify a selection set for a list view. The same schema is used for table, wide, and custom views.

XML

```
<View>
  <Name>Name of View</Name>
  <ViewSelectedBy>
    <SelectionSetName>NameofSelectionSet</SelectionSetName>>
  </ViewSelectedBy>
  <ListControl>...</ListControl>
</View>
```

See Also

Defining Selection Sets

ViewSelectedBy Element

Writing a PowerShell Formatting File

TypeName Element for ViewSelectedBy

Article • 09/17/2021

Specifies a .NET object that is displayed by the view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- ViewSelectedBy Element
- TypeName Element

Syntax

```
XML

<TypeName>FullyQualifiedTypeName</TypeName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent elements of the `TypeName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
ViewSelectedBy Element	Defines the .NET objects that are displayed by the view.

Text Value

Specify the fully qualified name of the .NET type, such as `System.IO.DirectoryInfo`.

Remarks

For more information about how this element is used in different views, see Creating a Table View, Creating a List View, Creating a Wide View, and Custom View Components.

Example

The following example shows how to specify the System.Serviceprocess.Servicecontroller object for a list view. The same schema is used for table, wide, and custom views.

XML

```
<View>
  <Name>System.ServiceProcess.ServiceController</Name>
  <ViewSelectedBy>
    <TypeName>System.ServiceProcess.ServiceController</TypeName>
  </ViewSelectedBy>
  <ListControl>...</ListControl>
</View>
```

See Also

Creating a List View

Creating a Table View

Creating a Wide View

Creating Custom Controls

ViewSelectedBy Element

Writing a PowerShell Formatting File

WideControl Element

Article • 09/17/2021

Defines a wide (single value) list format for the view. This view displays a single property value or script value for each object.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- WideControl Element

Syntax

XML

```
<WideControl>
  <AutoSize/>
  <ColumnNumber>PositiveInteger</ColumnNumber>
  <WideEntries>...</WideEntries>
</WideControl>
```

Attributes and Elements

The following sections describe the attributes, child elements, and parent element of the `WideControl` element. You cannot specify the `AutoSize` and `ColumnNumber` elements at the same time.

Attributes

None.

Child Elements

Element	Description

Element	Description
AutoSize Element for WideControl	Optional element. Specifies whether the column size and the number of columns are adjusted based on the size of the data.
ColumnNumber Element for WideControl	Optional element. Specifies the number of columns displayed in the wide view.
WideEntries Element	Required element. Provides the definitions of the wide view.

Parent Elements

Element	Description
View Element	Defines a view that is used to display one or more .NET objects.

Remarks

When defining a wide view, you can add the `AutoSize` element or the `ColumnNumber` but you cannot add both.

In most cases, only one definition is required for each wide view, but it is possible to have multiple definitions if you want to use the same view to display different .NET objects. In those cases, you can provide a separate definition for each object or set of objects.

For more information about the components of a wide view, see Wide View Components.

Example

The following example shows a `WideControl` element that is used to display a property of the System.Diagnostics.Process object.

XML

```
<View>
  <Name>process</Name>
  <ViewSelectedBy>
```

```
    <TypeName>System.Diagnostics.Process</TypeName>
  </ViewSelectedBy>
  <WideControl>
    <WideEntries>...</WideEntries>
  </WideControl>
</View>
```

For a complete example of a wide view, see Wide View (Basic).

See Also

Autosize Element for WideControl

ColumnNumber Element for WideControl

View Element

WideEntries Element

Wide View (Basic)

Creating a Wide View

Writing a PowerShell Formatting File

AutoSize Element for WideControl

Article • 09/17/2021

Specifies whether the column size and the number of columns are adjusted based on the size of the data.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- WideControl Element
- Autosize Element

Syntax

XML

```
<AutoSize/>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `AutoSize` element.

Attributes

None.

Child Elements

None

Parent Elements

Element	Description
WideControl Element	Defines a wide (single value) list format for the view.

Remarks

When defining a wide view, you can add the `AutoSize` element or the ColumnNumber element, but you cannot add both.

For more information about the components of a wide view, see Creating a Wide View.

For an example of a wide view, see Wide View (Basic).

See Also

ColumnNumber Element for WideControl

Creating a Wide View

WideControl Element

Writing a PowerShell Formatting File

ColumnNumber Element for WideControl

Article • 09/17/2021

Specifies the number of columns displayed in the wide view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- WideControl Element
- ColumnNumber Element

Syntax

XML

```
<ColumnNumber>PositiveInteger</ColumnNumber>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ColumnNumber` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description

Element	Description
WideControl Element	Defines a wide (single value) list format for the view.

Text Value

Specify a positive integer value.

Remarks

When defining a wide view, you can add the `AutoSize` element or the `ColumnNumber` element, but you cannot add both.

For more information about the components of a wide view, see Creating a Wide View.

For an example of a wide view, see Wide View (Basic).

See Also

Autosize Element for WideControl

Creating a Wide View

Wide View (Basic)

Writing a PowerShell Formatting File

WideEntries Element

Article • 09/17/2021

Provides the definitions of the wide view. The wide view must specify one or more definitions.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- WideControl Element
- WideEntries Element

Syntax

XML

```
<WideEntries>
  <WideEntry>...</WideEntry>
</WideEntries>
```

Attributes and Elements

The following sections describe the attributes, child elements, and parent element of the `WideEntries` element. At least one child element must be specified.

Attributes

None.

Child Elements

Element	Description
WideEntry Element	Provides a definition of the wide view.

Parent Elements

Element	Description
WideControl Element	Defines a wide (single value) list format for the view.

Remarks

A wide view is a list format that displays a single property value or script value for each object. For more information about the components of a wide view, see Wide View Components.

Example

The following example shows a `WideEntries` element that defines a single `WideEntry` element. The `WideEntry` element contains a single `WideItem` element that defines what property or script value is displayed in the view.

XML

```
<WideControl>
  <WideEntries>
    <WideEntry>
      <WideItem>...</WideItem>
    <WideEntry>
  </WideEntries>
</WideControl>
```

For a complete example of a wide view, see Wide View (Basic).

See Also

Creating a Wide View

WideControl Element

WideEntry Element

Writing a PowerShell Formatting File

WideEntry Element

Article • 09/17/2021

Provides a definition of the wide view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- WideControl Element
- WideEntries Element
- WideEntry Element

Syntax

XML

```
<WideEntry>
  <EntrySelectedBy>...</EntrySelectedBy>
  <WideItem>...</WideItem>
</WideEntry>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `WideEntry` element. You must specify a single `WideItem` child element.

Attributes

None.

Child Elements

Element	Description

Element	Description
EntrySelectedBy Element for WideEntry	Optional element. Defines the .NET types that use this wide entry definition or the condition that must exist for this definition to be used.
WideItem Element	Required element. Defines the property or script whose value is displayed.

Parent Elements

Element	Description
WideEntries Element	Provides the definitions of the wide view.

Remarks

A wide view is a list format that displays a single property value or script value for each object. Unlike other types of views, you can specify only one item element for each view definition. For more information about the other components of a wide view, see Creating a Wide View.

Example

The following example shows a `WideEntry` element that defines a single `WideItem` element. The `WideItem` element defines the property whose value is displayed in the view.

XML

```
<WideEntries>
  <WideEntry>
    <WideItem>
      <PropertyName>ProcessName</PropertyName>
    </WideItem>
  </WideEntry>
</WideEntries>
```

For a complete example of a wide view, see Wide View (Basic).

See Also

Creating a Wide View

SelectionCondition Element for WideEntry

SelectionSetName Element for WideEntry

TypeName Element for WideEntry

WideEntries Element

WideItem Element

Writing a PowerShell Formatting File

EntrySelectedBy Element for WideEntry

Article • 09/17/2021

Defines the .NET types that use this definition of the wide view or the condition that must exist for this definition to be used.

Schema

Configuration Element ViewDefinitions Element View Element WideControl Element WideEntries Element WideEntry Element EntrySelectedBy Element

Syntax

XML

```
<EntrySelectedBy>
  <TypeName>Nameof.NetType</TypeName>
  <SelectionSetName>NameofSelectionSet</SelectionSetName>
  <SelectionCondition>...</SelectionCondition>
</EntrySelectedBy>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `EntrySelectedBy` element.

Attributes

None.

Child Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for WideEntry	Optional element. Defines the condition that must exist for this wide view definition to be used.

Element	Description
SelectionSetName Element for EntrySelectedBy for WideEntry	Optional element. Specifies a set of .NET types that use this wide view definition.
TypeName Element for EntrySelectedBy for WideEntry	Optional element. Specifies a .NET type that uses this wide view definition.

Parent Elements

Element	Description
WideEntry Element	Provides a definition of the wide view.

Remarks

You must specify at least one type, selection set, or selection condition for a wide view definition. There is no maximum limit to the number of child elements that you can use.

Selection conditions are used to define a condition that must exist for the definition to be used, such as when an object has a specific property or that a specific property value or script value evaluates to `true`. For more information about selection conditions, see Defining Conditions for Displaying Data.

For more information about other components of a wide view, see Creating a Wide View.

See Also

WideEntry Element

SelectionCondition Element for EntrySelectedBy for WideEntry

SelectionSetName Element for EntrySelectedBy for WideEntry

TypeName Element for EntrySelectedBy for WideEntry

Creating a Wide View

Defining Conditions for Displaying Data

SelectionCondition Element for EntrySelectedBy for WideControl

Article • 09/17/2021

Defines the condition that must exist for this definition to be used. There is no limit to the number of selection conditions that can be specified for a wide entry definition.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- WideControl Element
- WideEntries Element
- WideEntry Element
- EntrySelectedBy Element
- SelectionCondition Element

Syntax

XML

```
<SelectionCondition>
  <TypeName>Nameof.NetType</TypeName>
  <SelectionSetName>NameofSelectionSet</SelectionSetName>
  <PropertyName>.NetTypeProperty</PropertyName>
  <ScriptBlock>ScriptToEvaluate</ScriptBlock>
</SelectionCondition>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `SelectionCondition` element. You must specify a single `PropertyName` or `ScriptBlock` element. The `SelectionSetName` and `TypeName` elements are optional. You can specify one of either element.

Attributes

None.

Child Elements

Element	Description
PropertyName Element for SelectionCondition for EntrySelectedBy for WideEntry	Optional element. Specifies the .NET property that triggers the condition.
ScriptBlock Element for SelectionCondition for EntrySelectedBy for WideEntry	Optional element. Specifies the script block that triggers the condition.
SelectionSetName Element for SelectionCondition for EntrySelectedBy for WideEntry	Optional element. Specifies the set of .NET types that triggers the condition.
TypeName Element for SelectionCondition for EntrySelectedBy for WideEntry	Optional element. Specifies a .NET type that triggers the condition.

Parent Elements

Element	Description
EntrySelectedBy Element for WideEntry	Defines the .NET types that use this wide entry or the condition that must exist for this entry to be used.

Remarks

Each wide entry must have at least one type name, selection set, or selection condition defined.

When you are defining a selection condition, the following requirements apply:

- The selection condition must specify a least one property name or a script block, but cannot specify both.
- The selection condition can specify any number of .NET types or selection sets, but cannot specify both.

For more information about how to use selection conditions, see Defining Conditions for when a View Entry or Item is Used.

For more information about other components of a wide view, see Creating a Wide View.

See Also

Creating a Wide View

Defining Conditions for When Data Is Displayed

EntrySelectedBy Element for WideEntry

PropertyName Element for SelectionCondition for EntrySelectedBy for WideEntry

ScriptBlock Element for SelectionCondition for EntrySelectedBy for WideEntry

SelectionSetName Element for SelectionCondition for EntrySelectedBy for WideEntry

TypeName Element for SelectionCondition for EntrySelectedBy for WideEntry

Writing a PowerShell Formatting File

PropertyName Element for SelectionCondition for EntrySelectedBy for WideEntry

Article • 09/17/2021

Specifies the .NET property that triggers the condition. When this property is present or when it evaluates to `true`, the condition is met, and the definition is used.

- Configuration Element
- ViewDefinitions Element
- View Element
- WideControl Element
- WideEntries Element
- WideEntry Element
- EntrySelectedBy Element
- SelectionCondition Element
- PropertyName Element

Syntax

XML

```
<PropertyName>.NetTypeProperty</PropertyName>
```

C#

```

```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `PropertyName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for WideEntry	Defines the condition that must exist for this definition to be used.

Text Value

Specify the .NET property name.

Remarks

The selection condition must specify at least one property name or a script to evaluate, but cannot specify both. For more information about how to use selection conditions, see Defining Conditions for when Data is Displayed.

For more information about other components of a wide view, see Wide View.

See Also

Creating a Wide View

Defining Conditions for When Data Is Displayed

ScriptBlock Element for SelectionCondition for EntrySelectedBy for WideEntry

SelectionCondition Element for EntrySelectedBy for WideEntry

Writing a PowerShell Formatting File

ScriptBlock Element for SelectionCondition for EntrySelectedBy for WideControl

Article • 09/17/2021

Specifies the script that triggers the condition. When this script is evaluated to `true`, the condition is met, and the wide entry definition is used.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- WideControl Element
- WideEntries Element
- WideEntry Element
- EntrySelectedBy Element
- SelectionCondition
- ScriptBlock Element

Syntax

XML

```
<ScriptBlock>ScriptToEvaluate</ScriptBlock>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `ScriptBlock` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for WideEntry	Defines the condition that must exist for this definition to be used.

Text Value

Specify the script that is evaluated.

Remarks

The selection condition must specify at least one script or property name to evaluate, but cannot specify both. For more information about how to use selection conditions, see Defining Conditions for when Data is Displayed.

For more information about other components of a wide view, see Wide View.

See Also

Creating a Wide View

Defining Conditions for When Data Is Displayed

PropertyName Element for SelectionCondition for EntrySelectedBy for WideEntry

SelectionCondition Element for EntrySelectedBy for WideEntry

Writing a PowerShell Formatting File

SelectionSetName Element for SelectionCondition for EntrySelectedBy for WideEntry

Article • 09/17/2021

Specifies the set of .NET types that trigger the condition. When any of the types in this set are present, the condition is met, and the object is displayed by using this definition of the wide view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- WideControl Element
- WideEntries Element
- WideEntry Element
- EntrySelectedBy Element
- SelectionCondition Element
- SelectionSetName Element

Syntax

XML

```
<SelectionSetName>NameofSelectionSet</SelectionSetName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `SelectionSetName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for WideEntry	Defines the condition that must exist for this definition to be used.

Text Value

Specify the name of the selection set.

Remarks

The selection condition can specify a selection set or .NET type, but cannot specify both. For more information about how to use selection conditions, see Defining Conditions for when Data is Displayed.

Selection sets are common groups of .NET objects that can be used by any view that the formatting file defines. For more information about creating and referencing selection sets, see Defining Sets of Objects.

For more information about other components of a wide view, see Creating a Wide View.

See Also

Creating a Wide View

Defining Conditions for When Data Is Displayed

Defining Selection Sets

SelectionCondition Element for EntrySelectedBy for WideEntry

TypeName Element for SelectionCondition for EntrySelectedBy for WideEntry

Writing a PowerShell Formatting File

TypeName Element for SelectionCondition for EntrySelectedBy for WideControl

Article • 09/17/2021

Specifies a .NET type that triggers the condition. When this type is present, the definition is used.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- WideControl Element
- WideEntries Element
- WideEntry Element
- EntrySelectedBy Element
- SelectionCondition Element
- TypeName Element

Syntax

XML

```
<TypeName>Nameof.NetType</TypeName>
```

Attributes and Elements

The following sections describe attributes, child elements, and the parent element of the `TypeName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
SelectionCondition Element for EntrySelectedBy for WideEntry	Defines the condition that must exist for this wide entry to be used.

Text Value

Specify the fully qualified name of the .NET type, such as `System.IO.DirectoryInfo`.

Remarks

The selection condition can specify a .NET type or a selection set, but cannot specify both. For more information about how to use selection conditions, see Defining Conditions for when Data is Displayed.

For more information about other components of a wide view, see Creating a Wide View.

See Also

Creating a Wide View

Defining Conditions for When Data Is Displayed

SelectionCondition Element for EntrySelectedBy for WideEntry

SelectionSetName Element for SelectionCondition for EntrySelectedBy for WideEntry

Writing a PowerShell Formatting File

TypeName Element for EntrySelectedBy for WideEntry

Article • 09/17/2021

Specifies a .NET type for the definition. The definition is used whenever this object is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- WideControl Element
- WideEntries Element
- WideEntry Element
- EntrySelectedBy Element
- TypeName Element

Syntax

XML

```
<TypeName>Nameof.NetType</TypeName>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `TypeName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
EntrySelectedBy Element for WideEntry	Defines the .NET types that use this wide entry or the condition that must exist for this entry to be used.

Text Value

Specify the fully qualified name of the .NET type, such as `System.IO.DirectoryInfo`.

Remarks

Each wide entry must specify one or more .NET types, a selection set, or the selection condition that must exist for the definition to be used.

For more information about other components of a wide view, see Creating a Wide View.

See Also

Creating a Wide View

EntrySelectedBy Element for WideEntry

Writing a PowerShell Formatting File

SelectionSetName Element for EntrySelectedBy for WideControl

Article • 09/17/2021

Specifies a set of .NET objects for the definition. The definition is used whenever one of these objects is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- WideControl Element
- WideEntries Element
- WideEntry Element
- EntrySelectedBy Element
- SelectionSetName Element

Syntax

XML

```
<SelectionSetName>NameofSelectionSet</SelectionSetName>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `SelectionSetName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
EntrySelectedBy Element for WideEntry	Defines the .NET types that use this wide entry or the condition that must exist for this entry to be used.

Text Value

Specify the name of the selection set.

Remarks

Each definition must specify one type name, selection set, or selection condition.

Selection sets are typically used when you want to define a group of objects that are used in multiple views. For example, you might want to create a table view and a list view for the same set of objects. For more information about defining selection sets, see Defining Sets of Objects for a View.

For more information about other components of a wide view, see Creating a Wide View.

See Also

Creating a Wide View

Defining Selection Sets

EntrySelectedBy Element for WideEntry

Writing a PowerShell Formatting File

WideItem Element for WideControl

Article • 09/17/2021

Defines the property or script whose value is displayed.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- WideControl Element
- WideEntries Element
- WideEntry Element
- WideItem Element

Syntax

XML

```
<WideItem>
  <PropertyName>.NetTypeProperty</PropertyName>
  <ScriptBlock>ScriptToExecute</ScriptBlock>
  <FormatString>FormatPattern</FormatString>
</WideItem>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `WideItem` element. The `FormatString` element is optional. However, you must specify a `PropertyName` or `ScriptBlock` element, but you cannot specify both.

Attributes

None.

Child Elements

Element	Description

Element	Description
FormatString Element for WideItem for WideControl	Optional element. Specifies a format pattern that defines how the property or script value is displayed in the view.
PropertyName Element for WideItem	Specifies the property of the object whose value is displayed in the wide view.
ScriptBlock Element for WideItem	Specifies the script whose value is displayed in the wide view.

Parent Elements

Element	Description
WideEntry Element	Provides a definition of the wide view.

Remarks

For more information about the components of a wide view, see Wide View.

Example

The following example shows a `WideEntry` element that defines a single `WideItem` element. The `WideItem` element defines the property or script whose value is displayed in the view.

XML

```
<WideEntry>
  <WideItem>
    <PropertyName>ProcessName</PropertyName>
  </WideItem>
</WideEntry>
```

For a complete example of a wide view, see Wide View (Basic).

See Also

FormatString Element for WideItem for WideControl

PropertyName Element for WideItem

ScriptBlock Element for WideItem

WideEntry Element

Writing a PowerShell Formatting File

FormatString Element for WideItem

Article • 01/18/2022

Specifies a format pattern that defines how the property or script value is displayed in the view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- WideControl Element
- WideEntries Element
- WideEntry Element
- WideItem Element
- FormatString Element

Syntax

XML

```
<FormatString>PropertyPattern</FormatString>
```

Attributes and Elements

The following sections describe the attributes, child elements, and the parent element of the `FormatString` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
WideItem Element for WideControl	Defines the property or script whose value is displayed in a row of the list view.

Text Value

Specify the pattern that is used to format the data. For example, you can use this pattern to format the value of any property that is of type System.Timespan: {0:MMM}{0:dd} {0:HH}:{0:mm}.

Remarks

Format strings can be used when creating table views, list views, wide views, or custom views. For more information about formatting a value displayed in a view, see Formatting Displayed Data.

For more information about using format strings in wide views, see Creating a Wide View.

Example

The following example shows how to define a formatting string for the value of the `StartTime` property.

XML

```
<WideItem>
  <PropertyName>StartTime</PropertyName>
  <FormatString>{0:MMM} {0:DD} {0:HH}:{0:MM}</FormatString>
</WideItem>
```

See Also

Creating a Wide View

WideItem Element for WideControl

Writing a Windows PowerShell Formatting and Types File

PropertyName Element for WideItem for WideControl

Article • 09/17/2021

Specifies the property of the object whose value is displayed in the wide view.

- Configuration Element
- ViewDefinitions Element
- View Element
- WideControl Element
- WideEntries Element
- WideEntry Element
- WideItem Element
- PropertyName Element

Syntax

XML

```
<PropertyName>.NetTypeProperty</PropertyName>
```

Attributes and Elements

The following sections describe the attributes, child elements, and parent element of the `PropertyName` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description

Element	Description
WideItem Element	Defines the property or script whose value is displayed in the wide view.

Text Value

Specify the name of the property whose value is displayed.

Remarks

For more information about the components of a wide view, see Creating a Wide View.

Example

This example shows a wide view that displays the value of the ProcessName property of the System.Diagnostics.Process object.

XML

```
View>
  <Name>process</Name>
  <ViewSelectedBy>
    <TypeName>System.Diagnostics.Process</TypeName>
  </ViewSelectedBy>
  <WideControl>
    <WideEntries>
      <WideEntry>
        <WideItem>
          <PropertyName>ProcessName</PropertyName>
        </WideItem>
      </WideEntry>
    </WideEntries>
  </WideControl>
</View>
```

See Also

WideItem Element

Creating a Wide View

Writing a PowerShell Formatting File

ScriptBlock Element for WideItem for WideControl

Article • 09/17/2021

Specifies the script whose value is displayed in the wide view.

Schema

- Configuration Element
- ViewDefinitions Element
- View Element
- WideControl Element
- WideEntries Element
- WideEntry Element
- WideItem Element
- ScriptBlock Element

Syntax

```
XML

<ScriptBlock>ScriptToExecute</ScriptBlock>
```

Attributes and Elements

The following sections describe the attributes, child elements, and parent element of the `ScriptBlock` element.

Attributes

None.

Child Elements

None.

Parent Elements

Element	Description
WideItem Element	Defines the property or script block whose value is displayed in the wide view.

Text Value

Specify the script whose value is displayed.

Remarks

For more information about the components of a wide view, see Creating a Wide View.

Example

This example shows a `WideItem` element that defines a script whose value is displayed in the view.

XML

```
<WideItem>
  <ScriptBlock>ScriptToExecute</ScriptBlock>
</WideItem>
```

See Also

WideItem Element

Creating a Wide View

Writing a PowerShell Formatting File

Writing Help for PowerShell Scripts and Functions

Article • 07/10/2023

PowerShell scripts and functions should be fully documented whenever they're shared with others. The `Get-Help` cmdlet displays the script and function help topics in the same format as it displays help for cmdlets, and all the `Get-Help` parameters work on script and function help topics.

PowerShell scripts can include a help topic about the script and help topics about each functions in the script. Functions that are shared independently of scripts can include their own help topics.

This document explains the format and correct placement of the help topics, and it suggests guidelines for the content.

Types of Script and Function Help

Comment-Based Help

The help topic that describes a script or function can be implemented as a set of comments within the script or function. When writing comment-based help for a script and for functions in a script, pay careful attention to the rules for placing the comment-based help. The placement determines whether the `Get-Help` cmdlet associates the help topic with the script or a function. For more information about writing comment-based help topics, see about_Comment_Based_Help.

XML-Based Command Help

The help topic that describes a script or function can be implemented in an XML file that uses the command help schema. To associate the script or function with the XML file, use the `ExternalHelp` comment keyword followed by the path and name of the XML file.

When the `ExternalHelp` comment keyword is present, it takes precedence over comment-based help, even when `Get-Help` can't find a help file that matches the value of the `ExternalHelp` keyword.

Online Help

You can post your help topics on the internet and then direct `Get-Help` to open the topics. For more information about writing comment-based help topics, see Supporting Online Help.

There is no established method for writing conceptual ("About") topics for scripts and functions. However, you can post conceptual topics on the internet list the topics and their URLs in the Related Links section of a command help topic.

Content Considerations for Script and Function Help

- If you are writing a very brief help topic with only a few of the available command help sections, be sure to include clear descriptions of the script or function parameters. Also include one or two sample commands in the examples section, even if you decide to omit example descriptions.

- In all descriptions, refer to the command as a script or function. This information helps the user to understand and manage the command.

  For example, the following detailed description states that the New-Topic command is a script. This reminds users that they need to specify the path and full name when they run it.

  > "The New-Topic script creates a blank conceptual topic for each topic name in the input file..."

  The following detailed description states that `Disable-PSRemoting` is a function. This information is particularly useful to users when the session includes multiple commands with the same name, some of which might be hidden by a command with higher precedence.

  > The `Disable-PSRemoting` function disables all session configurations on the local computer...

- In a script help topic, explain how to use the script as a whole. If you are also writing help topics for functions in the script, mention the functions in your script help topic and include references to the function help topics in the Related Links section of the script help topic. Conversely, when a function is part of a script, explain in the function help topic the role that the function plays in the script and how it might be used independently. Then list the script help topic in the Related Links section of the function help topic.

- When writing examples for a script help topic, be sure to include the path to the script file in the example command. This reminds users that they must specify the path explicitly, even when the script is in the current directory.
- In a function help topic, remind users that the function exists only in the current session and, to use it in other sessions, they need to add it, or add it a PowerShell profile.
- `Get-Help` displays the help topic for a script or function only when the script file and help topic files are saved in the correct locations. Therefore, it's not useful to include instructions for installing PowerShell, or saving or installing the script or function in a script or function help topic. Instead, include any installation instructions in the document that you use to distribute the script or function.

See Also

Writing Comment-Based Help Topics

Writing Comment-Based Help Topics

Article • 07/10/2023

You can write comment-based Help topics for functions and scripts using special Help comment keywords.

The `Get-Help` cmdlet displays comment-based Help in the same format in which it displays the cmdlet Help topics that are generated from XML files. Users can use all of the parameters of `Get-Help`, such as Detailed, Full, Example, and Online, to display function and script Help.

You can also write XML-based Help topics for scripts and functions and use the Help comment keywords to redirect users to the XML-based topics or other topics.

In This Section

- Syntax of Comment-Based Help - Describes the syntax of comment-based help.
- Comment-Based Help Keywords - Lists the keywords in comment-based help.
- Placing Comment-Based Help in Functions - Shows where to place comment-based help for a function.
- Placing Comment-Based Help in Scripts - Shows where to place comment-based help for a script.

Syntax of Comment-Based Help

Article • 07/10/2023

This section describes the syntax of comment-based help.

Syntax Diagram

The syntax for comment-based Help is as follows:

```
# .< help keyword>
# <help content>
```

-or -

```
<#
.< help keyword>
< help content>
#>
```

Syntax Description

Comment-based Help is written as a series of comments. You can type a comment symbol (`#`) before each line of comments, or you can use the `<#` and `#>` symbols to create a comment block. All the lines within the comment block are interpreted as comments.

Each section of comment-based Help is defined by a keyword and each keyword is preceded by a dot (`.`). The keywords can appear in any order. The keyword names aren't case-sensitive.

A comment block must contain at least one help keyword. Some of the keywords, such as **EXAMPLE**, can appear many times in the same comment block. The Help content for each keyword begins on the line after the keyword and can span multiple lines.

All the lines in a comment-based Help topic must be contiguous. If a comment-based Help topic follows a comment that isn't part of the Help topic, there must be at least

one blank line between the last non-Help comment line and the beginning of the comment-based Help.

For example, the following comment-based help topic contains the .Description keyword and its value, which is a description of a function or script.

PowerShell

```
<#
    .Description
    The Get-Function function displays the name and syntax of all functions
in the session.
#>
```

Comment-Based Help Keywords

Article • 07/10/2023

This topic lists and describes the keywords in comment-based help.

Keywords in Comment-Based Help

The following are valid comment-based Help keywords. They're listed in the order in which they typically appear in a Help topic along with their intended use. These keywords can appear in any order in the comment-based Help, and they're not case-sensitive.

Note that the `.EXTERNALHELP` keyword takes precedence over all other comment-based help keywords. When `.EXTERNALHELP` is present, the Get-Help cmdlet doesn't display comment-based help, even when it can't find a help file that matches the value of the keyword.

`.SYNOPSIS`

A brief description of the function or script. This keyword can be used only once in each topic.

`.DESCRIPTION`

A detailed description of the function or script. This keyword can be used only once in each topic.

`.PARAMETER <Parameter-Name>`

The description of a parameter. You can include a `.PARAMETER` keyword for each parameter in the function or script.

The `.PARAMETER` keywords can appear in any order in the comment block, but the order in which the parameters appear in the `Param` statement or function declaration determines the order in which the parameters appear in Help topic. To change the order of parameters in the Help topic, change the order of the parameters in the `Param` statement or function declaration.

You can also specify a parameter description by placing a comment in the `Param` statement immediately before the parameter variable name. If you use both a `Param` statement comment and a `.PARAMETER` keyword, the description associated with the `.PARAMETER` keyword is used, and the `Param` statement comment is ignored.

.EXAMPLE

A sample command that uses the function or script, optionally followed by sample output and a description. Repeat this keyword for each example.

.INPUTS

The Microsoft .NET Framework types of objects that can be piped to the function or script. You can also include a description of the input objects.

.OUTPUTS

The .NET Framework type of the objects that the cmdlet returns. You can also include a description of the returned objects.

.NOTES

Additional information about the function or script.

.LINK

The name of a related topic. Repeat this keyword for each related topic. This content appears in the Related Links section of the Help topic.

The `.LINK` keyword content can also include a Uniform Resource Identifier (URI) to an online version of the same Help topic. The online version opens when you use the `Online` parameter of `Get-Help`. The URI must begin with "http" or "https".

.COMPONENT

The name of the technology or feature that the function or script uses, or to which it's related. The **Component** parameter of `Get-Help` uses this value to filter the search results returned by `Get-Help`.

`.ROLE`

The name of the user role for the help topic. The **Role** parameter of `Get-Help` uses this value to filter the search results returned by `Get-Help`.

`.FUNCTIONALITY`

The keywords that describe the intended use of the function. The **Functionality** parameter of `Get-Help` uses this value to filter the search results returned by `Get-Help`.

`.FORWARDHELPTARGETNAME <Command-Name>`

Redirects to the Help topic for the specified command. You can redirect users to any Help topic, including Help topics for a function, script, cmdlet, or provider.

`.FORWARDHELPCATEGORY <Category>`

Specifies the Help category of the item in `.FORWARDHELPTARGETNAME`. Use this keyword to avoid conflicts when there are commands with the same name.

Valid values are:

- Alias
- Cmdlet
- HelpFile
- Function
- Provider
- General
- FAQ
- Glossary
- ScriptCommand
- ExternalScript
- Filter
- All

`.REMOTEHELPRUNSPACE <PSSession-variable>`

Specifies a session that contains the Help topic. Enter a variable that contains a PSSession. This keyword is used by the `Export-PSSession` cmdlet to find the Help topics

for the exported commands.

`.EXTERNALHELP <XML Help File>`

Specifies the path and/or name of an XML-based Help file for the script or function.

The `.EXTERNALHELP` keyword tells the Get-Help cmdlet to get help for the script or function in an XML-based file. The `.EXTERNALHELP` keyword is required when using an XML-based help file for a script or function. Without it, `Get-Help` will not find a help file for the function or script.

The `.EXTERNALHELP` keyword takes precedence over all other comment-based help keywords. When `.EXTERNALHELP` is present, the Get-Help cmdlet doesn't display comment-based help, even when it can't find a help file that matches the value of the keyword.

When the function is exported by a script module, the value of `.EXTERNALHELP` should be a filename without a path. `Get-Help` looks for the file in a locale-specific subdirectory of the module directory. There are no requirements for the filename, but a best practice is to use the following filename format: `<ScriptModule>.psm1-help.xml`.

When the function isn't associated with a module, include a path and filename in the value of the `.EXTERNALHELP` keyword. If the specified path to the XML file contains UI-culture-specific subdirectories, `Get-Help` searches the subdirectories recursively for an XML file with the name of the script or function in accordance with the language fallback standards established for Windows, just as it does for all XML-based Help topics.

For more information about the cmdlet Help XML-based Help file format, see Writing Windows PowerShell Cmdlet Help.

Placing Comment-Based Help in Functions

Article • 07/10/2023

This topic explains where to place comment-based help for a function so that the `Get-Help` cmdlet associates the comment-based help topic with the correct function.

Where to Place Comment-Based Help for a Function

- At the beginning of the function body.
- At the end of the function body.
- Before the `Function` keyword. When the function is in a script or script module, there can't be more than one blank line between the last line of the comment-based help and the `Function` keyword. Otherwise, `Get-Help` associates the help with the script, not with the function.

Examples of Help Placement in a Function

The following examples show each of the three placement options for comment-based help for a function.

Help at the Beginning of a Function Body

The following example shows comment-based at the beginning of a function body.

PowerShell

```
function MyProcess
{
    <#
       .Description
       The MyProcess function gets the Windows PowerShell process.
    #>

    Get-Process powershell
}
```

Help at the End of a Function Body

The following example shows comment-based at the end of a function body.

PowerShell

```
function MyFunction
{
    Get-Process powershell

    <#
       .Description
       The MyProcess function gets the Windows PowerShell process.
    #>
}
```

Help Before the Function Keyword

The following examples shows comment-based on the line before the function keyword.

PowerShell

```
<#
    .Description
    The MyProcess function gets the Windows PowerShell process.
#>
function MyFunction { Get-Process powershell}
```

Placing Comment-Based Help in Scripts

Article • 07/10/2023

This topic explains where to place comment-based help for a script so that the `Get-Help` cmdlet associates the comment-based help topic with scripts and not with any functions that might be in the script.

Where to Place Comment-Based Help for a Script

- At the beginning of the script file.

  Script Help can be preceded in the script only by comments and blank lines.

- At the end of the script file.

  If the first item in the script body (after the Help) is a function declaration, there must be at least two blank lines between the end of the script Help and the function declaration. Otherwise, the Help is interpreted as being Help for the function, not Help for the script.

Examples of Help Placement in a Script

The following examples show each of the placement options for comment-based help for a script.

Help at the Beginning of a Script

The following example shows comment-based at the beginning of a script.

PowerShell

```
<#
.Description
This script performs a series of network connection tests.
#>

param [string]$ComputerName
...
```

Help at the End of a Script

The following example shows comment-based at the end of a script.

PowerShell

```
...
function Ping { Test-Connection -ComputerName $ComputerName }

<#
.Description
This script performs a series of network connection tests.
#>
```

Autogenerated Elements of Comment-Based Help

Article • 07/10/2023

The `Get-Help` cmdlet automatically generates several elements of a comment-based topic. These autogenerated elements make comment-based help look very much like the help that's generated from XML files.

Autogenerated Elements

The `Get-Help` cmdlet automatically generates the following elements of a help topic. You can't edit these elements directly, but you can change the results by changing the source of the element.

Name

The Name section of a function Help topic is taken from the function name in the function definition. The Name of a script Help topic is taken from the script filename. To change the name or its capitalization, change the function definition or the script filename.

Syntax

The Syntax section of the Help topic is generated from the parameter list in the Param statement of the function or script. To add detail to the Help topic syntax, such as the .NET type of a parameter, add the detail to the parameter list. If you don't specify a parameter type, the **Object** type is inserted as the default value.

Parameter List

The Parameters section of the Help topic is generated from the parameter list in the function or script and from the descriptions that you add using the `.Parameters` keyword or comments in the parameter list.

Parameters appear in the Parameters section in the same order that they appear in the parameter list. The spelling and capitalization of parameter names is also taken from the parameter list; it isn't affected by the parameter name specified by the `.Parameter` keyword.

Common Parameters

The common parameters are added to the syntax and parameter list of the Help topic, even if they have no effect. For more information about the common parameters, see about_CommonParameters.

Parameter Attribute Table

`Get-Help` generates the table of parameter attributes that appears when you use the **Full** or **Parameter** parameter of `Get-Help`. The value of the **Required**, **Position**, and **Default** value attributes is taken from the function or script syntax.

Remarks

The Remarks section of the Help topic is automatically generated from the function or script name. You can't change or affect its content.

Examples of Comment-Based Help

Article • 07/10/2023

This topic includes example that demonstrate how to use comment-based help for scripts and functions.

Example 1: Comment-Based Help for a Function

The following sample function includes comment-based Help.

PowerShell

```
function Add-Extension
{
    param ([string]$Name,[string]$Extension = "txt")
    $name = $name + "." + $extension
    $name

    <#
        .SYNOPSIS
        Adds a file name extension to a supplied name.

        .DESCRIPTION
        Adds a file name extension to a supplied name.
        Takes any strings for the file name or extension.

        .PARAMETER Name
        Specifies the file name.

        .PARAMETER Extension
        Specifies the extension. "Txt" is the default.

        .INPUTS
        None. You can't pipe objects to Add-Extension.

        .OUTPUTS
        System.String. Add-Extension returns a string with the extension or
file name.

        .EXAMPLE
        PS> extension -name "File"
        File.txt

        .EXAMPLE
        PS> extension -name "File" -extension "doc"
        File.doc

        .EXAMPLE
        PS> extension "File" "doc"
```

```
        File.doc

        .LINK
        Online version: http://www.fabrikam.com/extension.html

        .LINK
        Set-Item
    #>
}
```

The following output shows the results of a `Get-Help` command that displays the help for the `Add-Extension` function.

PowerShell

```
PS> Get-Help Add-Extension -full
```

Output

```
        NAME
            Add-Extension

        SYNOPSIS
            Adds a file name extension to a supplied name.

        SYNTAX
            Add-Extension [[-Name] <String>] [[-Extension] <String>]
[<CommonParameters>]

        DESCRIPTION
            Adds a file name extension to a supplied name. Takes any strings
for the file name or extension.

        PARAMETERS
           -Name
               Specifies the file name.

               Required?                    false
               Position?                    0
               Default value
               Accept pipeline input?       false
               Accept wildcard characters?

           -Extension
               Specifies the extension. "Txt" is the default.

               Required?                    false
               Position?                    1
               Default value
               Accept pipeline input?       false
               Accept wildcard characters?
```

```
            <CommonParameters>
               This cmdlet supports the common parameters: -Verbose, -Debug,
               -ErrorAction, -ErrorVariable, -WarningAction, -
WarningVariable,
               -OutBuffer and -OutVariable. For more information, type
               "get-help about_commonparameters".

        INPUTS
            None. You can't pipe objects to Add-Extension.

        OUTPUTS
            System.String. Add-Extension returns a string with the extension
or file name.

            -------------------------- EXAMPLE 1 --------------------------

            PS> extension -name "File"
            File.txt

            -------------------------- EXAMPLE 2 --------------------------

            PS> extension -name "File" -extension "doc"
            File.doc

            -------------------------- EXAMPLE 3 --------------------------

            PS> extension "File" "doc"
            File.doc

        RELATED LINKS
            Online version: http://www.fabrikam.com/extension.html
            Set-Item
```

Example 2: Comment-Based Help for a Script

The following sample function includes comment-based Help.

Notice the blank lines between the closing `#>` and the `Param` statement. In a script that does not have a `Param` statement, there must be at least two blank lines between the final comment in the Help topic and the first function declaration. Without these blank lines, `Get-Help` associates the Help topic with the function, instead of the script.

PowerShell

```
<#
  .SYNOPSIS
  Performs monthly data updates.

  .DESCRIPTION
```

```
  The Update-Month.ps1 script updates the registry with new data generated
  during the past month and generates a report.

  .PARAMETER InputPath
  Specifies the path to the CSV-based input file.

  .PARAMETER OutputPath
  Specifies the name and path for the CSV-based output file. By default,
  MonthlyUpdates.ps1 generates a name from the date and time it runs, and
  saves the output in the local directory.

  .INPUTS
  None. You can't pipe objects to Update-Month.ps1.

  .OUTPUTS
  None. Update-Month.ps1 doesn't generate any output.

  .EXAMPLE
  PS> .\Update-Month.ps1

  .EXAMPLE
  PS> .\Update-Month.ps1 -inputpath C:\Data\January.csv

  .EXAMPLE
  PS> .\Update-Month.ps1 -inputpath C:\Data\January.csv -outputPath
C:\Reports\2009\January.csv
#>

param ([string]$InputPath, [string]$OutPutPath)

function Get-Data { }
```

The following command gets the script Help. Because the script isn't in a directory that's listed in the Path environment variable, the `Get-Help` command that gets the script Help must specify the script path.

PowerShell

```
PS> Get-Help c:\ps-test\update-month.ps1 -full
```

Output

```
            NAME
                C:\ps-test\Update-Month.ps1

            SYNOPSIS
                Performs monthly data updates.

            SYNTAX
                C:\ps-test\Update-Month.ps1 [-InputPath] <String> [[-
OutputPath]
```

```
                <String>] [<CommonParameters>]

            DESCRIPTION
                The Update-Month.ps1 script updates the registry with new
data
                generated during the past month and generates a report.

            PARAMETERS
               -InputPath
                   Specifies the path to the CSV-based input file.

                   Required?                    true
                   Position?                    0
                   Default value
                   Accept pipeline input?       false
                   Accept wildcard characters?

               -OutputPath
                   Specifies the name and path for the CSV-based output
file. By
                   default, MonthlyUpdates.ps1 generates a name from the
date
                   and time it runs, and saves the output in the local
directory.

                   Required?                    false
                   Position?                    1
                   Default value
                   Accept pipeline input?       false
                   Accept wildcard characters?

               <CommonParameters>
                   This cmdlet supports the common parameters: -Verbose, -
Debug,
                   -ErrorAction, -ErrorVariable, -WarningAction, -
WarningVariable,
                   -OutBuffer and -OutVariable. For more information, type,
                   "get-help about_commonparameters".

            INPUTS
                   None. You can't pipe objects to Update-Month.ps1.

            OUTPUTS
                   None. Update-Month.ps1 doesn't generate any output.

            -------------------------- EXAMPLE 1 -------------------------

            PS> .\Update-Month.ps1

            -------------------------- EXAMPLE 2 -------------------------

            PS> .\Update-Month.ps1 -inputpath C:\Data\January.csv

            -------------------------- EXAMPLE 3 -------------------------
```

```
            PS> .\Update-Month.ps1 -inputpath C:\Data\January.csv -
outputPath
            C:\Reports\2009\January.csv

            RELATED LINKS
```

Example 3: Parameter Descriptions in a Param Statement

This example shows how to insert parameter descriptions in the `Param` statement of a function or script. This format is most useful when the parameter descriptions are brief.

PowerShell

```
function Add-Extension
{
    param
    (
        [string]
        # Specifies the file name.
        $name,

        [string]
        # Specifies the file name extension. "Txt" is the default.
        $extension = "txt"
    )
    $name = $name + "." + $extension
    $name

    <#
        .SYNOPSIS
        Adds a file name extension to a supplied name.
...
    #>
```

The results are the same as the results for Example 1. `Get-Help` interprets the parameter descriptions as though they were accompanied by the `.Parameter` keyword.

Example 4: Redirecting to an XML File

You can write XML-based Help topics for functions and scripts. Although comment-based Help is easier to implement, XML-based Help is required if you want more precise control over Help content or if you are translating Help topics into multiple languages.The following example shows the first few lines of the `Update-Month.ps1`

script. The script uses the `.ExternalHelp` keyword to specify the path to an XML-based Help topic for the script.

PowerShell

```
#  .ExternalHelp C:\MyScripts\Update-Month-Help.xml

    param ([string]$InputPath, [string]$OutPutPath)

    function Get-Data { }
```

The following example shows the use of the `.ExternalHelp` keyword in a function.

PowerShell

```
function Add-Extension
{
    param ([string] $name, [string]$extension = "txt")
    $name = $name + "." + $extension
    $name

    # .ExternalHelp C:\ps-test\Add-Extension.xml
}
```

Example 5: Redirecting to a Different Help Topic

The following code is an excerpt from the beginning of the built-in `Help` function in PowerShell, which displays one screen of Help text at a time. Because the Help topic for the Get-Help cmdlet describes the Help function, the Help function uses the `.ForwardHelpTargetName` and `.ForwardHelpCategory` keywords to redirect the user to the Get-Help cmdlet Help topic.

PowerShell

```
function help
{

    <#
      .FORWARDHELPTARGETNAME Get-Help
      .FORWARDHELPCATEGORY Cmdlet
    #>
    [CmdletBinding(DefaultParameterSetName='AllUsersView')]
    param(
            [Parameter(Position=0, ValueFromPipelineByPropertyName=$true)]
            [System.String]
```

```
            ${Name},
    ...
```

The following command uses this feature. When a user types a `Get-Help` command for the `Help` function, `Get-Help` displays the Help topic for the `Get-Help` cmdlet.

PowerShell

```
PS> get-help help
```

Output

```
            NAME
                Get-Help

            SYNOPSIS
                Displays information about Windows PowerShell cmdlets and
concepts.
            ...
```

Writing Help for PowerShell Cmdlets

Article • 07/10/2023

PowerShell cmdlets can be useful, but unless your Help topics clearly explain what the cmdlet does and how to use it, the cmdlet may not get used or, even worse, it might frustrate users. The XML-based cmdlet Help file format enhances consistency, but great help requires much more.

If you have never written cmdlet Help, review the following guidelines. The XML schema required to author the cmdlet Help topic is described in the following section. Start with Creating the Cmdlet Help File. That topic includes a description of the top-level XML nodes.

Writing Guidelines for Cmdlet Help

Write well

Nothing replaces a well-written topic. If you aren't a professional writer, find a writer or editor to help you. Another alternative is to copy your Help text into Microsoft Word and use the grammar and spelling checks to improve your work.

Write simply

Use simple words and phrases. Avoid jargon. Consider that many readers are equipped only with a foreign-language dictionary and your Help topic.

Write consistently

Help for related cmdlets should be similar (for example, `Get-Content` and `Set-Content`). Use the standard descriptions for standard parameters, like **Force** and **InputObject**. (Copy them from Help for the core cmdlets.) Use standard terms. For example, use "parameter", not "argument", and use "cmdlet" not "command" or "command-let."

Start the synopsis with a verb

The synopsis field informs the user what the cmdlet does, not what it's or how it works. Verbs create a task-based statement that informs users if this cmdlet meets their requirements. Use simple verbs like "get", "create", and "change." Avoid "set", which can be vague and fancy words like "modify".

Focus on objects

Most "get" cmdlets display something, but their primary function is to get an object. In your Help, focus on the object, so that users understand that the default display is one of many, and that they can use the methods and properties of the object that you retrieved for them in different ways.

Write detailed descriptions

Briefly list everything that the cmdlet can do in the detailed description. If the main function is to change one property, but the cmdlet can change all properties, list this in the detailed description.

Use conventional syntax

Use the standard Backus-Naur format which is common for Windows and UNIX command-line Help.

Use Microsoft .NET types for parameter values

The placeholders for parameter values (in the syntax and parameter descriptions) show the .NET Framework types of the objects that the parameter will accept. The PowerShell team developed this convention to help teach users about the .NET Framework.

Write complete parameter descriptions

Parameter descriptions must inform users of two things: what the parameter does (its effect) and what they must type for the parameter values.

Write practical examples

The examples should show how to use all of the parameters, but the most important thing is to show how to use the cmdlet in real-world tasks. Start with a simple example and write increasingly complex examples. In the final example, show how to use the cmdlet in a pipeline.

Use the Notes field

Use the Notes field to explain concepts that users need to understand the cmdlet. You can also use notes to help users avoid common errors. Avoid URLs as they change.

Instead, provide users terms to search for.

Test your Help

Test the Help just like you test your code. Have friends and colleagues read your Help content and provide feedback. You can also solicit feedback from newsgroups.

See Also

- How to Create the Cmdlet Help File
- How to Add the Cmdlet Name and Synopsis to a Cmdlet Help Topic
- How to Add the Detailed Description to a Cmdlet Help Topic
- How to Add Syntax to a Cmdlet Help Topic
- How to Add Parameters to a Cmdlet Help Topic
- How to add Input Types to a Cmdlet Help Topic
- How to Add Return Values to a Cmdlet Help Topic
- How to Add Notes to a Cmdlet Help Topic
- How to Add Examples to a Cmdlet Help Topic
- How to Add Related Links to a Cmdlet Help Topic
- Windows PowerShell SDK

How to create the cmdlet help file

Article • 07/10/2023

> **Note**
>
> Manual authoring of XML-based help is very difficult. The **PlatyPS** module allows you to write help in Markdown and then convert it to XML-based help. This makes it much easier to write and maintain help. **PlatyPS** can also create the Updateable Help packages for you. For more information, see **Create XML-based help using PlatyPS**.

This section describes how to create a valid XML file that contains content for Windows PowerShell cmdlet Help topics. This section discusses how to name the Help file, how to add the appropriate XML headers, and how to add nodes that will contain the different sections of the cmdlet Help content.

> **Note**
>
> For a complete view of a Help file, open one of the `dll-Help.xml` files located in the Windows PowerShell installation directory. For example, the `Microsoft.PowerShell.Commands.Management.dll-Help.xml` file contains content for several of the PowerShell cmdlets.

How to create a cmdlet help file

1. Create a text file and save it using UTF8 encoding. The filename must have the following format so that Windows PowerShell can detect it as a cmdlet Help file.

   `<PSSnapInAssemblyName>.dll-Help.xml`

2. Add the following XML headers to the text file. Be aware that the file will be validated against the Microsoft Assistance Markup Language (MAML) schema. Currently, PowerShell doesn't provide any tools to validate the file.

   `<?xml version="1.0" encoding="utf-8" ?> <helpItems xmlns="http://msh" schema="maml">`

3. Add a **Command** node to the cmdlet Help file for each cmdlet in the assembly. Each node within the **Command** node relates to the different sections of the

cmdlet Help topic.

The following table lists the XML element for each node, followed by a descriptions of each node.

Node	Description
`<details>`	Adds content for the NAME and SYNOPSIS sections of the cmdlet Help topic. For more information, see How to Add the Cmdlet Name and Synopsis.
`<maml:description>`	Adds content for the DESCRIPTION section of the cmdlet Help topic. For more information, see How to Add the Detailed Description to a Cmdlet Help Topic.
`<command:syntax>`	Adds content for the SYNTAX section of the cmdlet Help topic. For more information, see How to Add Syntax to a Cmdlet Help Topic.
`<command:parameters>`	Adds content for the PARAMETERS section of the cmdlet Help topic. For more information, see How to Add Parameters to a Cmdlet Help Topic.
`<command:inputTypes>`	Adds content for the INPUTS section of the cmdlet Help topic. For more information, see How to Add Input Types to a Cmdlet Help Topic.
`<command:returnValues>`	Adds content for the OUTPUTS section of the cmdlet Help topic. For more information, see How to Add Return Values to a Cmdlet Help Topic.
`<maml:alertset>`	Adds content for the NOTES section of the cmdlet Help topic. For more information, see How to add Notes to a Cmdlet Help Topic.
`<command:examples>`	Adds content for the EXAMPLES section of the cmdlet Help topic. For more information, see How to Add Examples to a Cmdlet Help Topic.
`<maml:relatedLinks>`	Adds content for the RELATED LINKS section of the cmdlet Help topic. For more information, see How to Add Related Links to a Cmdlet Help Topic.

Example

Here is an example of a **Command** node that includes the nodes for the various sections of the cmdlet Help topic.

```
XML
```

```
<command:command
  xmlns:maml="http://schemas.microsoft.com/maml/2004/10"
  xmlns:command="http://schemas.microsoft.com/maml/dev/command/2004/10"
  xmlns:dev="http://schemas.microsoft.com/maml/dev/2004/10">
  <command:details>
    <!--Add name and synopsis here-->
  </command:details>
  <maml:description>
    <!--Add detailed description here-->
  </maml:description>
  <command:syntax>
    <!--Add syntax information here-->
  </command:syntax>
  <command:parameters>
    <!--Add parameter information here-->
  </command:parameters>
  <command:inputTypes>
    <!--Add input type information here-->
  </command:inputTypes>
  <command:returnValues>
    <!--Add return value information here-->
  </command:returnValues>
  <maml:alertSet>
    <!--Add Note information here-->
  </maml:alertSet>
  <command:examples>
    <!--Add cmdlet examples here-->
  </command:examples>
  <maml:relatedLinks>
    <!--Add links to related content here-->
  </maml:relatedLinks>
</command:command>
```

See also

- How to Add the Cmdlet Name and Synopsis
- How to Add the Detailed Description to a Cmdlet Help Topic
- How to Add Syntax to a Cmdlet Help Topic
- How to Add Parameters to a Cmdlet Help Topic
- How to Add Input Types to a Cmdlet Help Topic
- How to Add Return Values to a Cmdlet Help Topic
- How to add Notes to a Cmdlet Help Topic
- How to Add Examples to a Cmdlet Help Topic
- How to Add Related Links to a Cmdlet Help Topic
- Windows PowerShell SDK

How to add the cmdlet name and synopsis to a cmdlet help topic

Article • 07/10/2023

> **Note**
>
> Manual authoring of XML-based help is very difficult. The **PlatyPS** module allows you to write help in Markdown and then convert it to XML-based help. This makes it much easier to write and maintain help. **PlatyPS** can also create the Updateable Help packages for you. For more information, see **Create XML-based help using PlatyPS**.

This section describes how to add content that's displayed in the **NAME** and **SYNOPSIS** sections of the cmdlet help. In the Help file, this content is added to the Command node for each cmdlet.

> **Note**
>
> For a complete view of a Help file, open one of the `dll-Help.xml` files located in the PowerShell installation directory. For example, the `Microsoft.PowerShell.Commands.Management.dll-Help.xml` file contains content for several of the PowerShell cmdlets.

To add the cmdlet name and a synopsis

- The cmdlet Help can display two descriptions for the cmdlet. The first description is a short description that's referred to as the synopsis. The second description is a more detailed description that's discussed in Adding the Detailed Description to a Cmdlet Help Topic. Both these descriptions should be written as a single paragraph.
- In the synopsis don't repeat the cmdlet name. Informing the user that the `Get-Server` cmdlet gets a server is brief, but not informative. Instead, use synonyms and add details to the description.

  Example: "Gets an object that represents a local or remote computer."

- Use simple verbs like "get", "create", and "change" in the synopsis. Avoid using "set" because it is vague, and fancy words such as "modify."

  Example: "Gets information about the Authenticode signature in a file."

- Write in active voice. For example, "Use the TimeSpan object..." is much clearer than "the TimeSpan object can be used to..."

- Avoid the verb "display" when describing cmdlets that get objects. Although Windows PowerShell displays cmdlet data, it's important to introduce users to the concept that the cmdlet returns .NET Framework objects whose data may not be displayed. If you emphasize the display, the user might not realize that the cmdlet may have returned many other useful properties and methods that aren't displayed.

See also

Windows PowerShell SDK

How to Add a Cmdlet Description

Article • 07/10/2023

> **Note**
>
> Manual authoring of XML-based help is very difficult. The **PlatyPS** module allows you to write help in Markdown and then convert it to XML-based help. This makes it much easier to write and maintain help. **PlatyPS** can also create the Updateable Help packages for you. For more information, see **Create XML-based help using PlatyPS**.

This section describes how to add content that's displayed in the **DESCRIPTION** section of the cmdlet Help. In the Help file, this content is added to the **Command** node for each cmdlet.

> **Note**
>
> For a complete view of a Help file, open one of the `dll-Help.xml` files located in the PowerShell installation directory. For example, the `Microsoft.PowerShell.Commands.Management.dll-Help.xml` file contains content for several of the PowerShell cmdlets.

To Add a Description

- Begin by explaining the basic features of the cmdlet in more detail. In many cases, you can explain the terms used in the cmdlet name and illustrate unfamiliar concepts with an example. For example, if the cmdlet appends data to a file, explain that it adds data to the end of an existing file.
- To find all of the features of the cmdlet, review the parameter list. Describe the primary function of the cmdlet, and then include other functions and features. For example, if the main function of the cmdlet is to change one property, but the cmdlet can change all of the properties, say so in the detailed description. If the cmdlet parameters let the users solicit information in different ways, explain it.
- Include information on ways that users can use the cmdlet, in addition to the obvious uses. For example, you can use the object that the `Get-Host` cmdlet retrieves to change the color of text in the Windows PowerShell command window.

Example: "The `Get-Acl` cmdlet gets objects that represent the security descriptor of a file or resource. The security descriptor contains the access control lists (ACLs) of the resource. The ACL specifies the permissions that users and user groups have to access the resource."

- The detailed description should describe the cmdlet, but it shouldn't describe concepts that the cmdlet uses. Place concept definitions in Additional Notes.

See Also

Windows PowerShell SDK

How to add syntax to a cmdlet help topic

Article • 07/10/2023

> **Note**
>
> Manual authoring of XML-based help is very difficult. The **PlatyPS** module allows you to write help in Markdown and then convert it to XML-based help. This makes it much easier to write and maintain help. **PlatyPS** can also create the Updateable Help packages for you. For more information, see **Create XML-based help using PlatyPS**.

Before you start to code the XML for the syntax diagram in the cmdlet Help file, read this section to get a clear picture of the kind of data you need to provide, such as the parameter attributes, and how that data is displayed in the syntax diagram..

Parameter attributes

- Required
  - If true, the parameter must appear in all commands that use the parameter set.
  - If false, the parameter is optional in all commands that use the parameter set.
- Position
  - If named, the parameter name is required.
  - If positional, the parameter name is optional. When it's omitted, the parameter value must be in the specified position in the command. For example, if the value is position="1", the parameter value must be the first or only unnamed parameter value in the command.
- Pipeline Input
  - If true (ByValue), you can pipe input to the parameter. The input is associated with ("bound to") the parameter even if the property name and the object type don't match the expected type. The PowerShell parameter binding components try to convert the input to the correct type and fail the command only when the type can't be converted. Only one parameter in a parameter set can be associated by value.
  - If true (ByPropertyName), you can pipe input to the parameter. However, the input is associated with the parameter only when the parameter name matches the name of a property of the input object. For example, if the parameter name

is `Path`, objects piped to the cmdlet are associated with that parameter only when the object has a property named path.
    - If true (ByValue, ByPropertyName), you can pipe input to the parameter either by property name or by value. Only one parameter in a parameter set can be associated by value.
    - If false, you can't pipe input to this parameter.
- Globbing
    - If true, the text that the user types for the parameter value can include wildcard characters.
    - If false, the text that the user types for the parameter value can't include wildcard characters.

Parameter value attributes

- Required
    - If true, the specified value must be used whenever using the parameter in a command.
    - If false, the parameter value is optional. Typically, a value is optional only when it's one of several valid values for a parameter, such as in an enumerated type.

The **Required** attribute of a parameter value is different from the **Required** attribute of a parameter.

The required attribute of a parameter indicates whether the parameter (and its value) must be included when invoking the cmdlet. In contrast, the required attribute of a parameter value is used only when the parameter is included in the command. It indicates whether that particular value must be used with the parameter.

Typically, parameter values that are placeholders are required and parameter values that are literal aren't required, because they're one of several values that might be used with the parameter.

Gathering syntax information

1. Start with the cmdlet name.

```
SYNTAX
    Get-Tech
```

2. List all the parameters of the cmdlet. Type a hyphen (`-`) before each parameter name. Separate the parameters into parameter sets (some cmdlets may have only one parameter set). In this example the Get-Tech cmdlet has two parameter sets.

```
SYNTAX
    Get-Tech -name -type
    Get-Tech -ID -list -type
```

   Start each parameter set with the cmdlet name.

   List the default parameter set first. The default parameter is specified by the cmdlet class.

   For each parameter set, list its unique parameter first, unless there are positional parameters that must appear first. In the previous example, the Name and ID parameters are unique parameters for the two parameter sets (each parameter set must have one parameter that's unique to that parameter set). This makes it easier for users to identify what parameter they need to supply for the parameter set.

   List the parameters in the order that they should appear in the command. If the order doesn't matter, list related parameters together, or list the most frequently used parameters first.

   Be sure to list the WhatIf and Confirm parameters if the cmdlet supports ShouldProcess.

   Don't list the common parameters (such as Verbose, Debug, and ErrorAction) in your syntax diagram. The `Get-Help` cmdlet adds that information for you when it displays the Help topic.

3. Add the parameter values. In PowerShell, parameter values are represented by their .NET type. However, the type name can be abbreviated, such as "string" for System.String.

```
SYNTAX
    Get-Tech -name string -type basic advanced
    Get-Tech -ID int -list -type basic advanced
```

   Abbreviate types as long as their meaning is clear, such as **string** for **System.String** and **int** for **System.Int32**.

List all values of enumerations, such as the `-type` parameter in the previous example, which can be set to **basic** or **advanced**.

Switch parameters, such as `-list` in the previous example, don't have values.

4. Add angle brackets to parameters values that are placeholder, as compared to parameter values that are literals.

```
SYNTAX
    Get-Tech -name <string> -type basic advanced
    Get-Tech -ID <int> -list -type basic advanced
```

5. Enclose optional parameters and their vales in square brackets.

```
SYNTAX
    Get-Tech -name <string> [-type basic advanced]
    Get-Tech -ID <int> [-list] [-type basic advanced]
```

6. Enclose optional parameters names (for positional parameters) in square brackets. The name for parameters that are positional, such as the Name parameter in the following example, don't have to be included in the command.

```
SYNTAX
    Get-Tech [-name] <string> [-type basic advanced]
    Get-Tech -ID <int> [-list] [-type basic advanced]
```

7. If a parameter value can contain multiple values, such as a list of names in the Name parameter, add a pair of square brackets directly following the parameter value.

```
SYNTAX
    Get-Tech [-name] <string[]> [-type basic advanced]
    Get-Tech -ID <int[]> [-list] [-type basic advanced]
```

8. If the user can choose from parameters or parameter values, such as the Type parameter, enclose the choices in curly brackets and separate them with the exclusive OR symbol(;).

```
SYNTAX
    Get-Tech [-name] <string[]> [-type {basic | advanced}]
    Get-Tech -ID <int[]> [-list] [-type {basic | advanced}]
```

9. If the parameter value must use specific formatting, such as quotation marks or parentheses, show the format in the syntax.

```
SYNTAX
    Get-Tech [-name] <"string[]"> [-type {basic | advanced}]
    Get-Tech -ID <int[]> [-list] [-type {basic | advanced}]
```

Coding the syntax diagram XML

The syntax node of the XML begins immediately after the description node, which ends with the `</maml:description>` tag. For information about gathering the data used in the syntax diagram, see Gathering Syntax Information.

Adding a syntax node

The syntax diagram displayed in the cmdlet Help topic is generated from the data in the syntax node of the XML. The syntax node is enclosed in a pair of `<command:syntax>` tags. With each parameter set of the cmdlet enclosed in a pair of `<command:syntaxitem>` tags. There is no limit to the number of `<command:syntaxitem>` tags that you can add.

The following example shows a syntax node that has syntax item nodes for two parameter sets.

XML

```
<command:syntax>
  <command:syntaxItem>
    ...
    <!--Parameter Set 1 (default parameter set) parameters go here-->
    ...
  </command:syntaxItem>
  <command:syntaxItem>
    ...
    <!--Parameter Set 2 parameters go here-->
    ...
```

```
  </command:syntaxItem>
</command:syntax>
```

Adding the cmdlet name to the parameter set data

Each parameter set of the cmdlet is specified in a syntax item node. Each syntax item node begins with a pair of `<maml:name>` tags that include the name of the cmdlet.

The following example includes a syntax node that has syntax item nodes for two parameter sets.

XML

```
<command:syntax>
  <command:syntaxItem>
    <maml:name>Cmdlet-Name</maml:name>
  </command:syntaxItem>
  <command:syntaxItem>
    <maml:name>Cmdlet-Name</maml:name>
  </command:syntaxItem>
</command:syntax>
```

Adding parameters

Each parameter added to the syntax item node is specified within a pair of `<command:parameter>` tags. You need a pair of `<command:parameter>` tags for each parameter included in the parameter set, with the exception of the common parameters that are provided by PowerShell.

The attributes of the opening `<command:parameter>` tag determine how the parameter appears in the syntax diagram. For information on parameter attributes, see Parameter Attributes.

> **Note**
>
> The `<command:parameter>` tag supports a child element `<maml:description>` whose content is never displayed. The parameter descriptions are specified in the parameter node of the XML. To avoid inconsistencies between the information in the syntax item bodes and the parameter node, omit the (`<maml:description>` or leave it empty.

The following example includes a syntax item node for a parameter set with two parameters.

XML

```
<command:syntaxItem>
  <maml:name>Cmdlet-Name</maml:name>
  <command:parameter required="true" globbing="true"
    pipelineInput="true (ByValue)" position="1">
    <maml:name>ParameterName1</maml:name>
    <command:parameterValue required="true">
      string[]
    </command:parameterValue>
  </command:parameter>
  <command:parameter required="true" globbing="true"
    pipelineInput="true (ByPropertyName)">
    <maml:name>ParameterName2</maml:name>
    <command:parameterValue required="true">
      int32[]
    </command:parameterValue>
  </command:parameter>
</command:syntaxItem>
```

How to add parameter information

Article • 07/10/2023

> **Note**
>
> Manual authoring of XML-based help is very difficult. The **PlatyPS** module allows you to write help in Markdown and then convert it to XML-based help. This makes it much easier to write and maintain help. **PlatyPS** can also create the Updateable Help packages for you. For more information, see **Create XML-based help using PlatyPS**.

This section describes how to add content that's displayed in the **PARAMETERS** section of the cmdlet Help topic. The **PARAMETERS** section of the Help topic lists each of the parameters of the cmdlet and provides a detailed description of each parameter.

The content of the **PARAMETERS** section should be consistent with the content of the **SYNTAX** section of the Help topic. It's the responsibility of the Help author to make sure that both the **Syntax** and **Parameters** node contain similar XML elements.

> **Note**
>
> For a complete view of a Help file, open one of the `dll-Help.xml` files located in the PowerShell installation directory. For example, the `Microsoft.PowerShell.Commands.Management.dll-Help.xml` file contains content for several of the PowerShell cmdlets.

To add parameters

1. Open the cmdlet Help file and locate the **Command** node for the cmdlet you are documenting. If you are adding a new cmdlet you will need to create a new **Command** node. Your Help file will contain a **Command** node for each cmdlet that you are providing Help content for. Here is an example of a blank **Command** node.

   XML

   ```xml
   <command:command>
   </command:command>
   ```

2. Within the **Command** node, locate the **Description** node and add a **Parameters** node as shown below. Only one **Parameters** node is allowed, and it should immediately follow the **Syntax** node.

```
XML

<command:command>
  <command:details></command:details>
  <maml:description></maml:description>
  <command:syntax></command:syntax>
  <command:parameters>
  </command:parameters>
</command:command>
```

3. Within the Parameters node, add a **Parameter** node for each parameter of the cmdlet as shown below.

   In this example, a **Parameter** node is added for three parameters.

```
XML

<command:parameters>
  <command:parameter></command:parameter>
  <command:parameter></command:parameter>
  <command:parameter></command:parameter>
</command:parameters>
```

   Because these are the same XML tags that are used in the **Syntax** node, and because the parameters specified here must match the parameters specified by the **Syntax** node, you can copy the **Parameter** nodes from the **Syntax** node and paste them into the **Parameters** node. However, be sure to copy only one instance of a **Parameter** node, even if the parameter is specified in multiple parameter sets in the syntax.

4. For each Parameter node, set the attribute values that define the characteristics of each parameter. These attributes include the following: required, **globbing**, **pipelineinput**, and **position**.

```
XML

<command:parameters>
  <command:parameter required="true" globbing="true"
           pipelineInput="false" position="named">
  </command:parameter>
  <command:parameter required="false" globbing="false"
           pipelineInput="false" position="named">
  </command:parameter>
```

```
  <command:parameter required="false" globbing="false"
           pipelineInput="false" position="named" ></command:parameter>
</command:parameters>
```

5. For each **Parameter** node, add the name of the parameter. Here is an example of the parameter name added to the **Parameter** node.

```
XML

<command:parameters>
  <command:parameter required="true" globbing="true"
           pipelineInput="false" position="named">
    <maml:name> Add parameter name...  </maml:name>
  </command:parameter>
</command:parameters>
```

6. For each **Parameter** node, add the description of the parameter. Here is an example of the parameter description added to the **Parameter** node.

```
XML

<command:parameters>
  <command:parameter required="true" globbing="true"
           pipelineInput="false" position="named">
    <maml:name> Add parameter name...  </maml:name>
    <maml:description>
      <maml:para> Add parameter description... </maml:para>
    </maml:description>
  </command:parameter>
</command:parameters>
```

7. For each **Parameter** node, add the .NET type of the parameter. The parameter type is displayed along with the parameter name.

   Here is an example of the parameter .NET type added to the **Parameter** node.

```
XML

<command:parameters>
  <command:parameter required="true" globbing="true"
           pipelineInput="false" position="named">
    <maml:name> Add parameter name...  </maml:name>
    <maml:description>
      <maml:para> Add parameter description... </maml:para>
    </maml:description>
    <dev:type> Add .NET Framework type... </dev:type>
  </command:parameter>
</command:parameters>
```

8. For each **Parameter** node, add the default value of the parameter. The following sentence is added to the parameter description when the content is displayed: **DefaultValue** is the default.

   Here is an example of the parameter default value is added to the **Parameter** node.

   XML

   ```
   <command:parameters>
     <command:parameter required="true" globbing="true"
              pipelineInput="false" position="named">
       <maml:name> Add parameter name...  </maml:name>
       <maml:description>
         <maml:para> Add parameter description... </maml:para>
       </maml:description>
       <dev:type> Add .NET Framework type... </dev:type>
       <dev:defaultvalue> Add default value...</dev:defaultvalue>
     </command:parameter>
   </command:parameters>
   ```

9. For each Parameter that has multiple values, add a **possibleValues** node.

   Here is an example of the of a **possibleValues** node that defines two possible values for the parameter

   XML

   ```
   <dev:possibleValues>
     <dev:possibleValue>
       <dev:value>Unknown</dev:value>
       <maml:description>
         <maml:para></maml:para>
       </maml:description>
     </dev:possibleValue>
     <dev:possibleValue>
       <dev:value>String</dev:value>
       <maml:description>
         <maml:para></maml:para>
       </maml:description>
     </dev:possibleValue>
   </dev:possibleValues>
   ```

Here are some things to remember when adding parameters.

- The attributes of the parameter aren't displayed in all views of the cmdlet Help topic. However, they're displayed in a table following the parameter description when the user asks for the **Full** (`Get-Help <cmdletname> -Full`) or **Parameter** (`Get-Help <cmdletname> -Parameter`) view of the topic.

- The parameter description is one of the most important parts of a cmdlet Help topic. The description should be brief, as well as thorough. Also, remember that if the parameter description becomes too long, such as when two parameters interact with each other, you can add more content in the **NOTES** section of the cmdlet Help topic.

  The parameter description provides two types of information.

- What the cmdlet does when the parameter is used.
- What a legal value is for the parameter.
- Because the parameter values are expressed as .NET objects, users need more information about these values than they would in a traditional command-line Help. Tell the user what type of data the parameter is designed to accept, and include examples.

The default value of the parameter is the value that's used if the parameter isn't specified on the command line. Note that the default value is optional, and isn't needed for some parameters, such as required parameters. However, you should specify a default value for most optional parameters.

The default value helps the user to understand the effect of not using the parameter. Describe the default value very specifically, such as the "Current directory" or the "PowerShell installation directory (`$PSHOME`)" for an optional path. You can also write a sentence that describes the default, such as the following sentence used for the **PassThru** parameter: "If PassThru isn't specified, the cmdlet doesn't pass objects down the pipeline." Also, because the value is displayed opposite the field name **Default value**, you don't need to include the term "default value" in the entry.

The default value of the parameter isn't displayed in all views of the cmdlet Help topic. However, it's displayed in a table (along with the parameter attributes) following the parameter description when the user asks for the **Full** (`Get-Help <cmdletname> -Full`) or **Parameter** (`Get-Help <cmdletname> -Parameter`) view of the topic.

The following XML shows a pair of `<dev:defaultValue>` tags added to the `<command:parameter>` node. Notice that the default value follows immediately after the closing `</command:parameterValue>` tag (when the parameter value is specified) or the closing `</maml:description>` tag of the parameter description. name.

XML

```
<command:parameters>
  <command:parameter required="true" globbing="true"
```

```
            pipelineInput="false" position="named">
    <maml:name> Parameter name </maml:name>
    <maml:description>
      <maml:para> Parameter Description </maml:para>
    </maml:description>
    <command:parameterValue required="true">
      Value
    </command:parameterValue>
    <dev:defaultValue> Default parameter value </dev:defaultValue>
  </command:parameter>
</command:parameters>
```

Add Values for Enumerated Types

If the parameter has multiple values or values of an enumerated type, you can use an optional `<dev:possibleValues>` node. This node allows you to specify a name and description for multiple values.

Be aware that the descriptions of the enumerated values don't appear in any of the default Help views displayed by the `Get-Help` cmdlet, but other Help viewers may display this content in their views.

The following XML shows a `<dev:possibleValues>` node with two values specified.

XML

```
<command:parameters>
  <command:parameter required="true" globbing="true"
            pipelineInput="false" position="named">
    <maml:name> Parameter name </maml:name>
    <maml:description>
      <maml:para> Parameter Description </maml:para>
    </maml:description>
    <command:parameterValue required="true">
      Value
    </command:parameterValue>
    <dev:defaultValue> Default parameter value </dev:defaultValue>
    <dev:possibleValues>
      <dev:possibleValue>
        <dev:value> Value 1 </dev:value>
        <maml:description>
          <maml:para> Description 1 </maml:para>
        </maml:description>
      <dev:possibleValue>
      <dev:possibleValue>
        <dev:value> Value 2 </dev:value>
        <maml:description>
          <maml:para> Description 2 </maml:para>
        </maml:description>
      <dev:possibleValue>
    </dev:possibleValues>
```

```
    </command:parameter>
  </command:parameters>
```

How to add input types to a cmdlet help topic

Article • 07/10/2023

> **Note**
>
> Manual authoring of XML-based help is very difficult. The **PlatyPS** module allows you to write help in Markdown and then convert it to XML-based help. This makes it much easier to write and maintain help. **PlatyPS** can also create the Updateable Help packages for you. For more information, see **Create XML-based help using PlatyPS**.

This section describes how to add an **INPUTS** section to a PowerShell cmdlet Help topic. The **INPUTS** section lists the .NET classes of objects that the cmdlet accepts as input from the pipeline, either by value or by property name.

There is no limit to the number of classes that you can add to an **INPUTS** section. The input types are enclosed in a `<command:inputTypes>` node, with each class enclosed in a `<command:inputType>` element.

The schema includes two `<maml:description>` elements in each `<command:inputType>` element. However, the `Get-Help` cmdlet displays only the content of the `<command:inputType>/<maml:description>` element.

Beginning in PowerShell 3.0, the `Get-Help` cmdlet displays the content of the `<maml:uri>` element. This element lets you direct users to topics that describe the .NET class.

The following XML shows the `<maml:inputTypes>` node.

XML

```
<command:inputTypes>
  <command:inputType>
    <dev:type>
      <maml:name> Class name </maml:name>
      <maml:uri>  URI of a topic that describes the class </maml:uri>
      <maml:description/>
    </dev:type>
    <maml:description>
      <maml:para> Brief description </maml:para>
    </maml:description>
```

```
  </command:inputType>
</command:inputTypes>
```

The following XML shows an example of using the `<maml:inputTypes>` node to document an input type.

XML

```
<command:inputTypes>
  <command:inputType>
    <dev:type>
      <maml:name>System.DateTime</maml:name>

<maml:uri>https://learn.microsoft.com/dotnet/api/system.datetime</maml:uri>
      <maml:description/>
    </dev:type>
    <maml:description>
      <maml:para> You can pipe a date to the Set-Date cmdlet. <maml:para>
    <maml:description>
  </command:inputType>
</command:inputTypes>
```

How to add return values to a cmdlet help topic

Article • 07/10/2023

This section describes how to add an OUTPUTS section to a PowerShell cmdlet Help topic. The **OUTPUTS** section lists the .NET classes of objects that the cmdlet returns or passes down the pipeline.

There is no limit to the number of classes that you can add to the **OUTPUTS** section. The return types of a cmdlet are enclosed in a `<command:returnValues>` node, with each class enclosed in a `<command:returnValue>` element.

If a cmdlet doesn't generate any output, use this section to indicate that there is no output. For example, in place of the class name, write **None** and provide a brief explanation. If the cmdlet generates output conditionally, use this node to explain the conditions and describe the conditional output.

The schema includes two `<maml:description>` elements in each `<command:returnValue>` element. However, the `Get-Help` cmdlet displays only the content of the `<command:returnValue>/<maml:description>` element.

Beginning in PowerShell 3.0, the `Get-Help` cmdlet displays the content of the `<maml:uri>` element. This element lets you direct users to topics that describe the .NET class.

The following XML shows the `<maml:returnValues>` node.

XML

```
<command:returnValues>
  <command:returnValue>
    <dev:type>
      <maml:name> Class Name </maml:name>
      <maml:uri>  URI of a topic that describes the class </maml:uri>
      <maml:description/>
    </dev:type>
    <maml:description>
       <maml:para> Brief description <maml:para>

</maml:description>
  </command: returnValue>
</command: returnValues>
```

The following XML shows an example of using the `<maml:returnValues>` node to document an output type.

XML

```
<command:returnValues>
  <command:returnValue>
    <dev:type>
      <maml:name> System.DateTime </maml:name>
      <maml:uri>  https://learn.microsoft.com/dotnet/api/system.datetime
</maml:uri>
      <maml:description/>
    </dev:type>
    <maml:description>
      <maml:para> Get-Date returns a DateTime object. <maml:para>
    </maml:description>
  </command: returnValue>
</command: returnValues>
```

How to add notes to a cmdlet help topic

Article • 07/10/2023

> **Note**
>
> Manual authoring of XML-based help is very difficult. The **PlatyPS** module allows you to write help in Markdown and then convert it to XML-based help. This makes it much easier to write and maintain help. **PlatyPS** can also create the Updateable Help packages for you. For more information, see **Create XML-based help using PlatyPS**.

This section describes how to add a **NOTES** section to a PowerShell cmdlet Help topic. The **NOTES** section is used to explain details that don't fit easily into the other structured sections, such as a more detailed explanation of a parameter. This content could include comments on how the cmdlet works with a specific provider, some unique, yet important, uses of the cmdlet, or ways to avoid possible error conditions.

The **NOTES** section is defined using a single `<maml:alertset>` node. There are no limits to the number of notes that you can add to a Notes section. For each note, add a pair of `<maml:alert>` tags to the `<maml:alertset>` node. The content of each note is added within a set of `<maml:para>` tags. Use blank `<maml:para>` tags for spacing.

XML

```xml
<maml:alertSet>
  <maml:title>Optional title for Note</maml:title>
  <maml:alert>
    <maml:para>Note 1</maml:para>
    <maml:para>Note a</maml:para>
  </maml:alert>
  <maml:alert>
    <maml:para>Note 2</maml:para>
  </maml:alert>
</maml:alertSet>
```

How to add examples to a cmdlet help topic

Article • 07/10/2023

> **Note**
>
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Things to know about examples in cmdlet help

- List all of the parameter names in the command, even when the parameter names are optional. This helps the user to interpret the command easily.
- Avoid aliases and partial parameter names, even though they work in PowerShell.
- In the example description, explain the rational for the construction of the command. Explain why you chose particular parameters and values, and how you use variables.
- If the command uses expressions, explain them in detail.
- If the command uses properties and methods of objects, especially properties that don't appear in the default display, use the example as an opportunity tell the user about the object.

Help Views that Display Examples

Examples appear only in the Detailed and Full views of cmdlet Help.

Adding an examples node

The following XML shows how to add an **Examples** node that contains a single **Example** node. Add additional example nodes for each examples you want to include in the topic.

```
XML
```

```
<command:examples>
  <command:example>
  </command:example>
</command:examples>
```

Adding an example title

The following XML shows how to add a **title** for the example. The **title** is used to set the example apart from other examples. PowerShell uses a standard header that includes a sequential example number.

XML

```
<command:examples>
  <command:example>
    <maml:title>----------  EXAMPLE 1  ----------</maml:title>
  </command:example>
</command:examples>
```

Adding preceding characters

The following XML shows how to add characters, such as the Windows PowerShell prompt, that are displayed immediately before the example command (without any intervening spaces). PowerShell uses the Windows PowerShell prompt: `C:\PS>`.

XML

```
<command:examples>
  <command:example>
    <maml:title>----------  EXAMPLE 1  ----------</maml:title>
    <maml:Introduction>
      <maml:paragraph>C:\PS></maml:paragraph>
    </maml:Introduction>
</command:example>
</command:examples>
```

Adding the command

The following XML shows how to add the actual command of the example. When adding the command, type the entire name (do not use alias) of cmdlets and parameters. Also, use lowercase characters whenever possible.

XML

```
<command:examples>
  <command:example>
    <maml:title>----------  EXAMPLE 1  ----------</maml:title>
    <maml:Introduction>
      <maml:paragraph>C:\PS></maml:paragraph>
    </maml:Introduction>
    <dev:code> command </dev:code>
</command:example>
</command:examples>
```

Adding a Description

The following XML shows how to add a description for the example. PowerShell uses a single set of `<maml:para>` tags for the description, even though multiple `<maml:para>` tags can be used.

XML

```
<command:examples>
  <command:example>
    <maml:title>----------  EXAMPLE 1  ----------</maml:title>
    <maml:Introduction>
      <maml:paragraph>C:\PS></maml:paragraph>
    </maml:Introduction>
    <dev:code> command </dev:code>
    <dev:remarks>
      <maml:para> command description </maml:para>
    </dev:remarks>
</command:example>
</command:examples>
```

Adding example output

The following XML shows how to add the output of the command. The command results information is optional, but in some cases it's helpful to demonstrate the effect of using specific parameters. PowerShell uses two sets of blank `<maml:para>` tags to separate the command output from the command.

XML

```
<command:examples>
  <command:example>
    <maml:title>----------  EXAMPLE 1  ----------</maml:title>
    <maml:Introduction>
```

```
      <maml:paragraph>C:\PS></maml:paragraph>
    </maml:Introduction>
    <dev:code> command </dev:code>
    <dev:remarks>
      <maml:para> command description </maml:para>
      <maml:para></maml:para>
      <maml:para></maml:para>
      <maml:para> command output </maml:para>
</dev:remarks>
</command:example>
</command:examples>
```

How to add related links to a cmdlet help topic

Article • 07/10/2023

> **Note**
>
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This section describes how to add references to other content that's related to a PowerShell cmdlet Help topic. Because these references appear in a command window, they don't link directly to the referenced content.

In the cmdlet Help topics that are included in PowerShell, these links reference other cmdlets, conceptual content (`about_`), and other documents and Help files that aren't related to PowerShell.

The following XML shows how to add a **RelatedLinks** node that contains two references to related topics.

XML

```
<maml:relatedLinks>
  <maml:navigationLink>
    <maml:linkText>Topic-name</maml:linkText>
  </maml:navigationLink>
  <maml:navigationLink>
    <maml:linkText>Topic-name</maml:linkText>
  </maml:navigationLink>
</ maml:relatedLinks >
```

Writing Help for PowerShell Modules

Article • 07/10/2023

PowerShell modules can include Help topics about the module and about the module members, such as cmdlets, providers, functions and scripts. The `Get-Help` cmdlet displays the module Help topics in the same format as it displays Help for other PowerShell items, and users use standard `Get-Help` commands to get the Help topics.

This document explains the format and correct placement of module Help topics, and it suggests guidelines for module Help content.

Types of Module Help

A module can include the following types of Help.

- **Cmdlet Help**. The Help topics that describe cmdlets in a module are XML files that use the command help schema
- **Provider Help**. The Help topics that describe providers in a module are XML files that use the provider help schema.
- **Function Help**. The Help topics that describe functions in a module can be XML files that use the command help schema or comment-based Help topics within the function, or the script or script module
- **Script Help**. The Help topics that describe scripts in a module can be XML files that use the command help schema or comment-based Help topics in the script or script module.
- **Conceptual ("About") Help**. You can use a conceptual ("about") Help topic to describe the module and its members and to explain how the members can be used together to perform tasks. Conceptual Help topics are text files with Unicode (UTF-8) encoding. The filename must use the `about_<name>.help.txt` format, such as `about_MyModule.help.txt`. By default, PowerShell includes over 100 of these conceptual About Help topics, and they're formatted like the following example.

  Output

  ```
  TOPIC
      about_<subject or module name>

  SHORT DESCRIPTION
      A short, one-line description of the topic contents.
  ```

```
LONG DESCRIPTION
    A detailed, full description of the subject or purpose of the
module.

EXAMPLES
    Examples of how to use the module or how the subject feature works
in practice.

KEYWORDS
    Terms or titles on which you might expect your users to search for
the information in this topic.

SEE ALSO
    Text-only references for further reading. Hyperlinks can't work in
the PowerShell console.
```

All the schema files can be found in the `$PSHOME\Schemas\PSMaml` folder.

Placement of Module Help

The `Get-Help` cmdlet looks for module Help topic files in language-specific subdirectories of the module directory.

For example, the following directory structure diagram shows the location of the Help topics for the SampleModule module.

```
<ModulePath>
    \SampleModule
        \<en-US>
            \about_SampleModule.help.txt
            \SampleModule.dll-help.xml
            \SampleNestedModule.dll-help.xml
        \<fr-FR>
            \about_SampleModule.help.txt
            \SampleModule.dll-help.xml
            \SampleNestedModule.dll-help.xml
```

> ⓘ **Note**
>
> In the example, the `<ModulePath>` placeholder represents one of the paths in the `PSModulePath` environment variable, such as `$HOME\Documents\Modules`, `$PSHOME\Modules`, or a custom path that the user specifies.

Getting Module Help

When a user imports a module into a session, the Help topics for that module are imported into the session along with the module. You can list the Help topic files in the value of the FileList key in the module manifest, but Help topics aren't affected by the `Export-ModuleMember` cmdlet.

You can provide module Help topics in different languages. The `Get-Help` cmdlet automatically displays module Help topics in the language that's specified for the current user in the Regional and Language Options item in Control Panel. In Windows Vista and later versions of Windows, `Get-Help` searches for the Help topics in language-specific subdirectories of the module directory in accordance with the language fallback standards established for Windows.

Beginning in PowerShell 3.0, running a `Get-Help` command for a cmdlet or function triggers automatic importing of the module. The `Get-Help` cmdlet immediately displays the contents of the help topics in the module.

If the module doesn't contain help topics and there are no help topics for the commands in the module on the user's computer, `Get-Help` displays auto-generated help. The auto-generated help includes the command syntax, parameters, and input and output types, but doesn't include any descriptions. The auto-generated help includes text that directs the user to try to use the `Update-Help` cmdlet to download help for the command from the internet or a file share. It also recommends using the **Online** parameter of the `Get-Help` cmdlet to get the online version of the help topic.

Supporting Updatable Help

Users of PowerShell 3.0 and later versions of PowerShell can download and install updated help files for a module from the internet or from a local file share. The `Update-Help` and `Save-Help` cmdlets hide the management details from the user. Users run the `Update-Help` cmdlet and then use the `Get-Help` cmdlet to read the newest help files for the module at the PowerShell command prompt. Users don't need to restart Windows or PowerShell.

Users behind firewalls and those without internet access can use Updatable Help, as well. Administrators with internet access use the `Save-Help` cmdlet to download and install the newest help files to a file share. Then, users use the **Path** parameter of the `Update-Help` cmdlet to get the newest help files from the file share.

Module authors can include help files in the module and use Updatable Help to update the help files, or omit help files from the module and use Updatable Help both to install and to update them.

For more information about Updatable Help, see Supporting Updatable Help.

Supporting Online Help

Users who can't or don't install updated help files on their computers often rely on the online version of module help topics. The **Online** parameter of the `Get-Help` cmdlet opens the online version of a cmdlet or advanced function help topic for the user in their default internet browser.

The `Get-Help` cmdlet uses the value of the **HelpUri** property of the cmdlet or function to find the online version of the help topic.

Beginning in PowerShell 3.0, you can help users find the online version of cmdlet and function help topics by defining the HelpUri attribute on the cmdlet class or the **HelpUri** property of the **CmdletBinding** attribute. The value of the attribute is the value of the **HelpUri** property of the cmdlet or function.

For more information, see Supporting Online Help.

See Also

- Writing a PowerShell Module
- Supporting Updatable Help
- Supporting Online Help

Naming Help files

Article • 07/10/2023

> **Note**
>
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This topic explains how to name an XML-based help file so that the Get-Help cmdlet can find it. The name requirements differ for each command type.

Cmdlet Help files

The help file for a C# cmdlet must be named for the assembly in which the cmdlet is defined. Use the following filename format:

```
<AssemblyName>.dll-help.xml
```

The assembly name format is required even when the assembly is a nested module.

For example, the Get-WinEvent cmdlet is defined in the Microsoft.PowerShell.Diagnostics.dll assembly. The `Get-Help` cmdlet looks for a help topic for the `Get-WinEvent` cmdlet only in the `Microsoft.PowerShell.Diagnostics.dll-help.xml` file in the module directory.

Provider Help files

The help file for a PowerShell provider must be named for the assembly in which the provider is defined. Use the following filename format:

`<AssemblyName>.dll-help.xml`

The assembly name format is required even when the assembly is a nested module.

For example, the Certificate provider is defined in the `Microsoft.PowerShell.Security.dll` assembly. The `Get-Help` cmdlet looks for a help topic for the Certificate provider only in the `Microsoft.PowerShell.Security.dll-help.xml` file in the module directory.

Function Help files

Functions can be documented using comment-based help or documented in an XML help file. When the function is documented in an XML file, the function must have an `.ExternalHelp` comment keyword that associates the function with the XML file. Otherwise, the `Get-Help` cmdlet can't find the help file.

There are no technical requirements for the name of a function help file. However, a best practice is to name the help file for the script module in which the function is defined. For example, the following function is defined in the `MyModule.psm1` file.

```
C#

#.ExternalHelp MyModule.psm1-help.xml
function Test-Function { ... }
```

CIM Command Help files

The help file for a CIM command must be named for the CDXML file in which the CIM command is defined. Use the following filename format:

`<FileName>.cdxml-help.xml`

CIM commands are defined in CDXML files that can be included in modules as nested modules. When the CIM command is imported into the session as a function, PowerShell adds an `.ExternalHelp` comment keyword to the function definition that associates the function with an XML help file that is named for the CDXML file in which the CIM command is defined.

Script Workflow Help files

Script workflows that are included in modules can be documented in XML-based help files. There are no technical requirements for the name of the help file. However, a best practice is to name the help file for the script module in which the script workflow is defined. For example:

`<ScriptModule>.psm1-help.xml`

Unlike other scripted commands, script workflows don't require an `.ExternalHelp` comment keyword to associate them with a help file. Instead, PowerShell searches the UI-Culture-specific subdirectories of the module directory for XML-based help files and looks for help for the script workflow in all the files. `.ExternalHelp` comment keyword are ignored.

Because the `.ExternalHelp` comment keyword is ignored, the `Get-Help` cmdlet can find help for script workflows only when they're included in modules.

Supporting Updatable Help

Article • 07/10/2023

The *Windows PowerShell Updatable Help System*, introduced in Windows PowerShell 3.0, is designed to ensure that users always have the newest help topics at the command prompt on their local computer. Along with Windows PowerShell online help, Updatable Help provides a complete help solution for users. This section describes the Updatable Help System and explains how module authors can support Updatable Help for their modules.

This section includes the following topics.

- Updatable Help Overview
- Updatable Help Authoring: Step-by-Step
- How Updatable Help Works
- How to Create a HelpInfo XML File
- How to Prepare Updatable Help CAB Files
- How to Update Help Files
- How to Test Updatable Help

See Also

- Supporting Online Help
- Updatable Help Status Table

Updatable Help Overview

Article • 07/10/2023

This document provides a basic introduction to the design and operation of the PowerShell Updatable Help feature. It's designed for module authors and others who deliver Windows PowerShell help topics to users.

Introduction

PowerShell help topics are an integral part of the PowerShell experience. Like PowerShell modules, help topics are continually updated and improved by the authors and by the contributions of the community of PowerShell users.

The *Updatable Help* feature, introduced in Windows PowerShell 3.0, ensures that users have the newest versions of help topics at the command prompt, even for built-in PowerShell commands, without downloading new modules or running Windows Update. Updatable Help makes updating simple by providing cmdlets that download the newest versions of help topics from the internet and install them in the correct subdirectories on the user's local computer. Even users who are behind firewalls can use the new cmdlets to get updated help from an internal file share.

Updatable Help is fully supported by all Windows PowerShell modules in Windows 8 and Windows Server 2012, and its features are available to all Windows PowerShell module authors. Updatable Help supports only XML-based help files. It doesn't support comment-based help.

Updatable Help includes the following features.

- The Update-Help cmdlet, which determines whether users have the newest help files for a module and, if not, downloads the newest help files from the internet, unpacks them, and installs them in the correct module subdirectories on the user's computer. Users can use the Get-Help cmdlet to view the newly-installed help topics immediately. They don't need to restart PowerShell.

- The Save-Help cmdlet, which downloads the newest help files from the internet and saves them in a file system directory. Users can use the `Update-Help` cmdlet to get help files from the file system directory, and unpack and install them in the module subdirectories on the user's computer. The `Save-Help` cmdlet is designed for users who have limited or no internet access and for enterprises who prefer to limit internet access.

- **Help for a Module**. Help files for a module are managed and delivered as a unit, so users can get all of the help files for the modules they use. Updatable help is supported only for modules, not for Windows PowerShell snap-ins.

- **Version support**. Updatable Help uses standard four-position (N1.N2.N3.N4) version numbers. Updatable Help downloads help files when the version number of the help files on the user's computer (or in the `Save-Help` directory) is lower than the version number of the help files at the internet location.

- **Multi-language support**. Updatable Help supports module help files in multiple UI cultures. Updatable Help filenames include standard language codes, such as "en-US" and "ja-JP", and the `Update-Help` and `Save-Help` cmdlets place the help files into language-specific subdirectories of the module directory.

- **Auto-generated help**. The Get-Help cmdlet displays basic help for commands that don't have help files. The auto-generated help includes the command syntax and aliases, and instructions for using online help and Updatable Help.

- **Enhanced Online help**. Easy access to online help no longer requires help files. The **Online** parameter of the `Get-Help` cmdlet now gets the URL of an online help topic from the value of the **HelpUri** property of any command, if it can't find the online help URL in a help file. You can populate the **HelpUri** property by adding a **HelpUri** attribute to the code of cmdlets, functions, and CIM commands, or using the **.Link** comment-based help directive in workflows and scripts.

  To make our help files updatable, the Windows PowerShell modules in Windows don't come with help files. Users can use Updatable Help to install help files and update them. Authors of other modules can include help files in modules or omit them. Support for Updatable Help is optional, but recommended.

Updatable Help Authoring: Step-by-Step

Article • 07/10/2023

This article documents the steps required to publish Updatable Help.

Authoring Updatable Help: Step-by-Step

Updatable Help is designed for end-users, but it also provides significant benefits to module authors and help writers, including the ability to add content, fix errors, deliver in multiple UI cultures, and respond to user comments and requests, long after the module has shipped. This topic explains how you package and upload help files so that users can download and install them using the Update-Help and Save-Help cmdlets.

The following steps provide an overview of the process of supporting Updatable Help.

Step 1: Find an internet site for your help files

The first step in creating updatable help is to find an internet location for your module's help files. Actually, you can use two different locations. You can keep your module's help information file (HelpInfo XML - described below) at one internet location and the help content files (CAB and ZIP) at another internet location. All help content files for a module must be in the same location. You can place help content files for different modules in the same location.

Step 2: Add a HelpInfoURI key to your module manifest

Add a **HelpInfoURI** key to your module manifest. The value of the key is the Uniform Resource Identifier (URI) of the location of the HelpInfo XML information file for your module. For security, the address must begin with `http:` or `https:`. The URI should specify an internet location for the HelpInfo XML file. Don't include the HelpInfo XML filename.

For example:

PowerShell

```
@{
    RootModule = TestModule.psm1
    ModuleVersion = '2.0'
```

```
    HelpInfoURI = 'https://go.microsoft.com/fwlink/?LinkID=0123'
}
```

> **Note**
>
> The **HelpInfoURI** must end with a forward slash (`/`) character or redirect to a location that ends with a forward slash (`/`).

Step 3: Create a HelpInfo XML file

The HelpInfo XML information file contains the URI of the internet location of your help files and the version numbers of the newest help files for your module in each supported UI culture. Every PowerShell module has one HelpInfo XML file. When you update your help files, you must update the HelpInfo XML file. For more information, see How to Create a HelpInfo XML File.

Step 4: Create CAB and ZIP files

PowerShell on Windows expects the help content files a module to be stored in a CAB file. PowerShell on Linux or macOS expects the help content files a module to be stored in a ZIP file. If your module runs across multiple platforms you must create both formats.

Use a tool, such as `MakeCab.exe`, to create a CAB file that contains the help files for your module. Create a separate CAB file for the help files in each supported UI culture. For more information, see How to Prepare Updatable Help CAB Files.

You can use the Compress-Archive cmdlet to create a ZIP file.

Step 5: Upload your files

To publish new or updated help files, upload the help content files to the internet location specified by the **HelpContentUri** element in the HelpInfo XML file. Then, upload the HelpInfo XML file to the internet location specified by the value of the **HelpInfoUri** key in the module manifest.

Using PlatyPS to create help content

PlatyPS is a PowerShell module designed to help you create Help content for your modules. You author the help content in Markdown files. **PlatyPS** can create Markdown

templates for your cmdlet, convert the Markdown files to the XML help format (MAML), create HelpInfo XML files, and package the MAML help content into CAB and ZIP files.

For more information, see Create XML-based help using PlatyPS.

How Updatable Help Works

Article • 07/10/2023

This topic explains how Updatable Help processes the HelpInfo XML file and CAB files for each module, and installs updated help for users.

The Update-Help Process

The following list describes the actions of the Update-Help cmdlet when a user runs a command to update the help files for a module in a particular UI culture.

1. `Update-Help` gets the remote HelpInfo XML file from the location specified by the value of the **HelpInfoURI** key in the module manifest and validates the file against the schema. (To view the schema, see HelpInfo XML Schema.) Then `Update-Help` looks for a local HelpInfo XML file for the module in the module directory on the user's computer.

2. `Update-Help` compares the version number of the help files for the specified UI culture in the remote and local HelpInfo XML files for the module. If the version number on the remote file is greater than version number on the local file, or if the there is no local HelpInfo XML file for the module, `Update-Help` prepares to download new help files.

3. `Update-Help` selects the CAB file for the module from the location specified by the **HelpContentUri** element in the remote HelpInfo XML file. It uses the module name, module GUID, and UI culture to identify the CAB file.

4. `Update-Help` downloads the CAB file, unpacks it, validates the help content files, and saves the help content files in the language-specific subdirectory of the module directory on the user's computer.

5. `Update-Help` creates a local HelpInfo XML file by copying the remote HelpInfo XML file. It edits the local HelpInfo XML file so that it includes elements only for the CAB file that it installed. Then it saves the local HelpInfo XML file in the module directory and concludes the update.

The Save-Help Process

The following list describes the actions of the Save-Help and Update-Help cmdlets when a user runs commands to update the help files in a file share, and then use those files to

update the help files on the user's computer.

The `Save-Help` cmdlet performs the following actions in response to a command to save the help files for a module in a file share that's specified by the **DestinationPath** parameter.

1. `Save-Help` gets the remote HelpInfo XML file from the location specified by the value of the **HelpInfoURI** key in the module manifest and validates the file against the schema. (To view the schema, see HelpInfo XML Schema.) Then `Save-Help` looks for a local HelpInfo XML file in the directory that's specified by the **DestinationPath** parameter in the `Save-Help` command.

2. `Save-Help` compares the version number of the help files for the specified UI culture in the remote and local HelpInfo XML files for the module. If the version number on the remote file is greater than version number on the local file, or if the there is no local HelpInfo XML file for the module in the **DestinationPath** directory, `Save-Help` prepares to download new help files.

3. `Save-Help` selects the CAB file for the module from the location specified by the **HelpContentUri** element in the remote HelpInfo XML file. It uses the module name, module GUID, and UI culture to identify the CAB file.

4. `Save-Help` downloads the CAB file and saves it in the **DestinationPath** directory. (It does not create any language-specific subdirectories.)

5. `Save-Help` creates a local HelpInfo XML file by copying the remote HelpInfo XML file. It edits the local HelpInfo XML file so that it includes elements only for the CAB file that it saved. Then it saves the local HelpInfo XML file in the **DestinationPath** directory and concludes the update.

   The `Update-Help` cmdlet performs the following actions in response to a command to update the help files on a user's computer from the files in a file share that's specified by the **SourcePath** parameter.

6. `Update-Help` gets the remote HelpInfo XML file from the **SourcePath** directory. Then it looks for a local HelpInfo XML file in the module directory on the user's computer.

7. `Update-Help` compares the version number of the help files for the specified UI culture in the remote and local HelpInfo XML files for the module. If the version number on the remote file is greater than version number on the local file, or if the there is no local HelpInfo XML file, `Update-Help` prepares to install new help files.

8. `Update-Help` selects the CAB file for the module from **SourcePath** directory. It uses the module name, module GUID, and UI culture to identify the CAB file.

9. `Update-Help` unpacks the CAB file, validates the help content files, and saves the help content files in the language-specific subdirectory of the module directory on the user's computer.

10. `Update-Help` creates a local HelpInfo XML file by copying the remote HelpInfo XML file. It edits the local HelpInfo XML file so that it includes elements only for the CAB file that it installed. Then it saves the local HelpInfo XML file in the module directory and concludes the update.

How to create a HelpInfo XML file

Article • 07/10/2023

> **Note**
>
> Manual authoring of XML-based help is very difficult. The **PlatyPS** module allows you to write help in Markdown and then convert it to XML-based help. This makes it much easier to write and maintain help. **PlatyPS** can also create the Updateable Help packages for you. For more information, see **Create XML-based help using PlatyPS**.

This topics in this section explains how to create and populate a help information file, commonly known as a "HelpInfo XML file," for the PowerShell Updatable Help feature.

HelpInfo XML file overview

The HelpInfo XML file is the primary source of information about Updatable Help for the module. It includes the location of the help files for the modules, the supported UI cultures, and the version numbers that Updatable Help uses to determine whether the user has the newest help files.

Each module has just one HelpInfo XML file, even if the module includes multiple help files for multiple UI cultures. The module author creates the HelpInfo XML file and places it in the internet location that's specified by the **HelpInfoUri** key in the module manifest. When the module help files are updated and uploaded, the module author updates the HelpInfo XML file and replaces the original HelpInfo XML file with the new version.

It's critical that the HelpInfo XML file is carefully maintained. If you upload new files, but forget to increment the version numbers, Updatable Help will not download the new files to users' computers. if you add help files for a new UI culture, but don't update the HelpInfo XML file or place it in the correct location, Updatable Help will not download the new files.

In this section

This section includes the following topics.

- HelpInfo XML Schema

- HelpInfo XML Sample File
- How to Name a HelpInfo XML File
- How to Set HelpInfo XML Version Numbers

See also

Supporting Updatable Help

HelpInfo XML Schema

Article • 07/10/2023

This topic contains the XML schema for Updatable Help Information files, commonly known as "HelpInfo XML files."

HelpInfo XML Schema

HelpInfo XML files are based on the following XML schema.

XML

```
<?xml version="1.0" encoding="utf-8"?>
<schema elementFormDefault="qualified"
targetNamespace="http://schemas.microsoft.com/powershell/help/2010/05"
xmlns="http://www.w3.org/2001/XMLSchema">
  <element name="HelpInfo">
    <complexType>
      <sequence>
        <element name="HelpContentURI" type="anyURI" minOccurs="1"
maxOccurs="1" />
        <element name="SupportedUICultures" minOccurs="1" maxOccurs="1">
          <complexType>
            <sequence>
              <element name="UICulture" minOccurs="1" maxOccurs="unbounded">
                <complexType>
                  <sequence>
                    <element name="UICultureName" type="language"
minOccurs="1" maxOccurs="1" />
                    <element name="UICultureVersion" type="string"
minOccurs="1" maxOccurs="1" />
                  </sequence>
                </complexType>
              </element>
            </sequence>
          </complexType>
        </element>
      </sequence>
    </complexType>
  </element>
</schema>
```

HelpInfo XML Elements

The HelpInfo XML file includes the following elements.

- **HelpContentURI** - Contains the URI of the location of the help CAB files for the module. The URI must begin with "http" or "https". The URI should specify an internet location, but must not include the CAB filename. The **HelpContentURI** value can be the same or different from the **HelpInfoURI** value.
- **SupportedUICultures** - Represents the module help files in all UI cultures. Contains **UICulture** elements, each of which represents a set of help files for the module in a specified UI culture.
- **UICulture** - Represents a set of help files for the module in a specified UI culture. Add a **UICulture** element for each UI culture in which the help files are written.
- **UICultureName** - Contains the language code for the UI culture in which the help files are written.
- **UICultureVersion** - Contains a 4-part version number in "N1.N2.N3.N4" format that represents the version of the help CAB file in the UI culture. Increment this version number whenever you upload new help CAB files in the UI culture that's specified by **UICultureName**. For more information about this value, see Version Class.

> ⓘ **Note**
>
> Manual authoring of XML-based help is very difficult. The **PlatyPS** module allows you to write help in Markdown and then convert it to XML-based help. This makes it much easier to write and maintain help. **PlatyPS** can also create the Updateable Help packages for you. For more information, see **Create XML-based help using PlatyPS**.

HelpInfo XML Sample File

Article • 07/10/2023

This topic displays a sample of a well-formed Updatable Help Information file, commonly known as "HelpInfo XML file." In this sample file, the UI culture elements are arranged in alphabetical order by UI culture name. Alphabetical ordering is a best practice, but it's not required.

HelpInfo XML Sample File

XML

```xml
<?xml version="1.0" encoding="utf-8"?>
<HelpInfo xmlns="http://schemas.microsoft.com/powershell/help/2010/05">
   <HelpContentURI>https://go.microsoft.com/fwlink/?
LinkID=141553</HelpContentURI>
   <SupportedUICultures>
    <UICulture>
      <UICultureName>de-DE</UICultureName>
      <UICultureVersion>2.15.0.10</UICultureVersion>
    </UICulture>
    <UICulture>
      <UICultureName>en-US</UICultureName>
      <UICultureVersion>3.2.0.7</UICultureVersion>
    </UICulture>
    <UICulture>
      <UICultureName>it-IT</UICultureName>
      <UICultureVersion>1.1.0.5</UICultureVersion>
    </UICulture>
    <UICulture>
      <UICultureName>ja-JP</UICultureName>
      <UICultureVersion>3.2.0.4</UICultureVersion>
    </UICulture>
   </SupportedUICultures>
</HelpInfo>
```

> **Note**
>
> Manual authoring of XML-based help is very difficult. The **PlatyPS** module allows you to write help in Markdown and then convert it to XML-based help. This makes it much easier to write and maintain help. **PlatyPS** can also create the Updateable Help packages for you. For more information, see **Create XML-based help using PlatyPS**.

How to name a HelpInfo XML file

Article • 07/10/2023

> **Note**
>
> Manual authoring of XML-based help is very difficult. The **PlatyPS** module allows you to write help in Markdown and then convert it to XML-based help. This makes it much easier to write and maintain help. **PlatyPS** can also create the Updateable Help packages for you. For more information, see **Create XML-based help using PlatyPS**.

This topic explains the required name format for the Updatable Help Information files, commonly known as HelpInfo XML files. A HelpInfo XML file must have a name with the following format.

`<ModuleName>_<ModuleGUID>_HelpInfo.xml`

The elements of the name are as follows.

- `<ModuleName>` - The value of the **Name** property of the **ModuleInfo** object that the Get-Module cmdlet returns.
- `<ModuleGUID>` - The value of the **GUID** key in the module manifest.

For example, if the module name is "TestModule" and the module GUID is 9cabb9ad-f2ac-4914-a46b-bfc1bebf07f9, the name of the HelpInfo XML file for the module would be:

`TestModule_9cabb9ad-f2ac-4914-a46b-bfc1bebf07f9_HelpInfo.xml`

How to set HelpInfo XML version numbers

Article • 07/10/2023

> **Note**
>
> Manual authoring of XML-based help is very difficult. The **PlatyPS** module allows you to write help in Markdown and then convert it to XML-based help. This makes it much easier to write and maintain help. **PlatyPS** can also create the Updateable Help packages for you. For more information, see **Create XML-based help using PlatyPS**.

The version numbers in a HelpInfo XML file are critical to the operation of Updatable Help. The Update-Help and Save-Help cmdlets download new help files only when the version number for a UI culture in the remote HelpInfo XML file is greater than the version number for that UI culture in the local HelpInfo XML, or there is no local HelpInfo XML file.

The HelpInfo XML file uses the 4-part version number that's defined in the **System.Version** class of the Microsoft .NET Framework. The format is `N1.N2.N3.N4`. Module authors can use any version numbering scheme that's permitted by the **System.Version** class. Updatable Help requires only that the version number for a UI culture increase when a new version of the CAB file for that UI culture is uploaded to the location that's specified by the **HelpContentURI** element in the HelpInfo XML file.

The following example shows the elements of the HelpInfo XML file for the German (de-DE) UI culture when the version is 2.15.0.10.

XML

```xml
<UICulture>
  <UICultureName>de-DE</UICultureName>
  <UICultureVersion>2.15.0.10</UICultureVersion>
</UICulture>
```

The version number for a UI culture reflects the version of the CAB file for that UI culture. The version number applies to the entire CAB file. You can't set different version numbers for different files in the CAB file. The version number for each UI culture is evaluated independently and need not be related to the version numbers for other UI cultures that the module supports.

How to prepare Updatable Help CAB files

Article • 07/10/2023

> **Note**
>
> Manual authoring of XML-based help is very difficult. The **PlatyPS** module allows you to write help in Markdown and then convert it to XML-based help. This makes it much easier to write and maintain help. **PlatyPS** can also create the Updateable Help packages for you. For more information, see **Create XML-based help using PlatyPS**.

This topic explains the contents and use of cabinet files in Windows PowerShell Updatable Help.

This section includes the following topics.

- How to Create and Upload CAB Files
- How to Name an Updatable Help CAB File
- File Types Permitted in an Updatable Help CAB File

See also

Supporting Updatable Help

How to create and upload CAB files

Article • 07/10/2023

> **Note**
>
> Manual authoring of XML-based help is very difficult. The **PlatyPS** module allows you to write help in Markdown and then convert it to XML-based help. This makes it much easier to write and maintain help. **PlatyPS** can also create the Updateable Help packages for you. For more information, see **Create XML-based help using PlatyPS**.

This topic explains how to create Updatable Help CAB files and upload them to the location where the Updatable Help cmdlets can find them.

How to create and upload updatable help CAB files

You can use the Updatable Help feature to deliver new or updated help files for a module in multiple languages and cultures. An Updatable Help package for a module consists of one HelpInfo XML file and one or more cabinet (`.CAB`) files. Each CAB file contains help files for the module in one UI culture. Use the following procedure to create CAB files for Updatable Help.

1. Organize the help files for the module by UI culture. Each Updatable Help CAB file contains the help files for one module in one UI culture. You can deliver multiple help CAB files for the module, each for a different UI culture.

2. Verify that help files include only the file types permitted for Updatable Help and validate them against a help file schema. If the `Update-Help` cmdlet encounters a file that's invalid or is not a permitted type, it doesn't install the invalid file and stops installing files from the CAB. For a list of permitted file types, see File Types Permitted in an Updatable Help CAB File.

3. Include all the help files for the module in the UI culture, not only files that are new or have changed. If the CAB file is incomplete, users who download help files for the first time or do not download every update, won't have all the help files.

4. Use a utility that creates cabinet files, such as `MakeCab.exe`. PowerShell doesn't include cmdlets that create CAB files.

5. Name the CAB files. For more information, see How to Name an Updatable Help CAB File.

6. Upload the CAB files for the module to the location that's specified by the **HelpContentUri** element in the HelpInfo XML file for the module. Then upload the HelpInfo XML file to the location that's specified by the **HelpInfoUri** key of the module manifest. The **HelpContentUri** and **HelpInfoUri** can point to the same location.

> **⊗ Caution**
>
> The value of the **HelpInfoUri** key and the **HelpContentUri** element must begin with `http` or `https`. The value must a URL path pointing to the location (folder) containing the updateable help. The URL must end with `/`. The URL must not include a filename.

How to name an Updatable Help CAB file

Article • 07/10/2023

> **Note**
>
> Manual authoring of XML-based help is very difficult. The **PlatyPS** module allows you to write help in Markdown and then convert it to XML-based help. This makes it much easier to write and maintain help. **PlatyPS** can also create the Updateable Help packages for you. For more information, see **Create XML-based help using PlatyPS**.

A updatable cabinet (`.CAB`) file must have a name with the following format.

```
<ModuleName>_<ModuleGUID>_<UICulture>_HelpContent.cab
```

The elements of the name are as follows.

- `<ModuleName>` -The value of the **Name** property of the **ModuleInfo** object that the Get-Module cmdlet returns.
- `<ModuleGUID>` - The value of the **GUID** key in the module manifest.
- `<UICulture>` - The UI culture of the help files in the CAB file. This value must match the value of one of the **UICulture** elements in the HelpInfo XML file for the module.

For example, if the module name is "TestModule," the module GUID is 9cabb9ad-f2ac-4914-a46b-bfc1bebf07f9, and the UI culture is `en-US`, the name of the CAB file would be:

```
TestModule_9cabb9ad-f2ac-4914-a46b-bfc1bebf07f9_en-US_HelpContent.cab
```

File Types Permitted in an Updatable Help CAB File

Article • 07/10/2023

Uncompressed CAB file content is limited to 1 GB by default. To bypass this limit, users have to use the **Force** parameter of the Update-Help and Save-Help cmdlets.

To assure the security of help files that are downloaded from the internet, an Updatable Help CAB file can include only the file types listed below. The Update-Help cmdlet validates all files against the help topic schemas. If the `Update-Help` cmdlet encounters a file that's invalid or is not a permitted type, it doesn't install the invalid file and stops installing files from the CAB on the user's computer.

- XML-based help topics for cmdlets.
- XML-based help topics for scripts and functions.
- XML-based help topics for PowerShell providers.
- Text-based help topics, such as About topics.

The Update-Help verifies the CAB contents when it unpacks the CAB. If `Update-Help` finds non-compliant file types in an Updatable Help CAB file, it generates a terminating error and stops the operation. It doesn't install any help files from the CAB, even those of compliant file types.

> ⓘ **Note**
>
> Manual authoring of XML-based help is very difficult. The **PlatyPS** module allows you to write help in Markdown and then convert it to XML-based help. This makes it much easier to write and maintain help. **PlatyPS** can also create the Updateable Help packages for you. For more information, see **Create XML-based help using PlatyPS**.

How to update help files

Article • 07/10/2023

> **Note**
>
> Manual authoring of XML-based help is very difficult. The **PlatyPS** module allows you to write help in Markdown and then convert it to XML-based help. This makes it much easier to write and maintain help. **PlatyPS** can also create the Updateable Help packages for you. For more information, see **Create XML-based help using PlatyPS**.

There are many reasons to update help files, such as correcting errors, clarifying a concept, answering a frequently asked question, adding new files, or adding new and better examples.

To update a help file:

1. Change the files.
2. Translate the files into other UI cultures.
3. Collect all help files (new, changed, and unchanged) for the module in each UI culture.
4. Validate the files against the XML schema.
5. Rebuild the CAB files for each UI culture.
6. In the HelpInfo XML file, increment the version numbers of the CAB file for each UI culture.
7. Upload the new CAB files to the location that's specified by the value of the **HelpContentUri** element in the HelpInfo XML file. Replace the older CAB files with the new CAB files.
8. Upload the updated HelpInfo XML file to the location that's specified by the **HelpInfoUri** key in the module manifest. Replace the older HelpInfo XML file with the new file.

How to test Updatable Help

Article • 07/10/2023

> **Note**
>
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This topic describes approaches to testing Updatable Help for a module.

Using verbose to detect errors

After uploading the HelpInfo XML file and CAB files for your module, test the files by running an Update-Help command with the **Verbose** parameter. The **Verbose** parameter directs `Update-Help` to report the critical steps in its actions, from reading the **HelpInfoUri** key in the module manifest to validating the file types in the unpacked CAB file and placing the files in the language-specific module directory.

When all verbose messages are resolved, run an `Update-Help` command with the **Debug** parameter. This parameter should detect any remaining problems with the Updatable Help files.

Supporting Online Help

Article • 07/10/2023

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Beginning in PowerShell 3.0, there are two ways to support the `Get-Help` Online feature for PowerShell commands. This topic explains how to implement this feature for different command types.

About Online Help

Online help has always been a vital part of PowerShell. Although the `Get-Help` cmdlet displays help topics at the command prompt, many users prefer the experience of reading online, including color-coding, hyperlinks, and sharing ideas in Community Content and wiki-based documents. Most importantly, before the advent of Updatable Help, online help provided the most up-to-date version of the help files.

With the advent of Updatable Help in PowerShell 3.0, online help still plays a vital role. In addition to the flexible user experience, online help provides help to users who don't or can't use Updatable Help to download help topics.

How Get-Help -Online Works

To help users find the online help topics for commands, the `Get-Help` command has an Online parameter that opens the online version of help topic for a command in the user's default internet browser.

For example, the following command opens the online help topic for the `Invoke-Command` cmdlet.

PowerShell

```
Get-Help Invoke-Command -Online
```

To implement `Get-Help -Online`, the `Get-Help` cmdlet looks for a Uniform Resource Identifier (URI) for the online version help topic in the following locations.

- The first link in the **Related Links** section of the help topic for the command. The help topic must be installed on the user's computer. This feature was introduced in PowerShell 2.0.
- The **HelpUri** property of any command. The **HelpUri** property is accessible even when the help topic for the command isn't installed on the user's computer. This feature was introduced in PowerShell 3.0.

  `Get-Help` looks for a URI in the first entry in the **Related Links** section before getting the **HelpUri** property value. If the property value is incorrect or has changed, you can override it by entering a different value in the first related link. However, the first related link works only when the help topics are installed on the user's computer.

Adding a URI to the first related link of a command help topic

You can support `Get-Help -Online` for any command by adding a valid URI to the first entry in the **Related Links** section of the XML-based help topic for the command. This option is valid only in XML-based help topics and works only when the help topic is installed on the user's computer. When the help topic is installed and the URI is populated, this value takes precedence over the **HelpUri** property of the command.

To support this feature, the URI must appear in the `maml:uri` element under the first `maml:relatedLinks/maml:navigationLink` element in the `maml:relatedLinks` element.

The following XML shows the correct placement of the URI. The `Online version:` text in the `maml:linkText` element is a best practice, but it's not required.

XML

```
<maml:relatedLinks>
    <maml:navigationLink>
        <maml:linkText>Online version:</maml:linkText>
        <maml:uri>https://go.microsoft.com/fwlink/?LinkID=113279</maml:uri>
    </maml:navigationLink>
    <maml:navigationLink>
        <maml:linkText>about_History</maml:linkText>
        <maml:uri/>
```

```
    </maml:navigationLink>
</maml:relatedLinks>
```

Adding the HelpUri property to a command

This section shows how to add the **HelpUri** property to commands of different types.

Adding a HelpUri Property to a Cmdlet

For cmdlets written in C#, add a **HelpUri** attribute to the **Cmdlet** class. The value of the attribute must be a URI that begins with `http` or `https`.

The following code shows the **HelpUri** attribute of the `Get-History` cmdlet class.

C#

```
[Cmdlet(VerbsCommon.Get, "History", HelpUri =
"https://go.microsoft.com/fwlink/?LinkID=001122")]
```

Adding a HelpUri property to an advanced function

For advanced functions, add a **HelpUri** property to the **CmdletBinding** attribute. The value of the property must be a URI that begins with "http" or "https".

The following code shows the **HelpUri** attribute of the `New-Calendar` function

PowerShell

```
function New-Calendar {
    [CmdletBinding(SupportsShouldProcess=$true,
    HelpURI="https://go.microsoft.com/fwlink/?LinkID=01122")]
```

Adding a HelpUri attribute to a cim command

For CIM commands, add a **HelpUri** attribute to the **CmdletMetadata** element in the CDXML file. The value of the attribute must be a URI that begins with `http` or `https`.

The following code shows the HelpUri attribute of the `Start-Debug` CIM command

XML

```
<CmdletMetadata Verb="Debug" HelpUri="https://go.microsoft.com/fwlink/?
LinkID=001122"/>
```

Adding a HelpUri attribute to a workflow

For workflows that are written in the PowerShell language, add an `.ExternalHelp` comment directive to the workflow code. The value of the directive must be a URI that begins with `http` or `https`.

> **Note**
>
> The HelpUri property isn't supported for XAML-based workflows in PowerShell.

The following code shows the .ExternalHelp directive in a workflow file.

PowerShell

```
# .ExternalHelp "https://go.microsoft.com/fwlink/?LinkID=138338"
```

How to add dynamic parameters to a provider help topic

Article • 07/10/2023

> **Note**
>
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This section explains how to populate the **DYNAMIC PARAMETERS** section of a provider help topic.

Dynamic parameters are parameters of a cmdlet or function that are available only under specified conditions.

The dynamic parameters that are documented in a provider help topic are the dynamic parameters that the provider adds to the cmdlet or function when the cmdlet or function is used in the provider drive.

Dynamic parameters can also be documented in custom cmdlet help for a provider. When writing both provider help and custom cmdlet help for a provider, include the dynamic parameter documentation in both documents.

If a provider doesn't implement any dynamic parameters, the provider help topic contains an empty `DynamicParameters` element.

To add dynamic parameters

1. In the `<AssemblyName>.dll-help.xml` file, within the `providerHelp` element, add a `DynamicParameters` element. The `DynamicParameters` element should appear after the `Tasks` element and before the `RelatedLinks` element.

   For example:

   ```
   XML

   <providerHelp>
       <Tasks>
   ```

```
    </Tasks>
    <DynamicParameters>
    </DynamicParameters>
    <RelatedLinks>
    </RelatedLinks>
</providerHelp>
```

If the provider doesn't implement any dynamic parameters, the `DynamicParameters` element can be empty.

2. Within the `DynamicParameters` element, for each dynamic parameter, add a `DynamicParameter` element.

   For example:

   XML

   ```
   <DynamicParameters/>
       <DynamicParameter>
       </DynamicParameter>
   </DynamicParameters>
   ```

3. In each `DynamicParameter` element, add a `Name` and `CmdletSupported` element.

   - Name - Specifies the parameter name
   - CmdletSupported - Specifies the cmdlets in which the parameter is valid. Type a comma-separated list of cmdlet names.

   For example, the following XML documents the `Encoding` dynamic parameter that the Windows PowerShell FileSystem provider adds to the `Add-Content`, `Get-Content`, `Set-Content` cmdlets.

   XML

   ```
   <DynamicParameters/>
       <DynamicParameter>
           <Name> Encoding </Name>
           <CmdletSupported> Add-Content, Get-Content, Set-Content
   </CmdletSupported>
   </DynamicParameters>
   ```

4. In each `DynamicParameter` element, add a `Type` element. The `Type` element is a container for the `Name` element which contains the .NET type of the value of the dynamic parameter.

For example, the following XML shows that the .NET type of the `Encoding` dynamic parameter is the FileSystemCmdletProviderEncoding enumeration.

```
XML

<DynamicParameters/>
    <DynamicParameter>
        <Name> Encoding </Name>
        <CmdletSupported> Add-Content, Get-Content, Set-Content
</CmdletSupported>
        <Type>
            <Name>
Microsoft.PowerShell.Commands.FileSystemCmdletProviderEncoding </Name>
        <Type>
...
</DynamicParameters>
```

5. Add the `Description` element, which contains a brief description of the dynamic parameter. When composing the description, use the guidelines prescribed for all cmdlet parameters in How to Add Parameter Information.

   For example, the following XML includes the description of the `Encoding` dynamic parameter.

```
XML

<DynamicParameters/>
    <DynamicParameter>
        <Name> Encoding </Name>
        <CmdletSupported> Add-Content, Get-Content, Set-Content
</CmdletSupported>
        <Type>
            <Name>
Microsoft.PowerShell.Commands.FileSystemCmdletProviderEncoding </Name>
        <Type>
        <Description> Specifies the encoding of the output file that
contains the content. </Description>
...
</DynamicParameters>
```

6. Add the `PossibleValues` element and its child elements. Together, these elements describe the values of the dynamic parameter. This element is designed for enumerated values. If the dynamic parameter doesn't take a value, such as is the case with a switch parameter, or the values can't be enumerated, add an empty `PossibleValues` element.

The following table lists and describes the `PossibleValues` element and its child elements.

- PossibleValues - This element is a container. Its child elements are described below. Add one `PossibleValues` element to each provider help topic. The element can be empty.
- PossibleValue - This element is a container. Its child elements are described below. Add one `PossibleValue` element for each value of the dynamic parameter.
- Value - Specifies the value name.
- Description - This element contains a `Para` element. The text in the `Para` element describes the value that's named in the `Value` element.

For example, the following XML shows one `PossibleValue` element of the `Encoding` dynamic parameter.

XML

```
<DynamicParameters/>
    <DynamicParameter>
...
        <Description> Specifies the encoding of the output file that
contains the content. </Description>
        <PossibleValues>
            <PossibleValue>
                <Value> ASCII </Value>
                <Description>
                    <para> Uses the encoding for the ASCII (7-bit)
character set. </para>
                </Description>
            </PossibleValue>
...
        </PossibleValues>
</DynamicParameters>
```

Example

The following example shows the `DynamicParameters` element of the `Encoding` dynamic parameter.

XML

```
<DynamicParameters/>
    <DynamicParameter>
        <Name> Encoding </Name>
        <CmdletSupported> Add-Content, Get-Content, Set-Content
```

```
</CmdletSupported>
        <Type>
            <Name>
Microsoft.PowerShell.Commands.FileSystemCmdletProviderEncoding </Name>
        <Type>
        <Description> Specifies the encoding of the output file that
contains the content. </Description>
        <PossibleValues>
            <PossibleValue>
                <Value> ASCII </Value>
                <Description>
                    <para> Uses the encoding for the ASCII (7-bit) character
set. </para>
                </Description>
            </PossibleValue>
            <PossibleValue>
                <Value> Unicode </Value>
                <Description>
                    <para> Encodes in UTF-16 format using the little-endian
byte order. </para>
                </Description>
            </PossibleValue>
        </PossibleValues>
</DynamicParameters>
```

How to Add a See Also Section to a Provider Help Topic

Article • 07/10/2023

> **Note**
>
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This section explains how to populate the **SEE ALSO** section of a provider help topic.

The **SEE ALSO** section consists of a list of topics that are related to the provider or might help the user better understand and use the provider. The topic list can include cmdlet help, provider help and conceptual ("about") help topics in Windows PowerShell. It can also include references to books, paper, and online topics, including an online version of the current provider help topic.

When you refer to online topics, provide the URI or a search term in plain text. The `Get-Help` cmdlet doesn't link or redirect to any of the topics in the list. Also, the `Online` parameter of the `Get-Help` cmdlet doesn't work with provider help.

The **See Also** section is created from the `RelatedLinks` element and the tags that it contains. The following XML shows how to add the tags.

To Add SEE ALSO Topics

1. In the `<AssemblyName>.dll-help.xml` file, within the `providerHelp` element, add a `RelatedLinks` element. The `RelatedLinks` element should be the last element in the `providerHelp` element. Only one `RelatedLinks` element is permitted in each provider help topic.

   For example:

   XML

   ```
   <providerHelp>
       <RelatedLinks>
   ```

```
    </RelatedLinks>
</providerHelp>
```

2. For each topic in the **SEE ALSO** section, within the `RelatedLinks` element, add a `navigationLink` element. Then, within each `navigationLink` element, add one `linkText` element and one `uri` element. If you aren't using the `uri` element, you can add it as an empty element (<uri/>).

   For example:

   XML

   ```
   <providerHelp>
       <RelatedLinks>
           <navigationLink>
               <linkText> </linkText>
               <uri> </uri>
           </navigationLink>
       </RelatedLinks>
   </providerHelp>
   ```

3. Type the topic name between the `linkText` tags. If you are providing a URI, type it between the `uri` tags. To indicate the online version of the current provider help topic, between the `linkText` tags, type "Online version:" instead of the topic name. Typically, the "Online version:" link is the first topic in the SEE ALSO topic list.

   The following example include three SEE ALSO topics. The first refer to the online version of the current topic. The second refers to a Windows PowerShell cmdlet help topic. The third refers to another online topic.

   XML

   ```
   <providerHelp>
       <RelatedLinks>
           <navigationLink>
               <linkText> Online version: </linkText>
               <uri>http://www.fabrikam.com/help/myFunction.htm</uri>
           </navigationLink>
           <navigationLink>
               <linkText> about_functions </linkText>
               <uri/>
           </navigationLink>
           <navigationLink>
               <linkText> Windows PowerShell Getting Started Guide
   </linkText>
               <uri>https://go.microsoft.com/fwlink/?LinkID=89597<uri/>
           </navigationLink>
   ```

```
    </RelatedLinks>
</providerHelp>
```

Extended Type System Overview

Article • 09/17/2021

PowerShell uses its **PSObject** object to extend the types of objects in two ways. First, the **PSObject** object provides a way to show different views of specific object types. This is referred to as showing an adapted view of an object. Second, the **PSObject** object provides a way to add members to existing object. Together, by wrapping an existing object, referred to as the base object, the **PSObject** object provides an extended type system (ETS) that script and cmdlet developers can use to manipulate .NET objects within the shell.

Cmdlet and Script Development Issues

ETS resolves two fundamental issues:

First, some .NET Objects do not have the necessary default behavior for acting as the data between cmdlets.

- Some .NET objects are "meta" objects (for example: WMI Objects, ADO objects, and XML objects) whose members describe the data they contain. However, in a scripting environment it is the contained data that is most interesting, not the description of the contained data. ETS resolves this issue by introducing the notion of Adapters that adapt the underlying .NET object to have the expected default semantics.
- Some .NET Object members are inconsistently named, provide an insufficient set of public members, or provide insufficient capability. ETS resolves this issue by introducing the ability to extend the .NET object with additional members.

Second, the PowerShell scripting language is *typeless* in that a variable does not need to be declared of a particular type. That is, the variables a script developer creates are by nature *typeless*. However, the PowerShell system is "type-driven" in that it depends on having a type name to operate against for basic operations such as outputting results or sorting.

Therefore a script developer must have the ability to state the type of one of their variables and build up their own set of dynamically typed "objects" that contain properties and methods and can participate in the type-driven system. ETS solves this problem by providing a common object for the scripting language that has the ability to state its type dynamically and to add members dynamically.

Fundamentally, ETS resolves the issue mentioned previously by providing the **PSObject** object, which acts as the basis of all object access from the scripting language and provides a standard abstraction for the cmdlet developer.

Cmdlet Developers

For the cmdlet developers, ETS provides the following support:

- The abstractions to work against objects in a generic way using the **PSObject** object. ETS also provides the ability to drill past these abstractions if required.
- The mechanisms to create a default behavior for formatting, sorting, serialization, and other system manipulations of their object type using a well-known set of extended members.
- The means to operate against any object using the same semantics as the script language using a LanguagePrimitives object.
- The means to dynamically "type" a hash table so that the rest of the system can operate against it effectively.

Script Developers

For the script developers, ETS provides the following support:

- The ability to reference any underlying object type using the same syntax (`$a.x`).
- The ability to access beyond the abstraction provided by the **PSObject** object (such as accessing only adapted members, or accessing the base object itself).
- The ability to define well-known members that control the formatting, sorting, serialization, and other manipulations of an object instance or type.
- The means to name an object as a specific type and thus control the inheritance of its type-based members.
- The ability to add, remove, and modify extended members.
- The ability to manipulate the **PSObject** object itself if required.

The PSObject class

The **PSObject** object is the basis of all object access from the scripting language and provides a standard abstraction for the cmdlet developer. It contains a base-object (a .NET object) and any instance members (members, specifically extended members, that are present on a particular object instance while not necessarily on other objects of the same type). Depending on the type of the base-object, the **PSObject** object might also provide implicit and explicit access to adapted members as well as any type-based extended members.

The **PSObject** object provides the following mechanisms:

- The ability to construct an **PSObject** with or without a base-object.
- The ability to access of all members of each constructed **PSObject** object through a common lookup algorithm and the ability to override that algorithm when required.
- The ability to get and set the type-names of the constructed **PSObject** objects so that scripts and cmdlets can reference similar **PSObject** objects by the same type-name, regardless of the type of their base-object.

How to Construct a PSObject

The following list describes ways to create a **PSObject** object:

- Calling the **PSObject** .#ctor constructor creates a new **PSObject** object with a base-object of PSCustomObject. A base-object of this type indicates that the **PSObject** object has no meaningful base-object. However, a **PSObject** object with this type of base-object does provide a property bag that cmdlet developers can find helpful by adding extended-members.

Developers can also specify the object type-name, which allows this object to share its extended-members with other **PSObject** objects of the same type-name.

- Calling the **PSObject** .#ctor(System.Object) constructor creates a new **PSObject** object with a base-object of type System.Object.

  In this case, the type-name for the created object is a collection of the derivation hierarchy of the base-object. For example, the type-name for the **PSObject** that contains a ProcessInfo base-object would include the following names:
  - System.Diagnostics.Process
  - System.ComponentModel.Component
  - System.MarshalByRefObject
  - System.Object

- Calling the **PSObject** .AsPSObject(System.Object) method creates a new **PSObject** object based on a supplied object.

  If the supplied object is of type System.Object, the supplied object is used as the base-object for the new **PSObject** object. If the supplied object is already an **PSObject** object, the supplied object is returned as is.

Base, adapted, and extended members

Conceptually, ETS uses the following terms to show the relationship between the original members of the base-object and those members added by PowerShell. For more information about the specific types of members that are used by the **PSObject** object, see PSObject class.

Base-object members

If the base-object is specified when constructing the **PSObject** objects, then the members of the base-object are made available through the Members property.

Adapted members

When a base-object is a meta-object, one that contains data in a generic fashion whose properties "describe" their contained data, ETS adapts those objects to a view that allows for direct access to the data through adapted members of the **PSObject** object. Adapted members and base-object members are accessed through the Members property.

Extended members

In addition to the members made available from the base-object or those adapted members created by PowerShell, an **PSObject** may also define extended members that extend the original base-object with additional information that is useful in the scripting environment.

For example, all the core cmdlets provided by PowerShell, such as the Get-Content and Set-Content cmdlets, take a path parameter. To ensure that these cmdlets, and others, can work against objects of different types, a Path member can be added to those objects so that they all state their information in a common way. This extended Path member ensures that the cmdlets can work against all those types even though there base class might not have a Path member.

Extended members, adapted members, and base-object members are all accessed through the Members property.

Extended Type System class members

Article • 09/17/2021

ETS refers to a number of different kinds of members whose types are defined by the **PSMemberTypes** enumeration. These member types include properties, methods, members, and member sets that are each defined by their own CLR type. For example, a **NoteProperty** is defined by its own **PSNoteProperty** type. These individual CLR types have both their own unique properties and common properties that are inherited from the PSMemberInfo class.

The PSMemberInfo class

The **PSMemberInfo** class serves as a base class for all ETS member types. This class provides the following base properties to all member CLR types.

- **Name** property: The name of the member. This name can be defined by the base-object or defined by PowerShell when adapted members or extended members are exposed.
- **Value** property: The value returned from the particular member. Each member type defines how it handles its member value.
- **TypeNameOfValue** property: This is the name of the CLR type of the value that is returned by the Value property.

Accessing members

Collections of members can be accessed through the **Members**, **Methods**, and **Properties** properties of the **PSObject** object.

ETS properties

ETS properties are members that can be treated as a property. Essentially, they can appear on the left-hand side of an expression. They include alias properties, code properties, PowerShell properties, note properties, and script properties. For more information about these types of properties, see ETS properties.

ETS methods

ETS methods are members that can take arguments, may return results, and cannot appear on the left-hand side of an expression. They include code methods, PowerShell

methods, and script methods. For more information about these types of methods, see ETS methods.

ETS member sets

Article • 09/17/2021

Member sets allow you to partition the members of the **PSObject** object into two subsets so that the members of the subsets can be referenced together by their subset name. The two types of subsets include property sets and member sets. For example of how PowerShell uses member sets, there is a specific property set named **DefaultDisplayPropertySet** that is used to determine, at runtime, which properties to display for a given **PSObject** object.

Property Sets

Property sets can include any number of properties of an **PSObject** type. In general, a property set can be used whenever a collection of properties (of the same type) is needed. The property set is created by calling the `PSPropertySet(System.String,System.Collections.Generic.IEnumerable{System.String})` constructor with the name of the property set and the names of the referenced properties. The created **PSPropertySet** object can then be used as an alias that points to the properties in the set. The PSPropertySet class has the following properties and methods.

- **IsInstance** property: Gets a **Boolean** value that indicates the source of the property.
- **MemberType** property: Gets the type of properties in the property set.
- **Name** property: Gets the name of the property set.
- **ReferencedPropertyNames** property: Gets the names of the properties in the property set.
- **TypeNameOfValue** property: Gets a **PropertySet** enumeration constant that defines this set as a property set.
- **Value** property: Gets or sets the **PSPropertySet** object.
- `PSPropertySet.Copy` method: Makes an exact copy of the **PSPropertySet** object.
- `PSMemberSet.ToString` method: Converts the **PSPropertySet** object to a string.

Member Sets

Member sets can include any number of extended members of any type. The member set is created by calling the `PSMemberSet(System.String,System.Collections.Generic.IEnumerable{System.Management.Automation.PSMemberInfo})` constructor with the name of the member set and the names

of the referenced members. The created **PSPropertySet** object can then be used as an alias that points to the members in the set. The PSMemberSet class has the following properties and methods.

- **IsInstance** property: Gets a **Boolean** value that indicates the source of the member.
- **Members** property: Gets all the members of the member set.
- **MemberType** property: Gets a **MemberSet** enumeration constant that defines this set as a member set.
- **Methods** property: Gets the methods included in the member set.
- **Properties** property: Gets the properties included in the member set.
- **TypeNameOfValue** property: Gets a **MemberSet** enumeration constant that defines this set as a member set.
- **Value** property: Gets the **PSMemberSet** object.
- `PSMemberSet.Copy` method: Makes an exact copy of the **PSMemberSet** object.
- `PSMemberSet.ToString` method: Converts the **PSMemberSet** object to a string.

ETS properties

Article • 09/17/2021

Properties are members that can be treated as a property. Essentially, they can appear on the left-hand side of an expression. The properties that are available include alias, code, note, and script properties.

Alias Property

An alias property is a property that references another property that the **PSObject** object contains. It is used primarily to rename the referenced property. However, it may also be used to convert the referenced property's value to another type. With respect to ETS, this type of property is always an extended-member and is defined by the PSAliasProperty class. The class includes the following properties.

- **ConversionType** property: The CLR type used to convert the referenced member's value.
- **IsGettable** property: Indicates whether the value of the referenced property can be retrieved. This property is dynamically determined by examining the **IsGettable** property of the referenced property.
- **IsSettable** property: Indicates whether the value of the referenced property can be set. This property is dynamically determined by examining the **IsSettable** property of the referenced property.
- **MemberType** property: An **AliasProperty** enumeration constant that defines this property as an alias property.
- **ReferencedMemberName** property: The name of the referenced property that this alias refers to.
- **TypeNameOfValue** property: The full name of the CLR type of the referenced property's value.
- **Value** property: The value of the referenced property.

Code Property

A code property is a property that is a getter and setter that is defined in a CLR language. In order for a code property to become available, a developer must write the property in some CLR language, compile, and ship the resultant assembly. This assembly must be available in the runspace where the code property is desired. With respect to ETS, this type of property is always an extended-member and is defined by the PSCodeProperty class. The class includes the following properties.

- **GetterCodeReference** property: The method used to get the value of the code property.
- **IsGettable** property: Indicates whether the value of the code property can be retrieved, that the **SetterCodeReference** property: The method used to set the value of the code property.
- **IsSettable** property: Indicates whether the value of the code property can be set, that the **SetterCodeReference** property is not null.
- **MemberType** property: A **CodeProperty** enumeration constant that defines this property as a code property.
- **SetterCodeReference** property: The method used to get the value of the code property.
- **TypeNameOfValue** property: The CLR type of the code property value that is returned by the properties get operation.
- **Value** property: The value of the code property. When this property is retrieved, the getter code in the GetterCodeReference property is invoked, passing the current **PSObject** object and returning the value returned by the invocation. When this property is set, the setter code in the **SetterCodeReference** property is invoked, passing the current **PSObject** object as the first argument and the object used to set the value as the second argument.

Note Property

A Note property is a property that has a name/value pairing. With respect to ETS, this type of property is always an extended-member and is defined by the PSNoteProperty class. The class includes the following properties.

- **IsGettable** property: Indicates whether the value of the note property can be retrieved.
- **IsSettable** property: Indicates whether the value of the note property can be set.
- **MemberType** property: A **NoteProperty** enumeration constant that defines this property as a note property.
- **TypeNameOfValue** property: The fully-qualified type name of the object returned by the note property's get operation.
- **Value**: The value of the note property.

PowerShell property

A PowerShell property is a property defined on the base object or a property that is made available through an adapter. It can refer to both CLR fields as well as CLR properties. With respect to ETS, this type of property can be either a base-member or an

adapter-member and is defined by the PSProperty class. The class includes the following properties.

- **IsGettable** property: Indicates whether the value of the base or adapted property can be retrieved.
- **IsSettable** property: Indicates whether the value of the base or adapted property can be set.
- **MemberType** property: A Property enumeration constant that defines this property as a PowerShell property.
- **TypeNameOfValue** property: The fully-qualified name of the property value type. For example, for a property whose value is a string, its property value type is **System.String**.
- **Value** property: The value of the property. If the get or set operation is called on a property that does not support that operation, an **GetValueException** or **SetValueException** exception is thrown

PowerShell Script property

A Script property is a property that has getter and setter scripts. With respect to ETS, this type of property is always an extended-member and is defined by the PSScriptProperty class. The class includes the following properties.

- **GetterScript** property: The script used to retrieve the script property value.
- **IsGettable** property: Indicates whether the **GetterScript** property exposes a script block.
- **IsSettable** property: Indicates whether the **SetterScript** property exposes a script block.
- **MemberType** property: An ScriptProperty enumeration constant that identifies this property as a script property.
- **SetterScript** property: The script used to set the script property value.
- **TypeNameOfValue** property: The fully-qualified type name of the object returned by the getter script. In this case **System.Object** is always returned.
- **Value** property: The value of the script property. A get invokes the getter script and returns the value provided. A set invokes the setter script.

ETS class methods

Article • 09/17/2021

ETS methods are members that can take arguments, may return results, and cannot appear on the left-hand side of an expression. The methods that are available within ETS include code, Windows PowerShell, and script methods.

> ⓘ **Note**
>
> From scripts, methods are accessed using the same syntax as other members with the addition of parenthesis at the end of the method name.

Code Methods

A code method is an extended member that is defined in a CLR language. It provides similar functionality to a method defined on a base object; however, a code method may be added dynamically to an **PSObject** object. In order for a code method to become available, a developer must write the property in some CLR language, compile, and ship the resultant assembly. This assembly must be available in the runspace where the code method is desired. Be aware that a code method implementation must be thread safe. Access to these methods is done through PSCodeMethod objects that provides the following public methods and properties.

- `PSCodeMethod.Copy` method: Makes an exact copy of the **PSCodeMethod** object.
- `PSCodeMethod.Invoke(System.Object[])` method: Invokes the underlying code method.
- `PSCodeMethod.ToString` method: Converts the **PSCodeMethod** object to a string.
- `PSCodeMethod.CodeReference` property: Gets the underlying method that the code method is based on.
- **PSMemberInfo.IsInstance** property: Gets a **Boolean** value that indicates the source of the member.
- **PSCodeMethod.MemberType** property: Gets an **PSMemberTypes.CodeMethod** enumeration constant that identifies this method as a code method.
- **PSMemberInfo.Name** property: Gets the name of the underlying code method.
- **PSCodeMethod.OverloadDefinitions** property: Gets a definition of all the overloads of the underlying code method.
- **PSCodeMethod.TypeNameOfValue** property: Gets the full name of the code method.
- **PSMemberInfo.Value** property: Gets the **PSCodeMethod** object.

Windows PowerShell Methods

A PowerShell method is a CLR method defined on the base object or is made accessible through an adapter. Access to these methods is done through **PSMethod** objects that provides the following public methods and properties.

- `PSMethod.Copy` method: Makes an exact copy of the **PSMethod** object.
- `PSMethod.Invoke(System.Object[])` method: Invokes the underlying method.
- `PSMethod.ToString` method: Converts the **PSMethod** object to a string.
- **PSMemberInfo.IsInstance** property: Gets a **Boolean** value that indicates the source of the member.
- **PSMethod.MemberType** property: Gets an **PSMemberTypes.Method** enumeration constant that identifies this method as a PowerShell method.
- **PSMemberInfo.Name** property: Gets the name of the underlying method.
- **PSMethod.OverloadDefinitions** property: Gets the definitions of all the overloads of the underlying method.
- **PSMethod.TypeNameOfValue** property: Gets the ETS type of this method.
- **PSMemberInfo.Value** property: Gets the **PSMethod** object.

Script Methods

A script method is an extended member that is defined in the PowerShell language. It provides similar functionality to a method defined on a base object; however, a script method may be added dynamically to an **PSObject** object. Access to these methods is done through PSScriptMethod objects that provides the following public methods and properties.

- `PSScriptMethod.Copy` method: Makes an exact copy of the **PSScriptMethod** object.
- `PSScriptMethod.Invoke(System.Object[])` method: Invokes the underlying script method.
- `PSScriptMethod.ToString` method: Converts the **PSScriptMethod** object to a string.
- **PSMemberInfo.IsInstance** property: Gets a **Boolean** value that indicates the source of the member.
- **PSScriptMethod.MemberType** property: Gets a **PSMemberTypes.ScriptMethod** enumeration constant that identifies this method as a script method.
- **PSMemberInfo.Name** property: Gets the name of the underlying code method.
- **PSScriptMethod.OverloadDefinitions** property: Gets the definitions of all the overloads of the underlying script method.
- **PSScriptMethod.TypeNameOfValue** property: Gets the ETS type of this method.
- **PSScriptMethod.Script** property: Gets the script used to invoke the method.

- **PSMemberInfo.Value** property: Gets the **PSScriptMethod** object.

ETS type converters

Article • 09/17/2021

ETS uses two basic types of type converters when a call is made to the `LanguagePrimitives.ConvertTo(System.Object, System.Type)` method. When this method is called, PowerShell attempts to perform the type conversion using its standard PowerShell language converters or a custom converter. If PowerShell cannot perform the conversion, it throws an **PSInvalidCastException** exception.

Standard Windows PowerShell Language Converters

These standard conversions are checked before any custom conversions and cannot be overridden. The following table lists the type conversions performed by PowerShell when the `ConvertTo(System.Object, System.Type)` method is called. Be aware that references to the **valueToConvert** and **resultType** parameters refer to parameters of the `ConvertTo(System.Object,System.Type)` method.

From (valueToConvert)	To (resultType)	Returns
Null	String	""
Null	Char	'\0'
Null	Numeric	`0` of the type specified in the **resultType** parameter.
Null	Boolean	Results of call to the `IsTrue(System.Object)(Null)` method.
Null	PSObject	New object of type **PSObject**.
Null	Non-value-type	Null.
Null	Nullable<T>	Null.
Derived Class	Base class	**valueToConvert**
Anything	Void	**AutomationNull.Value**
Anything	String	Calls `ToString` mechanism.
Anything	Boolean	`IsTrue(System.Object) (valueToConvert)`

From (valueToConvert)	To (resultType)	Returns
Anything	PSObject	Results of call to the `AsPSObject(System.Object)(valueToConvert)` method.
Anything	Xml Document	Converts **valueToConvert** to string, then calls **XMLDocument** constructor.
Array	Array	Attempts to convert each element of the array.
Singleton	Array	`Array[0]` equals **valueToConvert** that is converted to the element type of the array.
IDictionary	Hash table	Results of call to Hashtable(valueToConvert).
String	Char[]	`valueToConvert.ToCharArray`
String	RegEx	Results of call to `Regx(valueToConvert)`.
String	Type	Returns the appropriate type using the **valueToConvert** parameter to search **RunspaceConfiguration.Assemblies**.
String	Numeric	If **valueToConvert** is "", returns `0` of the **resultType**. Otherwise the culture "culture invariant" is used to produce a numeric value.
Integer	System.Enum	Converts the integer to the constant if the integer is defined by the enumeration. If the integer is not defined an **PSInvalidCastException** exception is thrown.

Custom conversions

If PowerShell cannot convert the type using a standard PowerShell language converter, it then checks for custom converters. PowerShell looks for several types of custom converters in the order described in this section. Be aware that references to the **valueToConvert** and **resultType** parameters refer to parameters of the `ConvertTo(System.Object, System.Type)` method. If a custom converter throws an exception, then no further attempt is made to convert the object and that exception is wrapped in a **PSInvalidCastException** exception which is then thrown.

PowerShell type converter

PowerShell type converters are used to convert a single type or a family of types, such as all types that derive from the **System.Enum** class. To create a PowerShell type converter you must implement an PSTypeConverter class and associate that implementation with

the target class. There are two ways of associating the PowerShell type converter with its target class.

- Through the type configuration file
- By applying the **TypeConverterAttribute** attribute to the target class

PowerShell type converters, derived from the PSTypeConverter abstract class, provide methods for converting an object to a specific type or from a specific type. If the **valueToConvert** parameter contains an object that has a PowerShell Type converter associated with it, PowerShell calls the `PSTypeConverter.ConvertTo(System.Object, System.Type,System.IFormatProvider, System.Boolean)` method of the associated converter to convert the object to the type specified by the **resultType** parameter. If the **resultType** parameter references a type that has a PowerShell type converter associated with it, PowerShell calls the `PSTypeConverter.ConvertFrom(System.Object,System.Type, System.IFormatProvider, System.Boolean)` method of the associated converter to convert the object from the type specified by the **resultType** parameter.

System type converter

System type converters are used to convert a specific target class. This type of converter cannot be used to convert a family of classes. To create an system type converter you must implement an TypeConverter class and associate that implementation with the target class. There are two ways of associating the system type converter with its target class.

- Through the type configuration file
- By applying the TypeConverterAttribute attribute to the target class

Parse converter

If the **valueToConvert** parameter is a string, and the object type of the **resultType** parameter has a `Parse` method, then the `Parse` method is called to convert the string.

Constructor converter

If the object type of the **resultType** parameter has a constructor that has a single parameter that is the same type as the object of the **valueToConvert** parameter, then this constructor is called.

Implicit cast operator converter

If the **valueToConvert** parameter has an implicit cast operator that converts to **resultType**, then its cast operator is called. If the **resultType** parameter has an implicit cast operator that converts from **valueToConvert**, then its cast operator is called.

Explicit cast operator converter

If the **valueToConvert** parameter has an explicit cast operator that converts to **resultType**, then its cast operator is called. If the **resultType** parameter has an explicit cast operator that converts from **valueToConvert**, then its cast operator is called.

Errors and exceptions in the Extended Type System

Article • 09/17/2021

Errors can occur in ETS during the initialization of type data and when accessing a member of an **PSObject** object or using one of the utility classes such as **LanguagePrimitives**.

Runtime errors

With one exception, when casting, all exceptions thrown from ETS during runtime are either an **ExtendedTypeSystemException** exception or an exception derived from the **ExtendedTypeSystemException** class. This allows script developers to trap these exceptions using the `Trap` statement in their script.

Errors getting member values

All errors that occur when getting the value of an ETS member (property, method, or parameterized property) cause a **GetValueException** or **GetValueInvocationException** exception to be thrown. When ETS recognizes that an error occurred a **GetValueException** exception is thrown. When the underlying getter of a referenced member recognizes that an error occurred, a **GetValueInvocationException** exception is thrown that may or may not include the inner exception that caused the get invocation error.

Errors setting member values

All errors that occur when setting the value of an ETS property cause a **SetValueException** or **SetValueInvocationException** exception to be thrown. When ETS recognizes that an error occurred a **SetValueException** exception is thrown. When the underlying setter of a referenced property recognizes that an error occurred, a **SetValueInvocationException** exception is thrown that may or may not include the inner exception that caused the set invocation error.

Errors invoking a method

All errors that occur when invoking an ETS method cause a **MethodException** or **MethodInvocationException** exception to be thrown. When ETS recognizes that an error occurred a **MethodException** exception is thrown. When the referenced method recognizes that an error occurred, a **MethodInvocationException** exception is thrown that may or may not include the inner exception that caused the invocation error.

Casting errors

When an invalid cast is attempted, an **PSInvalidCastException** is thrown. Because this exception derives from **System.InvalidCastException**, it is not able to be directly trapped from script. Be aware that the entity attempting the cast would need to wrap **PSInvalidCastException** in an **PSRuntimeException** for this to be trappable by scripts. If an attempt is made to set the value of an **PSPropertySet**, **PSMemberSet**, **PSMethodInfo**, or a member of the **ReadOnlyPSMemberInfoCollection`1**, a **NotSupportedException** is thrown.

Common runtime errors

Any other common runtime errors that occur are of type **ExtendedTypeSystemException** exception with no additional specific exception types.

Initialization errors

Errors may occur when initializing `types.ps1xml`. Typically, these errors are displayed when the PowerShell runtime starts. However, they can also be displayed when a module is loaded.

Windows PowerShell Programmer's Guide

Article • 09/17/2021

This programmer's guide is targeted at developers who are interested in providing a command-line management environment for system administrators. Windows PowerShell provides a simple way for you to build management commands that expose .NET objects, while allowing Windows PowerShell to do most of the work for you.

In traditional command development, you are required to write a parameter parser, a parameter binder, filters, and all other functionality exposed by each command. Windows PowerShell provides the following to make it easy for you to write commands:

- A powerful Windows PowerShell runtime (execution engine) with its own parser and a mechanism for automatically binding command parameters.
- Utilities for formatting and displaying command results using a command line interpreter (CLI).
- Support for high levels of functionality (through Windows PowerShell providers) that make it easy to access stored data.

  At little cost, you can represent a .NET object by a rich command or set of commands that will offer a complete command-line experience to the administrator.

  The next section covers the key Windows PowerShell concepts and terms. Familiarize yourself with these concepts and terms before starting development.

About Windows PowerShell

Windows PowerShell defines several types of commands that you can use in development. These commands include: functions, filters, scripts, aliases, and executables (applications). The main command type discussed in this guide is a simple, small command called a "cmdlet". Windows PowerShell furnishes a set of cmdlets and fully supports cmdlet customization to suit your environment. The Windows PowerShell runtime processes all command types just as it does cmdlets, using pipelines.

In addition to commands, Windows PowerShell supports various customizable Windows PowerShell providers that make available specific sets of cmdlets. The shell operates within the Windows PowerShell-provided host application (Windows PowerShell.exe),

but it is equally accessible from a custom host application that you can develop to meet specific requirements. For more information, see How Windows PowerShell Works.

Windows PowerShell Cmdlets

A cmdlet is a lightweight command that is used in the Windows PowerShell environment. The Windows PowerShell runtime invokes these cmdlets within the context of automation scripts that are provided at the command line, and the Windows PowerShell runtime also invokes them programmatically through Windows PowerShell APIs.

For more information about cmdlets, see Writing a Windows PowerShell Cmdlet.

Windows PowerShell Providers

In performing administrative tasks, the user may need to examine data stored in a data store (for example, the file system, the Windows Registry, or a certificate store). To make these operations easier, Windows PowerShell defines a module called a Windows PowerShell provider that can be used to access a specific data store, such as the Windows Registry. Each provider supports a set of related cmdlets to give the user a symmetrical view of the data in the store.

Windows PowerShell provides several default Windows PowerShell providers. For example, the Registry provider supports navigation and manipulation of the Windows Registry. Registry keys are represented as items, and registry values are treated as properties.

If you expose a data store that the user will need to access, you might need to write your own Windows PowerShell provider, as described in Creating Windows PowerShell Providers. For more information aboutWindows PowerShell providers, see How Windows PowerShell Works.

Host Application

Windows PowerShell includes the default host application powershell.exe, which is a console application that interacts with the user and hosts the Windows PowerShell runtime using a console window.

Only rarely will you need to write your own host application for Windows PowerShell, although customization is supported. One case in which you might need your own application is when you have a requirement for a GUI interface that is richer than the interface provided by the default host application. You might also want a custom

application when you are basing your GUI on the command line. For more information, see How to Create a Windows PowerShell Host Application.

Windows PowerShell Runtime

The Windows PowerShell runtime is the execution engine that implements command processing. It includes the classes that provide the interface between the host application and Windows PowerShell commands and providers. The Windows PowerShell runtime is implemented as a runspace object for the current Windows PowerShell session, which is the operational environment in which the shell and the commands execute. For operational details, see How Windows PowerShell Works.

Windows PowerShell Language

The Windows PowerShell language provides scripting functions and mechanisms to invoke commands. For complete scripting information, see the Windows PowerShell Language Reference shipped with Windows PowerShell.

Extended Type System (ETS)

Windows PowerShell provides access to a variety of different objects, such as .NET and XML objects. As a consequence, to present a common abstraction for all object types the shell uses its extended type system (ETS). Most ETS functionality is transparent to the user, but the script or .NET developer uses it for the following purposes:

- Viewing a subset of the members of specific objects. Windows PowerShell provides an "adapted" view of several specific object types.
- Adding members to existing objects.
- Access to serialized objects.
- Writing customized objects.

  Using ETS, you can create flexible new "types" that are compatible with the Windows PowerShell language. If you are a .NET developer, you are able to work with objects using the same semantics as the Windows PowerShell language applies to scripting, for example, to determine if an object evaluates to `true`.

  For more information about ETS and how Windows PowerShell uses objects, see Windows PowerShell Object Concepts.

Programming for Windows PowerShell

Windows PowerShell defines its code for commands, providers, and other program modules using the .NET Framework. You are not confined to the use of Microsoft Visual Studio in creating customized modules for Windows PowerShell, although the samples provided in this guide are known to run in this tool. You can use any .NET language that supports class inheritance and the use of attributes. In some cases, Windows PowerShell APIs require the programming language to be able to access generic types.

Programmer's Reference

For reference when developing for Windows PowerShell, see the Windows PowerShell SDK.

Getting Started Using Windows PowerShell

For more information about starting to use the Windows PowerShell shell, see the Getting Started with Windows PowerShell shipped with Windows PowerShell. A Quick Reference tri-fold document is also supplied as a primer for cmdlet use.

Contents of This Guide

Topic	Definition
How to Create a Windows PowerShell Provider	This section describes how to build a Windows PowerShell provider for Windows PowerShell.
How to Create a Windows PowerShell Host Application	This section describes how to write a host application that manipulates a runspace and how to write a host application that implements its own custom host.
How to Create a Windows PowerShell Snap-in	This section describes how to create a snap-in that is used to register all cmdlets and providers in an assembly and how to create a custom snap-in.
How to Create a Console Shell	This section describes how to create a console shell that is not extensible.
Windows PowerShell Concepts	This section contains conceptual information that will help you understand Windows PowerShell from the viewpoint of a developer.

See Also

Windows PowerShell SDK

How to Create a Windows PowerShell Provider

Article • 09/17/2021

This section describes how to build a Windows PowerShell provider. A Windows PowerShell provider can be considered in two ways. To the user, the provider represents a set of stored data. For example, the stored data can be the Internet Information Services (IIS) Metabase, the Microsoft Windows Registry, the Windows file system, Active Directory, and the variable and alias data stored by Windows PowerShell.

To the developer, the Windows PowerShell provider is the interface between the user and the data that the user needs to access. From this perspective, each type of provider described in this section supports a set of specific base classes and interfaces that allow the Windows PowerShell runtime to expose certain cmdlets to the user in a common way.

Providers Provided by Windows PowerShell

Windows PowerShell provides several providers (such as the FileSystem provider, Registry provider, and Alias provider) that are used to access known data stores. For more information about the providers supplied by Windows PowerShell, use the following command to access online Help:

```
PS>get-help about_providers
```

Accessing the Stored Data Using Windows PowerShell Paths

Windows PowerShell providers are accessible to the Windows PowerShell runtime and to commands programmatically through the use of Windows PowerShell paths. Most of the time, these paths are used to directly access the data through the provider. However, some paths can be resolved to provider-internal paths that allow a cmdlet to use non-Windows PowerShell application programming interfaces (APIs) to access the data. For more information about how Windows PowerShell providers operate within Windows PowerShell, see How Windows PowerShell Works.

Exposing Provider Cmdlets Using Windows PowerShell Drives

A Windows PowerShell provider exposes its supported cmdlets using virtual Windows PowerShell drives. Windows PowerShell applies the following rules for a Windows PowerShell drive:

- The name of a drive can be any alphanumeric sequence.
- A drive can be specified at any valid point on a path, called a "root".
- A drive can be implemented for any stored data, not just the file system.
- Each drive keeps its own current working location, allowing the user to retain context when shifting between drives.

In This Section

The following table lists topics that include code examples that build on each other. Starting with the second topic, the basic Windows PowerShell provider can be initialized and uninitialized by the Windows PowerShell runtime, the next topic adds functionality for accessing the data, the next topic adds functionality for manipulating the data (the items in the stored data), and so on.

Topic	Definition
Designing Your Windows PowerShell Provider	This topic discusses things you should consider before implementing a Windows PowerShell provider. It summarizes the Windows PowerShell provider base classes and interfaces that are used.
Creating a Basic Windows PowerShell Provider	This topic shows how to create a Windows PowerShell provider that allows the Windows PowerShell runtime to initialize and uninitialize the provider.
Creating a Windows PowerShell Drive Provider	This topic shows how to create a Windows PowerShell provider that allows the user to access a data store through a Windows PowerShell drive.
Creating a Windows PowerShell Item Provider	This topic shows how to create a Windows PowerShell provider that allows the user to manipulate the items in a data store.

Topic	Definition
Creating a Windows PowerShell Container Provider	This topic shows how to create a Windows PowerShell provider that allows the user to work on multilayer data stores.
Creating a Windows PowerShell Navigation Provider	This topic shows how to create a Windows PowerShell provider that allows the user to navigate the items of a data store in a hierarchical manner.
Creating a Windows PowerShell Content Provider	This topic shows how to create a Windows PowerShell provider that allows the user to manipulate the content of items in a data store.
Creating a Windows PowerShell Property Provider	This topic shows how to create a Windows PowerShell provider that allows the user to manipulate the properties of items in a data store.

See Also

How Windows PowerShell Works

Windows PowerShell SDK

Windows PowerShell Programmer's Guide

Designing Your Windows PowerShell Provider

Article • 09/17/2021

You should implement a Windows PowerShell provider if your product or configuration exposes a set of stored data, such as a database that the user will want to navigate or browse. Additionally, if your product provides a container, even if it is not a multilevel container, it makes sense to implement a Windows PowerShell provider. For example, you might want to implement a Windows PowerShell container provider if the cmdlet verb Copy, Move, Rename, New, or Remove makes sense as an operation on your product or configuration data.

Windows PowerShell Paths Identify Your Provider

The Windows PowerShell runtime uses Windows PowerShell paths to access the appropriate Windows PowerShell provider. When a cmdlet specifies one of these paths, the runtime knows which provider to use to access the associated data store. These paths include drive-qualified paths, provider-qualified paths, provider-direct paths, and provider-internal paths. Each Windows PowerShell provider must support one or more of these paths.

For more information about Windows PowerShell paths, see How Windows PowerShell Works.

Defining a Drive-Qualified Path

To allow the user to access data located at a physical drive, your Windows PowerShell provider must support a drive-qualified path. This path starts with the drive name followed by a colon (:), for example, mydrive:\abc\bar.

Defining a Provider-Qualified Path

To allow the Windows PowerShell runtime to initialize and uninitialize the provider, your Windows PowerShell provider must support a provider-qualified path. For example, FileSystem::\\uncshare\abc\bar is the provider-qualified path for the filesystem provider furnished by Windows PowerShell.

Defining a Provider-Direct Path

To allow remote access to your Windows PowerShell provider, it should support a provider-direct path to pass directly to the Windows PowerShell provider for the current location. For example, the registry Windows PowerShell provider can use \\server\regkeypath as a provider-direct path.

Defining a Provider-Internal Path

To allow the provider cmdlet to access data using non-Windows PowerShell application programming interfaces (APIs), your Windows PowerShell provider should support a provider-internal path. This path is indicated after the "::" in the provider-qualified path. For example, the provider-internal path for the filesystem Windows PowerShell provider is \\uncshare\abc\bar.

Changing Stored Data

When overriding methods that modify the underlying data store, always call the System.Management.Automation.Provider.Cmdletprovider.Writeitemobject* method with the most up-to-date version of the item changed by that method. The provider infrastructure determines if the item object needs to be passed to the pipeline, such as when the user specifies the -PassThru parameter. If retrieving the most up-to-date item is a costly operation (performance-wise,) you can test the Context.PassThru property to determine if you actually need to write the resulting item.

Choose a Base Class for Your Provider

Windows PowerShell provides a number of base classes that you can use to implement your own Windows PowerShell provider. When designing a provider, choose the base class, described in this section, that is most suited to your requirements.

Each Windows PowerShell provider base class makes available a set of cmdlets. This section describes the cmdlets, but it does not describe their parameters.

Using the session state, the Windows PowerShell runtime makes several location cmdlets available to certain Windows PowerShell providers, such as the `Get-Location`, `Set-Location`, `Pop-Location`, and `Push-Location` cmdlets. You can use the `Get-Help` cmdlet to obtain information about these location cmdlets.

CmdletProvider Base Class

The System.Management.Automation.Provider.Cmdletprovider class defines a basic Windows PowerShell provider. This class supports the provider declaration and supplies a number of properties and methods that are available to all Windows PowerShell providers. The class is invoked by the `Get-PSProvider` cmdlet to list all available providers for a session. The implementation of this cmdlet is furnished by the session state.

> **Note**
>
> Windows PowerShell providers are available to all Windows PowerShell language scopes.

DriveCmdletProvider Base Class

The System.Management.Automation.Provider.Drivecmdletprovider class defines a Windows PowerShell drive provider that supports operations for adding new drives, removing existing drives, and initializing default drives. For example, the FileSystem provider provided by Windows PowerShell initializes drives for all volumes that are mounted, such as hard drives and CD/DVD device drives.

This class derives from the System.Management.Automation.Provider.Cmdletprovider base class. The following table lists the cmdlets exposed by this class. In addition to those listed, the `Get-PSDrive` cmdlet (exposed by session state) is a related cmdlet that is used to retrieve available drives.

Cmdlet	Definition
`New-PSDrive`	Creates a new drive for the session, and streams drive information.
`Remove-PSDrive`	Removes a drive from the session.

ItemCmdletProvider Base Class

The System.Management.Automation.Provider.Itemcmdletprovider class defines a Windows PowerShell item provider that performs operations on the individual items of the data store, and it does not assume any container or navigation capabilities. This class derives from the System.Management.Automation.Provider.Drivecmdletprovider base class. The following table lists the cmdlets exposed by this class.

Cmdlet	Definition

Cmdlet	Definition
`Clear-Item`	Clears the current content of items at the specified location, and replaces it with the "clear" value specified by the provider. This cmdlet does not pass an output object through the pipeline unless its `PassThru` parameter is specified.
`Get-Item`	Retrieves items from the specified location, and streams the resultant objects.
`Invoke-Item`	Invokes the default action for the item at the specified path.
`Set-Item`	Sets an item at the specified location with the indicated value. This cmdlet does not pass an output object through the pipeline unless its `PassThru` parameter is specified.
`Resolve-Path`	Resolves the wildcards for a Windows PowerShell path, and streams path information.
`Test-Path`	Tests for the specified path, and returns `true` if it exists and `false` otherwise. This cmdlet is implemented to support the `IsContainer` parameter for the System.Management.Automation.Provider.Cmdletprovider.Writeitemobject* method.

ContainerCmdletProvider Base Class

The System.Management.Automation.Provider.Containercmdletprovider class defines a Windows PowerShell container provider that exposes a container, for data store items, to the user. Be aware that a Windows PowerShell container provider can be used only when there is one container (no nested containers) with items in it. If there are nested containers, then you must implement a Windows PowerShell navigation provider .

This class derives from the System.Management.Automation.Provider.Itemcmdletprovider base class. The following table defines the cmdlets implemented by this class.

Cmdlet	Definition
`Copy-Item`	Copies items from one location to another. This cmdlet does not pass an output object through the pipeline unless its `PassThru` parameter is specified.
`Get-Childitem`	Retrieves the child items at the specified location, and streams them as objects.
`New-Item`	Creates new items at the specified location, and streams the resultant object.
`Remove-Item`	Removes items from the specified location.

Cmdlet	Definition
`Rename-Item`	Renames an item at the specified location. This cmdlet does not pass an output object through the pipeline unless its `PassThru` parameter is specified.

NavigationCmdletProvider Base Class

The System.Management.Automation.Provider.Navigationcmdletprovider class defines a Windows PowerShell navigation provider that performs operations for items that use more than one container. This class derives from the System.Management.Automation.Provider.Containercmdletprovider base class. The following table list the cmdlets exposed by this class.

Cmdlet	Definition
Combine-Path	Combines two paths into a single path, using a provider-specific delimiter between paths. This cmdlet streams strings.
`Move-Item`	Moves items to the specified location. This cmdlet does not pass an output object through the pipeline unless its `PassThru` parameter is specified.

A related cmdlet is the basic Parse-Path cmdlet furnished by Windows PowerShell. This cmdlet can be used to parse a Windows PowerShell path to support the `Parent` parameter. It streams the parent path string.

Select Provider Interfaces to Support

In addition to deriving from one of the Windows PowerShell base classes, your Windows PowerShell provider can support other functionality by deriving from one or more of the following provider interfaces. This section defines those interfaces and the cmdlets supported by each. It does not describe the parameters for the interface-supported cmdlets. Cmdlet parameter information is available online using the `Get-Command` and `Get-Help` cmdlets.

IContentCmdletProvider

The System.Management.Automation.Provider.Icontentcmdletprovider interface defines a content provider that performs operations on the content of a data item. The following table lists the cmdlets exposed by this interface.

Cmdlet	Definition

Cmdlet	Definition
`Add-Content`	Appends the indicated value lengths to the contents of the specified item. This cmdlet does not pass an output object through the pipeline unless its `PassThru` parameter is specified.
`Clear-Content`	Sets the content of the specified item to the "clear" value. This cmdlet does not pass an output object through the pipeline unless its `PassThru` parameter is specified.
`Get-Content`	Retrieves the contents of the specified items and streams the resultant objects.
`Set-Content`	Replaces the existing content for the specified items. This cmdlet does not pass an output object through the pipeline unless its `PassThru` parameter is specified.

IPropertyCmdletProvider

The System.Management.Automation.Provider.Ipropertycmdletprovider interface defines a property Windows PowerShell provider that performs operations on the properties of items in the data store. The following table lists the cmdlets exposed by this interface.

> ⓘ Note
>
> The `Path` parameter on these cmdlets indicates a path to an item instead of identifying a property.

Cmdlet	Definition
`Clear-ItemProperty`	Sets properties of the specified items to the "clear" value. This cmdlet does not pass an output object through the pipeline unless its `PassThru` parameter is specified.
`Get-ItemProperty`	Retrieves properties from the specified items and streams the resultant objects.
`Set-ItemProperty`	Sets properties of the specified items with the indicated values. This cmdlet does not pass an output object through the pipeline unless its `PassThru` parameter is specified.

IDynamicPropertyCmdletProvider

The System.Management.Automation.Provider.Idynamicpropertycmdletprovider interface, derived from

System.Management.Automation.Provider.Ipropertycmdletprovider, defines a provider that specifies dynamic parameters for its supported cmdlets. This type of provider handles operations for which properties can be defined at run time, for example, a new property operation. Such operations are not possible on items having statically defined properties. The following table lists the cmdlets exposed by this interface.

Cmdlet	Definition
`Copy-ItemProperty`	Copies a property from the specified item to another item. This cmdlet does not pass an output object through the pipeline unless its `PassThru` parameter is specified.
`Move-ItemProperty`	Moves a property from the specified item to another item. This cmdlet does not pass an output object through the pipeline unless its `PassThru` parameter is specified.
`New-ItemProperty`	Creates a property on the specified items and streams the resultant objects.
`Remove-ItemProperty`	Removes a property for the specified items.
`Rename-ItemProperty`	Renames a property of the specified items. This cmdlet does not pass an output object through the pipeline unless its `PassThru` parameter is specified.

ISecurityDescriptorCmdletProvider

The System.Management.Automation.Provider.Isecuritydescriptorcmdletprovider interface adds security descriptor functionality to a provider. This interface allows the user to get and set security descriptor information for an item in the data store. The following table lists the cmdlets exposed by this interface.

Cmdlet	Definition
`Get-Acl`	Retrieves the information contained in an access control list (ACL), which is part of a security descriptor used to guard operating system resources, for example, a file or an object.
`Set-Acl`	Sets the information for an ACL. It is in the form of an instance of System.Security.Accesscontrol.Objectsecurity on the item(s) designated for the specified path. This cmdlet can set information about files, keys, and subkeys in the registry, or any other provider item, if the Windows PowerShell provider supports the setting of security information.

See Also

Creating Windows PowerShell Providers

How Windows PowerShell Works

Windows PowerShell SDK

Creating a Basic Windows PowerShell Provider

Article • 09/17/2021

This topic is the starting point for learning how to create a Windows PowerShell provider. The basic provider described here provides methods for starting and stopping the provider, and although this provider does not provide a means to access a data store or to get or set the data in the data store, it does provide the basic functionality that is required by all providers.

As mentioned previously, the basic provider described here implements methods for starting and stopping the provider. The Windows PowerShell runtime calls these methods to initialize and uninitialize the provider.

> **Note**
>
> You can find a sample of this provider in the AccessDBSampleProvider01.cs file provided by Windows PowerShell.

Defining the Windows PowerShell Provider Class

The first step in creating a Windows PowerShell provider is to define its .NET class. This basic provider defines a class called `AccessDBProvider` that derives from the System.Management.Automation.Provider.Cmdletprovider base class.

It is recommended that you place your provider classes in a `Providers` namespace of your API namespace, for example, xxx.PowerShell.Providers. This provider uses the `Microsoft.Samples.PowerShell.Provider` namespace, in which all Windows PowerShell provider samples run.

> **Note**
>
> The class for a Windows PowerShell provider must be explicitly marked as public. Classes not marked as public will default to internal and will not be found by the Windows PowerShell runtime.

Here is the class definition for this basic provider:

C#

```
[CmdletProvider("AccessDB", ProviderCapabilities.None)]
public class AccessDBProvider : CmdletProvider
```

Right before the class definition, you must declare the System.Management.Automation.Provider.Cmdletproviderattribute attribute, with the syntax [CmdletProvider()].

You can set attribute keywords to further declare the class if necessary. Notice that the System.Management.Automation.Provider.Cmdletproviderattribute attribute declared here includes two parameters. The first attribute parameter specifies the default-friendly name for the provider, which the user can modify later. The second parameter specifies the Windows PowerShell-defined capabilities that the provider exposes to the Windows PowerShell runtime during command processing. The possible values for the provider capabilities are defined by the System.Management.Automation.Provider.Providercapabilities enumeration. Because this is a base provider, it supports no capabilities.

> ⓘ **Note**
>
> The fully qualified name of the Windows PowerShell provider includes the assembly name and other attributes determined by Windows PowerShell upon registration of the provider.

Defining Provider-Specific State Information

The System.Management.Automation.Provider.Cmdletprovider base class and all derived classes are considered stateless because the Windows PowerShell runtime creates provider instances only as required. Therefore, if your provider requires full control and state maintenance for provider-specific data, it must derive a class from the System.Management.Automation.Providerinfo class. Your derived class should define the members necessary to maintain the state so that the provider-specific data can be accessed when the Windows PowerShell runtime calls the System.Management.Automation.Provider.Cmdletprovider.Start* method to initialize the provider.

A Windows PowerShell provider can also maintain connection-based state. For more information about maintaining connection state, see Creating a PowerShell Drive Provider.

Initializing the Provider

To initialize the provider, the Windows PowerShell runtime calls the System.Management.Automation.Provider.Cmdletprovider.Start* method when Windows PowerShell is started. For the most part, your provider can use the default implementation of this method, which simply returns the System.Management.Automation.Providerinfo object that describes your provider. However, in the case where you want to add additional initialization information, you should implement your own System.Management.Automation.Provider.Cmdletprovider.Start* method that returns a modified version of the System.Management.Automation.Providerinfo object that is passed to your provider. In general, this method should return the provided System.Management.Automation.Providerinfo object passed to it or a modified System.Management.Automation.Providerinfo object that contains other initialization information.

This basic provider does not override this method. However, the following code shows the default implementation of this method:

The provider can maintain the state of provider-specific information as described in Defining Provider-specific Data State. In this case, your implementation must override the System.Management.Automation.Provider.Cmdletprovider.Start* method to return an instance of the derived class.

Start Dynamic Parameters

Your provider implementation of the System.Management.Automation.Provider.Cmdletprovider.Start* method might require additional parameters. In this case, the provider should override the System.Management.Automation.Provider.Cmdletprovider.Startdynamicparameters* method and return an object that has properties and fields with parsing attributes similar to a cmdlet class or a System.Management.Automation.Runtimedefinedparameterdictionary object.

This basic provider does not override this method. However, the following code shows the default implementation of this method:

Uninitializing the Provider

To free resources that the Windows PowerShell provider uses, your provider should implement its own System.Management.Automation.Provider.Cmdletprovider.Stop*

method. This method is called by the Windows PowerShell runtime to uninitialize the provider at the close of a session.

This basic provider does not override this method. However, the following code shows the default implementation of this method:

Code Sample

For complete sample code, see AccessDbProviderSample01 Code Sample.

Testing the Windows PowerShell Provider

Once your Windows PowerShell provider has been registered with Windows PowerShell, you can test it by running the supported cmdlets on the command line. For this basic provider, run the new shell and use the `Get-PSProvider` cmdlet to retrieve the list of providers and ensure that the AccessDb provider is present.

PowerShell

```
Get-PSProvider
```

The following output appears:

Output

```
Name                 Capabilities                 Drives
----                 ------------                 ------
AccessDb             None                         {}
Alias                ShouldProcess                {Alias}
Environment          ShouldProcess                {Env}
FileSystem           Filter, ShouldProcess        {C, Z}
Function             ShouldProcess                {function}
Registry             ShouldProcess                {HKLM, HKCU}
```

See Also

Creating Windows PowerShell Providers

Designing Your Windows PowerShell Provider

Creating a Windows PowerShell Drive Provider

Article • 09/17/2021

This topic describes how to create a Windows PowerShell drive provider that provides a way to access a data store through a Windows PowerShell drive. This type of provider is also referred to as Windows PowerShell drive providers. The Windows PowerShell drives used by the provider provide the means to connect to the data store.

The Windows PowerShell drive provider described here provides access to a Microsoft Access database. For this provider, the Windows PowerShell drive represents the database (it is possible to add any number of drives to a drive provider), the top-level containers of the drive represent the tables in the database, and the items of the containers represent the rows in the tables.

Defining the Windows PowerShell Provider Class

Your drive provider must define a .NET class that derives from the System.Management.Automation.Provider.Drivecmdletprovider base class. Here is the class definition for this drive provider:

C#

```
[CmdletProvider("AccessDB", ProviderCapabilities.None)]
public class AccessDBProvider : DriveCmdletProvider
```

Notice that in this example, the System.Management.Automation.Provider.Cmdletproviderattribute attribute specifies a user-friendly name for the provider and the Windows PowerShell specific capabilities that the provider exposes to the Windows PowerShell runtime during command processing. The possible values for the provider capabilities are defined by the System.Management.Automation.Provider.Providercapabilities enumeration. This drive provider does not support any of these capabilities.

Defining Base Functionality

As described in Design Your Windows PowerShell Provider, the System.Management.Automation.Provider.Drivecmdletprovider class derives from the

System.Management.Automation.Provider.Cmdletprovider base class that defines the methods needed for initializing and uninitializing the provider. To implement functionality for adding session-specific initialization information and for releasing resources that are used by the provider, see Creating a Basic Windows PowerShell Provider. However, most providers (including the provider described here) can use the default implementation of this functionality that is provided by Windows PowerShell.

Creating Drive State Information

All Windows PowerShell providers are considered stateless, which means that your drive provider needs to create any state information that is needed by the Windows PowerShell runtime when it calls your provider.

For this drive provider, state information includes the connection to the database that is kept as part of the drive information. Here is code that shows how this information is stored in the System.Management.Automation.PSDriveinfo object that describes the drive:

C#

```
internal class AccessDBPSDriveInfo : PSDriveInfo
{
    private OdbcConnection connection;

    /// <summary>
    /// ODBC connection information.
    /// </summary>
    public OdbcConnection Connection
    {
        get { return connection; }
        set { connection = value; }
    }

    /// <summary>
    /// Constructor that takes one argument
    /// </summary>
    /// <param name="driveInfo">Drive provided by this provider</param>
    public AccessDBPSDriveInfo(PSDriveInfo driveInfo)
        : base(driveInfo)
    { }

} // class AccessDBPSDriveInfo
```

Creating a Drive

To allow the Windows PowerShell runtime to create a drive, the drive provider must implement the System.Management.Automation.Provider.Drivecmdletprovider.Newdrive* method. The following code shows the implementation of the System.Management.Automation.Provider.Drivecmdletprovider.Newdrive* method for this drive provider:

C#

```
      protected override PSDriveInfo NewDrive(PSDriveInfo drive)
      {
          // check if drive object is null
          if (drive == null)
          {
              WriteError(new ErrorRecord(
                  new ArgumentNullException("drive"),
                  "NullDrive",
                  ErrorCategory.InvalidArgument,
                  null)
              );

              return null;
          }

          // check if drive root is not null or empty
          // and if its an existing file
          if (String.IsNullOrEmpty(drive.Root) || (File.Exists(drive.Root)
== false))
          {
              WriteError(new ErrorRecord(
                  new ArgumentException("drive.Root"),
                  "NoRoot",
                  ErrorCategory.InvalidArgument,
                  drive)
              );

              return null;
          }

          // create a new drive and create an ODBC connection to the new
drive
          AccessDBPSDriveInfo accessDBPSDriveInfo = new
AccessDBPSDriveInfo(drive);

          OdbcConnectionStringBuilder builder = new
OdbcConnectionStringBuilder();

          builder.Driver = "Microsoft Access Driver (*.mdb)";
          builder.Add("DBQ", drive.Root);

          OdbcConnection conn = new
OdbcConnection(builder.ConnectionString);
```

```
            conn.Open();
            accessDBPSDriveInfo.Connection = conn;

            return accessDBPSDriveInfo;
        } // NewDrive
```

Your override of this method should do the following:

- Verify that the System.Management.Automation.PSDriveinfo.Root* member exists and that a connection to the data store can be made.
- Create a drive and populate the connection member, in support of the `New-PSDrive` cmdlet.
- Validate the System.Management.Automation.PSDriveinfo object for the proposed drive.
- Modify the System.Management.Automation.PSDriveinfo object that describes the drive with any required performance or reliability information, or provide extra data for callers using the drive.
- Handle failures using the System.Management.Automation.Provider.Cmdletprovider.WriteError method and then return `null`.

  This method returns either the drive information that was passed to the method or a provider-specific version of it.

Attaching Dynamic Parameters to NewDrive

The `New-PSDrive` cmdlet supported by your drive provider might require additional parameters. To attach these dynamic parameters to the cmdlet, the provider implements the System.Management.Automation.Provider.Drivecmdletprovider.Newdrivedynamicparameters* method. This method returns an object that has properties and fields with parsing attributes similar to a cmdlet class or a System.Management.Automation.Runtimedefinedparameterdictionary object.

This drive provider does not override this method. However, the following code shows the default implementation of this method:

Removing a Drive

To close the database connection, the drive provider must implement the System.Management.Automation.Provider.Drivecmdletprovider.Removedrive* method. This method closes the connection to the drive after cleaning up any provider-specific information.

The following code shows the implementation of the System.Management.Automation.Provider.Drivecmdletprovider.Removedrive* method for this drive provider:

C#

```
protected override PSDriveInfo RemoveDrive(PSDriveInfo drive)
{
    // check if drive object is null
    if (drive == null)
    {
        WriteError(new ErrorRecord(
            new ArgumentNullException("drive"),
            "NullDrive",
            ErrorCategory.InvalidArgument,
            drive)
        );

       return null;
    }

    // close ODBC connection to the drive
    AccessDBPSDriveInfo accessDBPSDriveInfo = drive as AccessDBPSDriveInfo;

    if (accessDBPSDriveInfo == null)
    {
        return null;
    }
    accessDBPSDriveInfo.Connection.Close();

    return accessDBPSDriveInfo;
} // RemoveDrive
```

If the drive can be removed, the method should return the information passed to the method through the `drive` parameter. If the drive cannot be removed, the method should write an exception and then return `null`. If your provider does not override this method, the default implementation of this method just returns the drive information passed as input.

Initializing Default Drives

Your drive provider implements the System.Management.Automation.Provider.Drivecmdletprovider.Initializedefaultdrives* method to mount drives. For example, the Active Directory provider might mount a drive for the default naming context if the computer is joined to a domain.

This method returns a collection of drive information about the initialized drives, or an empty collection. The call to this method is made after the Windows PowerShell runtime calls the System.Management.Automation.Provider.Cmdletprovider.Start* method to initialize the provider.

This drive provider does not override the System.Management.Automation.Provider.Drivecmdletprovider.Initializedefaultdrives* method. However, the following code shows the default implementation, which returns an empty drive collection:

Things to Remember About Implementing InitializeDefaultDrives

All drive providers should mount a root drive to help the user with discoverability. The root drive might list locations that serve as roots for other mounted drives. For example, the Active Directory provider might create a drive that lists the naming contexts found in the `namingContext` attributes on the root Distributed System Environment (DSE). This helps users discover mount points for other drives.

Code Sample

For complete sample code, see AccessDbProviderSample02 Code Sample.

Testing the Windows PowerShell Drive Provider

When your Windows PowerShell provider has been registered with Windows PowerShell, you can test it by running the supported cmdlets on the command line, including any cmdlets made available by derivation. Let's test the sample drive provider.

1. Run the `Get-PSProvider` cmdlet to retrieve the list of providers to ensure that the AccessDB drive provider is present:

   PS> **`Get-PSProvider`**

   The following output appears:

   ```
   Output
   ```

```
Name                 Capabilities                 Drives
----                 ------------                 ------
AccessDB             None                         {}
Alias                ShouldProcess                {Alias}
Environment          ShouldProcess                {Env}
FileSystem           Filter, ShouldProcess        {C, Z}
Function             ShouldProcess                {function}
Registry             ShouldProcess                {HKLM, HKCU}
```

2. Ensure that a database server name (DSN) exists for the database by accessing the **Data Sources** portion of the **Administrative Tools** for the operating system. In the **User DSN** table, double-click **MS Access Database** and add the drive path `C:\ps\northwind.mdb`.

3. Create a new drive using the sample drive provider:

```
PowerShell

new-psdrive -name mydb -root c:\ps\northwind.mdb -psprovider AccessDb`
```

   The following output appears:

```
Output

Name     Provider     Root                 CurrentLocation
----     --------     ----                 ---------------
mydb     AccessDB     c:\ps\northwind.mdb
```

4. Validate the connection. Because the connection is defined as a member of the drive, you can check it using the Get-PDDrive cmdlet.

   > **Note**
   >
   > The user cannot yet interact with the provider as a drive, as the provider needs container functionality for that interaction. For more information, see **Creating a Windows PowerShell Container Provider**.

   PS> (get-psdrive mydb).connection

   The following output appears:

```
Output
```

```
ConnectionString  : Driver={Microsoft Access Driver
(*.mdb)};DBQ=c:\ps\northwind.mdb
ConnectionTimeout : 15
Database          : c:\ps\northwind
DataSource        : ACCESS
ServerVersion     : 04.00.0000
Driver            : odbcjt32.dll
State             : Open
Site              :
Container         :
```

5. Remove the drive and exit the shell:

PowerShell

```
PS> remove-psdrive mydb
PS> exit
```

See Also

Creating Windows PowerShell Providers

Design Your Windows PowerShell Provider

Creating a Basic Windows PowerShell Provider

Creating a Windows PowerShell item provider

Article • 05/12/2022

This topic describes how to create a Windows PowerShell provider that can manipulate the data in a data store. In this topic, the elements of data in the store are referred to as the "items" of the data store. As a consequence, a provider that can manipulate the data in the store is referred to as a Windows PowerShell item provider.

> **Note**
>
> You can download the C# source file (`AccessDBSampleProvider03.cs`) for this provider using the Microsoft Windows Software Development Kit for Windows Vista and .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded source files are available in the `PowerShell Samples` directory. For more information about other Windows PowerShell provider implementations, see **Designing Your Windows PowerShell Provider**.

The Windows PowerShell item provider described in this topic gets items of data from an Access database. In this case, an "item" is either a table in the Access database or a row in a table.

Defining the Windows PowerShell item provider class

A Windows PowerShell item provider must define a .NET class that derives from the System.Management.Automation.Provider.ItemCmdletProvider base class. The following is the class definition for the item provider described in this section.

C#

```
[CmdletProvider("AccessDB", ProviderCapabilities.None)]

public class AccessDBProvider : ItemCmdletProvider
```

Note that in this class definition, the System.Management.Automation.Provider.CmdletProviderAttribute attribute includes two parameters. The first parameter specifies a user-friendly name for the provider that

is used by Windows PowerShell. The second parameter specifies the Windows PowerShell specific capabilities that the provider exposes to the Windows PowerShell runtime during command processing. For this provider, there are no added Windows PowerShell specific capabilities.

Defining base functionality

As described in Design Your Windows PowerShell Provider, the System.Management.Automation.Provider.DriveCmdletProvider class derives from several other classes that provided different provider functionality. A Windows PowerShell item provider, therefore, must define all of the functionality provided by those classes.

For more information about how to implement functionality for adding session-specific initialization information and for releasing resources used by the provider, see Creating a Basic Windows PowerShell Provider. However, most providers, including the provider described here, can use the default implementation of this functionality that is provided by Windows PowerShell.

Before the Windows PowerShell item provider can manipulate the items in the store, it must implement the methods of the System.Management.Automation.Provider.DriveCmdletProvider base class to access to the data store. For more information about implementing this class, see Creating a Windows PowerShell Drive Provider.

Checking for path validity

When looking for an item of data, the Windows PowerShell runtime furnishes a Windows PowerShell path to the provider, as defined in the "PSPath Concepts" section of How Windows PowerShell Works. A Windows PowerShell item provider must verify the syntactic and semantic validity of any path passed to it by implementing the System.Management.Automation.Provider.ItemCmdletProvider.IsValidPath method. This method returns `true` if the path is valid, and `false` otherwise. Be aware that the implementation of this method should not verify the existence of the item at the path, but only that the path is syntactically and semantically correct.

Here is the implementation of the System.Management.Automation.Provider.ItemCmdletProvider.IsValidPath method for this provider. Note that this implementation calls a **NormalizePath** helper method to convert all separators in the path to a uniform one.

C#

```
protected override bool IsValidPath(string path)
{
    bool result = true;

    // check if the path is null or empty
    if (String.IsNullOrEmpty(path))
    {
        result = false;
    }

    // convert all separators in the path to a uniform one
    path = NormalizePath(path);

    // split the path into individual chunks
    string[] pathChunks = path.Split(pathSeparator.ToCharArray());

    foreach (string pathChunk in pathChunks)
    {
        if (pathChunk.Length == 0)
        {
            result = false;
        }
    }
    return result;
} // IsValidPath
```

Determining if an item exists

After verifying the path, the Windows PowerShell runtime must determine if an item of data exists at that path. To support this type of query, the Windows PowerShell item provider implements the System.Management.Automation.Provider.ItemCmdletProvider.ItemExists method. This method returns `true` an item is found at the specified path and `false` (default) otherwise.

Here is the implementation of the System.Management.Automation.Provider.ItemCmdletProvider.ItemExists method for this provider. Note that this method calls the **PathIsDrive**, **ChunkPath**, and **GetTable** helper methods, and uses a provider defined **DatabaseTableInfo** object.

C#

```
protected override bool ItemExists(string path)
{
    // check if the path represented is a drive
    if (PathIsDrive(path))
```

```
    {
        return true;
    }

    // Obtain type, table name and row number from path
    string tableName;
    int rowNumber;

    PathType type = GetNamesFromPath(path, out tableName, out rowNumber);

    DatabaseTableInfo table = GetTable(tableName);

    if (type == PathType.Table)
    {
        // if specified path represents a table then DatabaseTableInfo
        // object for the same should exist
        if (table != null)
        {
            return true;
        }
    }
    else if (type == PathType.Row)
    {
        // if specified path represents a row then DatabaseTableInfo should
        // exist for the table and then specified row number must be within
        // the maximum row count in the table
        if (table != null && rowNumber < table.RowCount)
        {
            return true;
        }
    }

    return false;

} // ItemExists
```

Things to remember about implementing ItemExists

The following conditions may apply to your implementation of System.Management.Automation.Provider.ItemCmdletProvider.ItemExists:

- When defining the provider class, a Windows PowerShell item provider might declare provider capabilities of `ExpandWildcards`, `Filter`, `Include`, or `Exclude`, from the System.Management.Automation.Provider.ProviderCapabilities enumeration. In these cases, the implementation of the System.Management.Automation.Provider.ItemCmdletProvider.ItemExists method must ensure that the path passed to the method meets the requirements of the specified capabilities. To do this, the method should access the appropriate property, for example, the

System.Management.Automation.Provider.CmdletProvider.Exclude and System.Management.Automation.Provider.CmdletProvider.Include properties.

- The implementation of this method should handle any form of access to the item that might make the item visible to the user. For example, if a user has write access to a file through the FileSystem provider (supplied by Windows PowerShell), but not read access, the file still exists and System.Management.Automation.Provider.ItemCmdletProvider.ItemExists returns `true`. Your implementation might require checking a parent item to see if the child item can be enumerated.

Attaching dynamic parameters to the Test-Path cmdlet

Sometimes the `Test-Path` cmdlet that calls System.Management.Automation.Provider.ItemCmdletProvider.ItemExists requires additional parameters that are specified dynamically at runtime. To provide these dynamic parameters the Windows PowerShell item provider must implement the System.Management.Automation.Provider.ItemCmdletProvider.ItemExistsDynamicParameters method. This method retrieves the dynamic parameters for the item at the indicated path and returns an object that has properties and fields with parsing attributes similar to a cmdlet class or a System.Management.Automation.RuntimeDefinedParameterDictionary object. The Windows PowerShell runtime uses the returned object to add the parameters to the `Test-Path` cmdlet.

This Windows PowerShell item provider does not implement this method. However, the following code is the default implementation of this method.

Retrieving an item

To retrieve an item, the Windows PowerShell item provider must override System.Management.Automation.Provider.ItemCmdletProvider.GetItem method to support calls from the `Get-Item` cmdlet. This method writes the item using the System.Management.Automation.Provider.CmdletProvider.WriteItemObject method.

Here is the implementation of the System.Management.Automation.Provider.ItemCmdletProvider.GetItem method for this provider. Note that this method uses the **GetTable** and **GetRow** helper methods to retrieve items that are either tables in the Access database or rows in a data table.

C#

```
protected override void GetItem(string path)
{
    // check if the path represented is a drive
    if (PathIsDrive(path))
    {
        WriteItemObject(this.PSDriveInfo, path, true);
        return;
    }// if (PathIsDrive...

     // Get table name and row information from the path and do
     // necessary actions
     string tableName;
     int rowNumber;

     PathType type = GetNamesFromPath(path, out tableName, out rowNumber);

     if (type == PathType.Table)
     {
         DatabaseTableInfo table = GetTable(tableName);
         WriteItemObject(table, path, true);
     }
     else if (type == PathType.Row)
     {
         DatabaseRowInfo row = GetRow(tableName, rowNumber);
         WriteItemObject(row, path, false);
     }
     else
     {
         ThrowTerminatingInvalidPathException(path);
     }

 } // GetItem
```

Things to remember about implementing GetItem

The following conditions may apply to an implementation of System.Management.Automation.Provider.ItemCmdletProvider.GetItem:

- When defining the provider class, a Windows PowerShell item provider might declare provider capabilities of `ExpandWildcards`, `Filter`, `Include`, or `Exclude`, from the System.Management.Automation.Provider.ProviderCapabilities enumeration. In these cases, the implementation of System.Management.Automation.Provider.ItemCmdletProvider.GetItem must ensure that the path passed to the method meets those requirements. To do this, the method should access the appropriate property, for example, the

System.Management.Automation.Provider.CmdletProvider.Exclude and System.Management.Automation.Provider.CmdletProvider.Include properties.

- By default, overrides of this method should not retrieve objects that are generally hidden from the user unless the System.Management.Automation.Provider.CmdletProvider.Force property is set to `true`. For example, the System.Management.Automation.Provider.ItemCmdletProvider.GetItem method for the FileSystem provider checks the System.Management.Automation.Provider.CmdletProvider.Force property before it attempts to call System.Management.Automation.Provider.CmdletProvider.WriteItemObject for hidden or system files.

Attaching dynamic parameters to the Get-Item cmdlet

Sometimes the `Get-Item` cmdlet requires additional parameters that are specified dynamically at runtime. To provide these dynamic parameters the Windows PowerShell item provider must implement the System.Management.Automation.Provider.ItemCmdletProvider.GetItemDynamicParameters method. This method retrieves the dynamic parameters for the item at the indicated path and returns an object that has properties and fields with parsing attributes similar to a cmdlet class or a System.Management.Automation.RuntimeDefinedParameterDictionary object. The Windows PowerShell runtime uses the returned object to add the parameters to the `Get-Item` cmdlet.

This provider does not implement this method. However, the following code is the default implementation of this method.

Setting an item

To set an item, the Windows PowerShell item provider must override the System.Management.Automation.Provider.ItemCmdletProvider.SetItem method to support calls from the `Set-Item` cmdlet. This method sets the value of the item at the specified path.

This provider does not provide an override for the System.Management.Automation.Provider.ItemCmdletProvider.SetItem method.

However, the following is the default implementation of this method.

Things to remember about implementing SetItem

The following conditions may apply to your implementation of System.Management.Automation.Provider.ItemCmdletProvider.SetItem:

- When defining the provider class, a Windows PowerShell item provider might declare provider capabilities of `ExpandWildcards`, `Filter`, `Include`, or `Exclude`, from the System.Management.Automation.Provider.ProviderCapabilities enumeration. In these cases, the implementation of System.Management.Automation.Provider.ItemCmdletProvider.SetItem must ensure that the path passed to the method meets those requirements. To do this, the method should access the appropriate property, for example, the System.Management.Automation.Provider.CmdletProvider.Exclude and System.Management.Automation.Provider.CmdletProvider.Include properties.

- By default, overrides of this method should not set or write objects that are hidden from the user unless the System.Management.Automation.Provider.CmdletProvider.Force property is set to `true`. An error should be sent to the System.Management.Automation.Provider.CmdletProvider.WriteError method if the path represents a hidden item and System.Management.Automation.Provider.CmdletProvider.Force is set to `false`.

- Your implementation of the System.Management.Automation.Provider.ItemCmdletProvider.SetItem method should call System.Management.Automation.Provider.CmdletProvider.ShouldProcess and verify its return value before making any changes to the data store. This method is used to confirm execution of an operation when a change is made to the data store, for example, deleting files. The System.Management.Automation.Provider.CmdletProvider.ShouldProcess method sends the name of the resource to be changed to the user, with the Windows PowerShell runtime taking into account any command-line settings or preference variables in determining what should be displayed.

  After the call to System.Management.Automation.Provider.CmdletProvider.ShouldProcess returns `true`, the System.Management.Automation.Provider.ItemCmdletProvider.SetItem method should call the System.Management.Automation.Provider.CmdletProvider.ShouldContinue

method. This method sends a message to the user to allow feedback to verify if the operation should be continued. The call to System.Management.Automation.Provider.CmdletProvider.ShouldContinue allows an additional check for potentially dangerous system modifications.

Retrieving dynamic parameters for SetItem

Sometimes the `Set-Item` cmdlet requires additional parameters that are specified dynamically at runtime. To provide these dynamic parameters the Windows PowerShell item provider must implement the System.Management.Automation.Provider.ItemCmdletProvider.SetItemDynamicParameters method. This method retrieves the dynamic parameters for the item at the indicated path and returns an object that has properties and fields with parsing attributes similar to a cmdlet class or a System.Management.Automation.RuntimeDefinedParameterDictionary object. The Windows PowerShell runtime uses the returned object to add the parameters to the `Set-Item` cmdlet.

This provider does not implement this method. However, the following code is the default implementation of this method.

Clearing an item

To clear an item, the Windows PowerShell item provider implements the System.Management.Automation.Provider.ItemCmdletProvider.ClearItem method to support calls from the `Clear-Item` cmdlet. This method erases the data item at the specified path.

This provider does not implement this method. However, the following code is the default implementation of this method.

Things to remember about implementing ClearItem

The following conditions may apply to an implementation of System.Management.Automation.Provider.ItemCmdletProvider.ClearItem:

- When defining the provider class, a Windows PowerShell item provider might declare provider capabilities of `ExpandWildcards`, `Filter`, `Include`, or `Exclude`, from the System.Management.Automation.Provider.ProviderCapabilities enumeration. In these cases, the implementation of System.Management.Automation.Provider.ItemCmdletProvider.ClearItem must

ensure that the path passed to the method meets those requirements. To do this, the method should access the appropriate property, for example, the System.Management.Automation.Provider.CmdletProvider.Exclude and System.Management.Automation.Provider.CmdletProvider.Include properties.

- By default, overrides of this method should not set or write objects that are hidden from the user unless the System.Management.Automation.Provider.CmdletProvider.Force property is set to `true`. An error should be sent to the System.Management.Automation.Provider.CmdletProvider.WriteError method if the path represents an item that is hidden from the user and System.Management.Automation.Provider.CmdletProvider.Force is set to `false`.

- Your implementation of the System.Management.Automation.Provider.ItemCmdletProvider.SetItem method should call System.Management.Automation.Provider.CmdletProvider.ShouldProcess and verify its return value before making any changes to the data store. This method is used to confirm execution of an operation when a change is made to the data store, for example, deleting files. The System.Management.Automation.Provider.CmdletProvider.ShouldProcess method sends the name of the resource to be changed to the user, with the Windows PowerShell runtime and handle any command-line settings or preference variables in determining what should be displayed.

  After the call to System.Management.Automation.Provider.CmdletProvider.ShouldProcess returns `true`, the System.Management.Automation.Provider.ItemCmdletProvider.SetItem method should call the System.Management.Automation.Provider.CmdletProvider.ShouldContinue method. This method sends a message to the user to allow feedback to verify if the operation should be continued. The call to System.Management.Automation.Provider.CmdletProvider.ShouldContinue allows an additional check for potentially dangerous system modifications.

Retrieve dynamic parameters for ClearItem

Sometimes the `Clear-Item` cmdlet requires additional parameters that are specified dynamically at runtime. To provide these dynamic parameters the Windows PowerShell item provider must implement the System.Management.Automation.Provider.ItemCmdletProvider.ClearItemDynamicParam

eters method. This method retrieves the dynamic parameters for the item at the indicated path and returns an object that has properties and fields with parsing attributes similar to a cmdlet class or a System.Management.Automation.RuntimeDefinedParameterDictionary object. The Windows PowerShell runtime uses the returned object to add the parameters to the `Clear-Item` cmdlet.

This item provider does not implement this method. However, the following code is the default implementation of this method.

Performing a default action for an item

A Windows PowerShell item provider can implement the System.Management.Automation.Provider.ItemCmdletProvider.InvokeDefaultAction method to support calls from the `Invoke-Item` cmdlet, which allows the provider to perform a default action for the item at the specified path. For example, the FileSystem provider might use this method to call **ShellExecute** for a specific item.

This provider does not implement this method. However, the following code is the default implementation of this method.

Things to remember about implementing InvokeDefaultAction

The following conditions may apply to an implementation of System.Management.Automation.Provider.ItemCmdletProvider.InvokeDefaultAction:

- When defining the provider class, a Windows PowerShell item provider might declare provider capabilities of `ExpandWildcards`, `Filter`, `Include`, or `Exclude`, from the System.Management.Automation.Provider.ProviderCapabilities enumeration. In these cases, the implementation of System.Management.Automation.Provider.ItemCmdletProvider.InvokeDefaultAction must ensure that the path passed to the method meets those requirements. To do this, the method should access the appropriate property, for example, the System.Management.Automation.Provider.CmdletProvider.Exclude and System.Management.Automation.Provider.CmdletProvider.Include properties.

- By default, overrides of this method should not set or write objects hidden from the user unless the System.Management.Automation.Provider.CmdletProvider.Force property is set to `true`. An error should be sent to the System.Management.Automation.Provider.CmdletProvider.WriteError method if

the path represents an item that is hidden from the user and System.Management.Automation.Provider.CmdletProvider.Force is set to `false`.

Retrieve dynamic parameters for InvokeDefaultAction

Sometimes the `Invoke-Item` cmdlet requires additional parameters that are specified dynamically at runtime. To provide these dynamic parameters the Windows PowerShell item provider must implement the System.Management.Automation.Provider.ItemCmdletProvider.InvokeDefaultActionDynamicParameters method. This method retrieves the dynamic parameters for the item at the indicated path and returns an object that has properties and fields with parsing attributes similar to a cmdlet class or a System.Management.Automation.RuntimeDefinedParameterDictionary object. The Windows PowerShell runtime uses the returned object to add the dynamic parameters to the `Invoke-Item` cmdlet.

This item provider does not implement this method. However, the following code is the default implementation of this method.

Implementing helper methods and classes

This item provider implements several helper methods and classes that are used by the public override methods defined by Windows PowerShell. The code for these helper methods and classes are shown in the Code Sample section.

NormalizePath method

This item provider implements a **NormalizePath** helper method to ensure that the path has a consistent format. The format specified uses a backslash (`\`) as a separator.

PathIsDrive method

This item provider implements a **PathIsDrive** helper method to determine if the specified path is actually the drive name.

ChunkPath method

This item provider implements a **ChunkPath** helper method that breaks up the specified path so that the provider can identify its individual elements. It returns an array composed of the path elements.

GetTable method

This item provider implements the **GetTables** helper method that returns a **DatabaseTableInfo** object that represents information about the table specified in the call.

GetRow method

The System.Management.Automation.Provider.ItemCmdletProvider.GetItem method of this item provider calls the **GetRows** helper method. This helper method retrieves a **DatabaseRowInfo** object that represents information about the specified row in the table.

DatabaseTableInfo class

This item provider defines a **DatabaseTableInfo** class that represents a collection of information in a data table in the database. This class is similar to the System.IO.Directoryinfo class.

The sample item provider defines a **DatabaseTableInfo.GetTables** method that returns a collection of table information objects defining the tables in the database. This method includes a try/catch block to ensure that any database error shows up as a row with zero entries.

DatabaseRowInfo class

This item provider defines the **DatabaseRowInfo** helper class that represents a row in a table of the database. This class is similar to the System.IO.FileInfo class.

The sample provider defines a **DatabaseRowInfo.GetRows** method to return a collection of row information objects for the specified table. This method includes a try/catch block to trap exceptions. Any errors will result in no row information.

Code sample

For complete sample code, see AccessDbProviderSample03 Code Sample.

Defining object types and formatting

When writing a provider, it may be necessary to add members to existing objects or define new objects. When finished, create a Types file that Windows PowerShell can use to identify the members of the object and a Format file that defines how the object is displayed. For more information, see Extending Object Types and Formatting.

Building the Windows PowerShell provider

See How to Register Cmdlets, Providers, and Host Applications.

Testing the Windows PowerShell provider

When this Windows PowerShell item provider is registered with Windows PowerShell, you can only test the basic and drive functionality of the provider. To test the manipulation of items, you must also implement container functionality described in Implementing a Container Windows PowerShell Provider.

See also

- Windows PowerShell SDK
- Windows PowerShell Programmer's Guide
- Creating Windows PowerShell Providers
- Designing Your Windows PowerShell provider
- Extending Object Types and Formatting
- How Windows PowerShell Works
- Creating a Container Windows PowerShell provider
- Creating a Drive Windows PowerShell provider
- How to Register Cmdlets, Providers, and Host Applications

Creating a Windows PowerShell Container Provider

Article • 11/08/2021

This topic describes how to create a Windows PowerShell provider that can work on multi-layer data stores. For this type of data store, the top level of the store contains the root items and each subsequent level is referred to as a node of child items. By allowing the user to work on these child nodes, a user can interact hierarchically through the data store.

Providers that can work on multi-level data stores are referred to as Windows PowerShell container providers. However, be aware that a Windows PowerShell container provider can be used only when there is one container (no nested containers) with items in it. If there are nested containers, then you must implement a Windows PowerShell navigation provider. For more information about implementing Windows PowerShell navigation provider, see Creating a Windows PowerShell Navigation Provider.

> ⓘ **Note**
>
> You can download the C# source file (AccessDBSampleProvider04.cs) for this provider using the Microsoft Windows Software Development Kit for Windows Vista and .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded source files are available in the **<PowerShell Samples>** directory. For more information about other Windows PowerShell provider implementations, see **Designing Your Windows PowerShell Provider**.

The Windows PowerShell container provider described here defines the database as its single container, with the tables and rows of the database defined as items of the container.

> ⊗ **Caution**
>
> Be aware that this design assumes a database that has a field with the name ID, and that the type of the field is LongInteger.

Defining a Windows PowerShell Container Provider Class

A Windows PowerShell container provider must define a .NET class that derives from the System.Management.Automation.Provider.Containercmdletprovider base class. Here is the class definition for the Windows PowerShell container provider described in this section.

C#

```
[CmdletProvider("AccessDB", ProviderCapabilities.None)]
public class AccessDBProvider : ContainerCmdletProvider
```

Notice that in this class definition, the System.Management.Automation.Provider.Cmdletproviderattribute attribute includes two parameters. The first parameter specifies a user-friendly name for the provider that is used by Windows PowerShell. The second parameter specifies the Windows PowerShell specific capabilities that the provider exposes to the Windows PowerShell runtime during command processing. For this provider, there are no Windows PowerShell specific capabilities that are added.

Defining Base Functionality

As described in Designing Your Windows PowerShell Provider, the System.Management.Automation.Provider.Containercmdletprovider class derives from several other classes that provided different provider functionality. A Windows PowerShell container provider, therefore, needs to define all of the functionality provided by those classes.

To implement functionality for adding session-specific initialization information and for releasing resources that are used by the provider, see Creating a Basic Windows PowerShell Provider. However, most providers (including the provider described here) can use the default implementation of this functionality that is provided by Windows PowerShell.

To get access to the data store, the provider must implement the methods of the System.Management.Automation.Provider.Drivecmdletprovider base class. For more information about implementing these methods, see Creating an Windows PowerShell Drive Provider.

To manipulate the items of a data store, such as getting, setting, and clearing items, the provider must implement the methods provided by the System.Management.Automation.Provider.Itemcmdletprovider base class. For more information about implementing these methods, see Creating an Windows PowerShell Item Provider.

Retrieving Child Items

To retrieve a child item, the Windows PowerShell container provider must override the System.Management.Automation.Provider.Containercmdletprovider.Getchilditems* method to support calls from the `Get-ChildItem` cmdlet. This method retrieves child items from the data store and writes them to the pipeline as objects. If the `recurse` parameter of the cmdlet is specified, the method retrieves all children regardless of what level they are at. If the `recurse` parameter is not specified, the method retrieves only a single level of children.

Here is the implementation of the System.Management.Automation.Provider.Containercmdletprovider.Getchilditems* method for this provider. Notice that this method retrieves the child items in all database tables when the path indicates the Access database, and retrieves the child items from the rows of that table if the path indicates a data table.

C#

```
protected override void GetChildItems(string path, bool recurse)
{
    // If path represented is a drive then the children in the path are
    // tables. Hence all tables in the drive represented will have to be
    // returned
    if (PathIsDrive(path))
    {
        foreach (DatabaseTableInfo table in GetTables())
        {
            WriteItemObject(table, path, true);

            // if the specified item exists and recurse has been set then
            // all child items within it have to be obtained as well
            if (ItemExists(path) && recurse)
            {
                GetChildItems(path + pathSeparator + table.Name, recurse);
            }
        } // foreach (DatabaseTableInfo...
    } // if (PathIsDrive...
    else
    {
        // Get the table name, row number and type of path from the
        // path specified
```

```
        string tableName;
        int rowNumber;

        PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

        if (type == PathType.Table)
        {
            // Obtain all the rows within the table
            foreach (DatabaseRowInfo row in GetRows(tableName))
            {
                WriteItemObject(row, path + pathSeparator + row.RowNumber,
                        false);
            } // foreach (DatabaseRowInfo...
        }
        else if (type == PathType.Row)
        {
            // In this case the user has directly specified a row, hence
            // just give that particular row
            DatabaseRowInfo row = GetRow(tableName, rowNumber);
            WriteItemObject(row, path + pathSeparator + row.RowNumber,
                        false);
        }
        else
        {
            // In this case, the path specified is not valid
            ThrowTerminatingInvalidPathException(path);
        }
    } // else
} // GetChildItems
```

Things to Remember About Implementing GetChildItems

The following conditions may apply to your implementation of System.Management.Automation.Provider.Containercmdletprovider.Getchilditems*:

- When defining the provider class, a Windows PowerShell container provider might declare provider capabilities of ExpandWildcards, Filter, Include, or Exclude, from the System.Management.Automation.Provider.Providercapabilities enumeration. In these cases, the implementation of the System.Management.Automation.Provider.Containercmdletprovider.Getchilditems* method needs to ensure that the path passed to the method meets the requirements of the specified capabilities. To do this, the method should access the appropriate property, for example, the System.Management.Automation.Provider.Cmdletprovider.Exclude* and System.Management.Automation.Provider.Cmdletprovider.Include* properties.

- The implementation of this method should take into account any form of access to the item that might make the item visible to the user. For example, if a user has write access to a file through the FileSystem provider (supplied by Windows PowerShell), but not read access, the file still exists and System.Management.Automation.Provider.Itemcmdletprovider.Itemexists* returns `true`. Your implementation might require the checking of a parent item to see if the child can be enumerated.

- When writing multiple items, the System.Management.Automation.Provider.Containercmdletprovider.Getchilditems* method can take some time. You can design your provider to write the items using the System.Management.Automation.Provider.Cmdletprovider.Writeitemobject* method one at a time. Using this technique will present the items to the user in a stream.

- Your implementation of System.Management.Automation.Provider.Containercmdletprovider.Getchilditems* is responsible for preventing infinite recursion when there are circular links, and the like. An appropriate terminating exception should be thrown to reflect such a condition.

Attaching Dynamic Parameters to the Get-ChildItem Cmdlet

Sometimes the `Get-ChildItem` cmdlet that calls System.Management.Automation.Provider.Containercmdletprovider.Getchilditems* requires additional parameters that are specified dynamically at runtime. To provide these dynamic parameters, the Windows PowerShell container provider must implement the System.Management.Automation.Provider.Containercmdletprovider.Getchilditemsdynamicparameters* method. This method retrieves dynamic parameters for the item at the indicated path and returns an object that has properties and fields with parsing attributes similar to a cmdlet class or a System.Management.Automation.Runtimedefinedparameterdictionary object. The Windows PowerShell runtime uses the returned object to add the parameters to the `Get-ChildItem` cmdlet.

This Windows PowerShell container provider does not implement this method. However, the following code is the default implementation of this method.

Retrieving Child Item Names

To retrieve the names of child items, the Windows PowerShell container provider must override the System.Management.Automation.Provider.Containercmdletprovider.Getchildnames* method to support calls from the `Get-ChildItem` cmdlet when its `Name` parameter is specified. This method retrieves the names of the child items for the specified path or child item names for all containers if the `returnAllContainers` parameter of the cmdlet is specified. A child name is the leaf portion of a path. For example, the child name for the path c:\windows\system32\abc.dll is "abc.dll". The child name for the directory c:\windows\system32 is "system32".

Here is the implementation of the System.Management.Automation.Provider.Containercmdletprovider.Getchildnames* method for this provider. Notice that the method retrieves table names if the specified path indicates the Access database (drive) and row numbers if the path indicates a table.

C#

```
protected override void GetChildNames(string path,
                                      ReturnContainers returnContainers)
{
    // If the path represented is a drive, then the child items are
    // tables. get the names of all the tables in the drive.
    if (PathIsDrive(path))
    {
        foreach (DatabaseTableInfo table in GetTables())
        {
            WriteItemObject(table.Name, path, true);
        } // foreach (DatabaseTableInfo...
    } // if (PathIsDrive...
    else
    {
        // Get type, table name and row number from path specified
        string tableName;
        int rowNumber;

        PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

        if (type == PathType.Table)
        {
            // Get all the rows in the table and then write out the
            // row numbers.
            foreach (DatabaseRowInfo row in GetRows(tableName))
            {
                WriteItemObject(row.RowNumber, path, false);
            } // foreach (DatabaseRowInfo...
        }
```

```
        else if (type == PathType.Row)
        {
            // In this case the user has directly specified a row, hence
            // just give that particular row
            DatabaseRowInfo row = GetRow(tableName, rowNumber);

            WriteItemObject(row.RowNumber, path, false);
        }
        else
        {
            ThrowTerminatingInvalidPathException(path);
        }
    } // else
} // GetChildNames
```

Things to Remember About Implementing GetChildNames

The following conditions may apply to your implementation of System.Management.Automation.Provider.Containercmdletprovider.Getchilditems*:

- When defining the provider class, a Windows PowerShell container provider might declare provider capabilities of ExpandWildcards, Filter, Include, or Exclude, from the System.Management.Automation.Provider.Providercapabilities enumeration. In these cases, the implementation of the System.Management.Automation.Provider.Containercmdletprovider.Getchilditems* method needs to ensure that the path passed to the method meets the requirements of the specified capabilities. To do this, the method should access the appropriate property, for example, the System.Management.Automation.Provider.Cmdletprovider.Exclude* and System.Management.Automation.Provider.Cmdletprovider.Include* properties.

  > ⓘ **Note**
  >
  > An exception to this rule occurs when the `returnAllContainers` parameter of the cmdlet is specified. In this case, the method should retrieve any child name for a container, even if it does not match the values of the **System.Management.Automation.Provider.Cmdletprovider.Filter***, **System.Management.Automation.Provider.Cmdletprovider.Include***, or **System.Management.Automation.Provider.Cmdletprovider.Exclude*** properties.

- By default, overrides of this method should not retrieve names of objects that are generally hidden from the user unless the

System.Management.Automation.Provider.Cmdletprovider.Force* property is specified. If the specified path indicates a container, the System.Management.Automation.Provider.Cmdletprovider.Force* property is not required.

- Your implementation of System.Management.Automation.Provider.Containercmdletprovider.Getchildnames* is responsible for preventing infinite recursion when there are circular links, and the like. An appropriate terminating exception should be thrown to reflect such a condition.

Attaching Dynamic Parameters to the Get-ChildItem Cmdlet (Name)

Sometimes the `Get-ChildItem` cmdlet (with the `Name` parameter) requires additional parameters that are specified dynamically at runtime. To provide these dynamic parameters, the Windows PowerShell container provider must implement the System.Management.Automation.Provider.Containercmdletprovider.Getchildnamesdynamicparameters* method. This method retrieves the dynamic parameters for the item at the indicated path and returns an object that has properties and fields with parsing attributes similar to a cmdlet class or a System.Management.Automation.Runtimedefinedparameterdictionary object. The Windows PowerShell runtime uses the returned object to add the parameters to the `Get-ChildItem` cmdlet.

This provider does not implement this method. However, the following code is the default implementation of this method.

Renaming Items

To rename an item, a Windows PowerShell container provider must override the System.Management.Automation.Provider.Containercmdletprovider.Renameitem* method to support calls from the `Rename-Item` cmdlet. This method changes the name of the item at the specified path to the new name provided. The new name must always be relative to the parent item (container).

This provider does not override the System.Management.Automation.Provider.Containercmdletprovider.Renameitem* method. However, the following is the default implementation.

Things to Remember About Implementing RenameItem

The following conditions may apply to your implementation of System.Management.Automation.Provider.Containercmdletprovider.Renameitem*:

- When defining the provider class, a Windows PowerShell container provider might declare provider capabilities of ExpandWildcards, Filter, Include, or Exclude, from the System.Management.Automation.Provider.Providercapabilities enumeration. In these cases, the implementation of the System.Management.Automation.Provider.Containercmdletprovider.Getchilditems* method needs to ensure that the path passed to the method meets the requirements of the specified capabilities. To do this, the method should access the appropriate property, for example, the System.Management.Automation.Provider.Cmdletprovider.Exclude* and System.Management.Automation.Provider.Cmdletprovider.Include* properties.

- The System.Management.Automation.Provider.Containercmdletprovider.Renameitem* method is intended for the modification of the name of an item only, and not for move operations. Your implementation of the method should write an error if the `newName` parameter contains path separators, or might otherwise cause the item to change its parent location.

- By default, overrides of this method should not rename objects unless the System.Management.Automation.Provider.Cmdletprovider.Force* property is specified. If the specified path indicates a container, the System.Management.Automation.Provider.Cmdletprovider.Force* property is not required.

- Your implementation of the System.Management.Automation.Provider.Containercmdletprovider.Renameitem* method should call System.Management.Automation.Provider.Cmdletprovider.ShouldProcess and check its return value before making any changes to the data store. This method is used to confirm execution of an operation when a change is made to system state, for example, renaming files. System.Management.Automation.Provider.Cmdletprovider.ShouldProcess sends the name of the resource to be changed to the user, with the Windows PowerShell runtime taking into account any command line settings or preference variables in determining what should be displayed.

  After the call to System.Management.Automation.Provider.Cmdletprovider.ShouldProcess returns

`true`, the System.Management.Automation.Provider.Containercmdletprovider.Renameitem* method should call the System.Management.Automation.Provider.Cmdletprovider.ShouldContinue method. This method sends a message a confirmation message to the user to allow additional feedback to say if the operation should be continued. A provider should call System.Management.Automation.Provider.Cmdletprovider.ShouldContinue as an additional check for potentially dangerous system modifications.

Attaching Dynamic Parameters to the Rename-Item Cmdlet

Sometimes the `Rename-Item` cmdlet requires additional parameters that are specified dynamically at runtime. To provide these dynamic parameters, Windows PowerShell container provider must implement the System.Management.Automation.Provider.Containercmdletprovider.Renameitemdynamicparameters* method. This method retrieves the parameters for the item at the indicated path and returns an object that has properties and fields with parsing attributes similar to a cmdlet class or a System.Management.Automation.Runtimedefinedparameterdictionary object. The Windows PowerShell runtime uses the returned object to add the parameters to the `Rename-Item` cmdlet.

This container provider does not implement this method. However, the following code is the default implementation of this method.

Creating New Items

To create new items, a container provider must implement the System.Management.Automation.Provider.Containercmdletprovider.Newitem* method to support calls from the `New-Item` cmdlet. This method creates a data item located at the specified path. The `type` parameter of the cmdlet contains the provider-defined type for the new item. For example, the FileSystem provider uses a `type` parameter with a value of "file" or "directory". The `newItemValue` parameter of the cmdlet specifies a provider-specific value for the new item.

Here is the implementation of the System.Management.Automation.Provider.Containercmdletprovider.Newitem* method for this provider.

C#

```
protected override void NewItem( string path, string type, object
newItemValue )
{
    // Create the new item here after
    // performing necessary validations
    //
    // WriteItemObject(newItemValue, path, false);

    // Example
    //
    // if (ShouldProcess(path, "new item"))
    // {
    //      // Create a new item and then call WriteObject
    //      WriteObject(newItemValue, path, false);
    // }

} // NewItem
```

C#

```
{
    case 1:
        {
            string name = pathChunks[0];

            if (TableNameIsValid(name))
            {
                tableName = name;
                retVal = PathType.Table;
            }
        }
        break;

    case 2:
        {
            string name = pathChunks[0];
```

Things to Remember About Implementing NewItem

The following conditions may apply to your implementation of System.Management.Automation.Provider.Containercmdletprovider.Newitem*:

- The System.Management.Automation.Provider.Containercmdletprovider.Newitem* method should perform a case-insensitive comparison of the string passed in the `type` parameter. It should also allow for least ambiguous matches. For example, for the types "file" and "directory", only the first letter is required to disambiguate. If

the `type` parameter indicates a type your provider cannot create, the System.Management.Automation.Provider.Containercmdletprovider.Newitem* method should write an ArgumentException with a message indicating the types the provider can create.

- For the `newItemValue` parameter, the implementation of the System.Management.Automation.Provider.Containercmdletprovider.Newitem* method is recommended to accept strings at a minimum. It should also accept the type of object that is retrieved by the System.Management.Automation.Provider.Itemcmdletprovider.Getitem* method for the same path. The System.Management.Automation.Provider.Containercmdletprovider.Newitem* method can use the System.Management.Automation.Languageprimitives.Convertto* method to convert types to the desired type.

- Your implementation of the System.Management.Automation.Provider.Containercmdletprovider.Newitem* method should call System.Management.Automation.Provider.Cmdletprovider.ShouldProcess and check its return value before making any changes to the data store. After the call to System.Management.Automation.Provider.Cmdletprovider.ShouldProcess returns true, the System.Management.Automation.Provider.Containercmdletprovider.Newitem* method should call the System.Management.Automation.Provider.Cmdletprovider.ShouldContinue method as an additional check for potentially dangerous system modifications.

Attaching Dynamic Parameters to the New-Item Cmdlet

Sometimes the `New-Item` cmdlet requires additional parameters that are specified dynamically at runtime. To provide these dynamic parameters, the container provider must implement the System.Management.Automation.Provider.Containercmdletprovider.Newitemdynamicparameters* method. This method retrieves the parameters for the item at the indicated path and returns an object that has properties and fields with parsing attributes similar to a cmdlet class or a System.Management.Automation.Runtimedefinedparameterdictionary object. The

Windows PowerShell runtime uses the returned object to add the parameters to the `New-Item` cmdlet.

This provider does not implement this method. However, the following code is the default implementation of this method.

Removing Items

To remove items, the Windows PowerShell provider must override the System.Management.Automation.Provider.Containercmdletprovider.Removeitem* method to support calls from the `Remove-Item` cmdlet. This method deletes an item from the data store at the specified path. If the `recurse` parameter of the `Remove-Item` cmdlet is set to `true`, the method removes all child items regardless of their level. If the parameter is set to `false`, the method removes only a single item at the specified path.

This provider does not support item removal. However, the following code is the default implementation of System.Management.Automation.Provider.Containercmdletprovider.Removeitem*.

Things to Remember About Implementing RemoveItem

The following conditions may apply to your implementation of System.Management.Automation.Provider.Containercmdletprovider.Newitem*:

- When defining the provider class, a Windows PowerShell container provider might declare provider capabilities of ExpandWildcards, Filter, Include, or Exclude, from the System.Management.Automation.Provider.Providercapabilities enumeration. In these cases, the implementation of the System.Management.Automation.Provider.Containercmdletprovider.Getchilditems* method needs to ensure that the path passed to the method meets the requirements of the specified capabilities. To do this, the method should access the appropriate property, for example, the System.Management.Automation.Provider.Cmdletprovider.Exclude* and System.Management.Automation.Provider.Cmdletprovider.Include* properties.

- By default, overrides of this method should not remove objects unless the System.Management.Automation.Provider.Cmdletprovider.Force* property is set to true. If the specified path indicates a container, the System.Management.Automation.Provider.Cmdletprovider.Force* property is not required.

- Your implementation of System.Management.Automation.Provider.Containercmdletprovider.Removeitem* is responsible for preventing infinite recursion when there are circular links, and the like. An appropriate terminating exception should be thrown to reflect such a condition.

- Your implementation of the System.Management.Automation.Provider.Containercmdletprovider.Removeitem* method should call System.Management.Automation.Provider.Cmdletprovider.ShouldProcess and check its return value before making any changes to the data store. After the call to System.Management.Automation.Provider.Cmdletprovider.ShouldProcess returns `true`, the System.Management.Automation.Provider.Containercmdletprovider.Removeitem* method should call the System.Management.Automation.Provider.Cmdletprovider.ShouldContinue method as an additional check for potentially dangerous system modifications.

Attaching Dynamic Parameters to the Remove-Item Cmdlet

Sometimes the `Remove-Item` cmdlet requires additional parameters that are specified dynamically at runtime. To provide these dynamic parameters, the container provider must implement the System.Management.Automation.Provider.Containercmdletprovider.Removeitemdynamicparameters* method to handle these parameters. This method retrieves the dynamic parameters for the item at the indicated path and returns an object that has properties and fields with parsing attributes similar to a cmdlet class or a System.Management.Automation.Runtimedefinedparameterdictionary object. The Windows PowerShell runtime uses the returned object to add the parameters to the `Remove-Item` cmdlet.

This container provider does not implement this method. However, the following code is the default implementation of System.Management.Automation.Provider.Containercmdletprovider.Removeitemdynamicparameters*.

Querying for Child Items

To check to see if child items exist at the specified path, the Windows PowerShell container provider must override the System.Management.Automation.Provider.Containercmdletprovider.Haschilditems* method. This method returns `true` if the item has children, and `false` otherwise. For a null or empty path, the method considers any items in the data store to be children and returns `true`.

Here is the override for the System.Management.Automation.Provider.Containercmdletprovider.Haschilditems* method. If there are more than two path parts created by the ChunkPath helper method, the method returns `false`, since only a database container and a table container are defined. For more information about this helper method, see the ChunkPath method is discussed in Creating a Windows PowerShell Item Provider.

C#

```
protected override bool HasChildItems( string path )
{
    return false;
} // HasChildItems
```

C#

```
        ErrorCategory.InvalidOperation, tableName));
}

return results;
```

Things to Remember About Implementing HasChildItems

The following conditions may apply to your implementation of System.Management.Automation.Provider.Containercmdletprovider.Haschilditems*:

- If the container provider exposes a root that contains interesting mount points, the implementation of the System.Management.Automation.Provider.Containercmdletprovider.Haschilditems* method should return `true` when a null or an empty string is passed in for the path.

Copying Items

To copy items, the container provider must implement the System.Management.Automation.Provider.ContainerCmdletProvider.CopyItem method to support calls from the `Copy-Item` cmdlet. This method copies a data item from the location indicated by the `path` parameter of the cmdlet to the location indicated by the `copyPath` parameter. If the `recurse` parameter is specified, the method copies all sub-containers. If the parameter is not specified, the method copies only a single level of items.

This provider does not implement this method. However, the following code is the default implementation of System.Management.Automation.Provider.ContainerCmdletProvider.CopyItem.

Things to Remember About Implementing CopyItem

The following conditions may apply to your implementation of System.Management.Automation.Provider.ContainerCmdletProvider.CopyItem:

- When defining the provider class, a Windows PowerShell container provider might declare provider capabilities of ExpandWildcards, Filter, Include, or Exclude, from the System.Management.Automation.Provider.Providercapabilities enumeration. In these cases, the implementation of the System.Management.Automation.Provider.Containercmdletprovider.Getchilditems* method needs to ensure that the path passed to the method meets the requirements of the specified capabilities. To do this, the method should access the appropriate property, for example, the System.Management.Automation.Provider.Cmdletprovider.Exclude* and System.Management.Automation.Provider.Cmdletprovider.Include* properties.

- By default, overrides of this method should not copy objects over existing objects unless the System.Management.Automation.Provider.Cmdletprovider.Force* property is set to `true`. For example, the FileSystem provider will not copy c:\temp\abc.txt over an existing c:\abc.txt file unless the System.Management.Automation.Provider.Cmdletprovider.Force* property is set to `true`. If the path specified in the `copyPath` parameter exists and indicates a container, the System.Management.Automation.Provider.Cmdletprovider.Force* property is not required. In this case, System.Management.Automation.Provider.ContainerCmdletProvider.CopyItem should copy the item indicated by the `path` parameter to the container indicated by the `copyPath` parameter as a child.

- Your implementation of System.Management.Automation.Provider.ContainerCmdletProvider.CopyItem is responsible for preventing infinite recursion when there are circular links, and the like. An appropriate terminating exception should be thrown to reflect such a condition.

- Your implementation of the System.Management.Automation.Provider.ContainerCmdletProvider.CopyItem method should call System.Management.Automation.Provider.Cmdletprovider.ShouldProcess and check its return value before making any changes to the data store. After the call to System.Management.Automation.Provider.Cmdletprovider.ShouldProcess returns true, the System.Management.Automation.Provider.ContainerCmdletProvider.CopyItem method should call the System.Management.Automation.Provider.Cmdletprovider.ShouldContinue method as an additional check for potentially dangerous system modifications. For more information about calling these methods, see Rename Items.

Attaching Dynamic Parameters to the Copy-Item Cmdlet

Sometimes the `Copy-Item` cmdlet requires additional parameters that are specified dynamically at runtime. To provide these dynamic parameters, the Windows PowerShell container provider must implement the System.Management.Automation.Provider.Containercmdletprovider.Copyitemdynamicparameters* method to handle these parameters. This method retrieves the parameters for the item at the indicated path and returns an object that has properties and fields with parsing attributes similar to a cmdlet class or a System.Management.Automation.Runtimedefinedparameterdictionary object. The Windows PowerShell runtime uses the returned object to add the parameters to the `Copy-Item` cmdlet.

This provider does not implement this method. However, the following code is the default implementation of System.Management.Automation.Provider.Containercmdletprovider.Copyitemdynamicparameters*.

Code Sample

For complete sample code, see AccessDbProviderSample04 Code Sample.

Building the Windows PowerShell Provider

See How to Register Cmdlets, Providers, and Host Applications.

Testing the Windows PowerShell Provider

When your Windows PowerShell provider has been registered with Windows PowerShell, you can test it by running the supported cmdlets on the command line. Be aware that the following example output uses a fictitious Access database.

1. Run the `Get-ChildItem` cmdlet to retrieve the list of child items from a Customers table in the Access database.

   PowerShell

   ```
   Get-ChildItem mydb:customers
   ```

   The following output appears.

   Output

   ```
   PSPath        : AccessDB::customers
   PSDrive       : mydb
   PSProvider    : System.Management.Automation.ProviderInfo
   PSIsContainer : True
   Data          : System.Data.DataRow
   Name          : Customers
   RowCount      : 91
   Columns       :
   ```

2. Run the `Get-ChildItem` cmdlet again to retrieve the data of a table.

   PowerShell

   ```
   (Get-ChildItem mydb:customers).data
   ```

   The following output appears.

   Output

   ```
   TABLE_CAT   : c:\PS\northwind
   TABLE_SCHEM :
   ```

```
TABLE_NAME  : Customers
TABLE_TYPE  : TABLE
REMARKS     :
```

3. Now use the `Get-Item` cmdlet to retrieve the items at row 0 in the data table.

```PowerShell
Get-Item mydb:\customers\0
```

The following output appears.

```Output
PSPath        : AccessDB::customers\0
PSDrive       : mydb
PSProvider    : System.Management.Automation.ProviderInfo
PSIsContainer : False
Data          : System.Data.DataRow
RowNumber     : 0
```

4. Reuse `Get-Item` to retrieve the data for the items in row 0.

```PowerShell
(Get-Item mydb:\customers\0).data
```

The following output appears.

```Output
CustomerID   : 1234
CompanyName  : Fabrikam
ContactName  : Eric Gruber
ContactTitle : President
Address      : 4567 Main Street
City         : Buffalo
Region       : NY
PostalCode   : 98052
Country      : USA
Phone        : (425) 555-0100
Fax          : (425) 555-0101
```

5. Now use the `New-Item` cmdlet to add a row to an existing table. The `Path` parameter specifies the full path to the row, and must indicate a row number that is greater than the existing number of rows in the table. The `Type` parameter

indicates "row" to specify that type of item to add. Finally, the `Value` parameter specifies a comma-delimited list of column values for the row.

PowerShell

```
New-Item -Path mydb:\Customers\3 -ItemType "row" -Value
"3,CustomerFirstName,CustomerLastName,CustomerEmailAddress,CustomerTitl
e,CustomerCompany,CustomerPhone,
CustomerAddress,CustomerCity,CustomerState,CustomerZip,CustomerCountry"
```

6. Verify the correctness of the new item operation as follows.

none

```
PS mydb:\> cd Customers
PS mydb:\Customers> (Get-Item 3).data
```

The following output appears.

Output

```
ID        : 3
FirstName : Eric
LastName  : Gruber
Email     : ericgruber@fabrikam.com
Title     : President
Company   : Fabrikam
WorkPhone : (425) 555-0100
Address   : 4567 Main Street
City      : Buffalo
State     : NY
Zip       : 98052
Country   : USA
```

See Also

Creating Windows PowerShell Providers

Designing Your Windows PowerShell Provider

Implementing an Item Windows PowerShell Provider

Implementing a Navigation Windows PowerShell Provider

How to Register Cmdlets, Providers, and Host Applications

Windows PowerShell SDK

Creating a Windows PowerShell Navigation Provider

Article • 09/17/2021

This topic describes how to create a Windows PowerShell navigation provider that can navigate the data store. This type of provider supports recursive commands, nested containers, and relative paths.

> **Note**
>
> You can download the C# source file (AccessDBSampleProvider05.cs) for this provider using the Microsoft Windows Software Development Kit for Windows Vista and .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded source files are available in the **<PowerShell Samples>** directory. For more information about other Windows PowerShell provider implementations, see **Designing Your Windows PowerShell Provider**.

The provider described here enables the user handle an Access database as a drive so that the user can navigate to the data tables in the database. When creating your own navigation provider, you can implement methods that can make drive-qualified paths required for navigation, normalize relative paths, move items of the data store, as well as methods that get child names, get the parent path of an item, and test to identify if an item is a container.

> **Caution**
>
> Be aware that this design assumes a database that has a field with the name ID, and that the type of the field is LongInteger.

Define the Windows PowerShell provider

A Windows PowerShell navigation provider must create a .NET class that derives from the System.Management.Automation.Provider.Navigationcmdletprovider base class. Here is the class definition for the navigation provider described in this section.

```
C#
```

```
[CmdletProvider("AccessDB", ProviderCapabilities.None)]
public class AccessDBProvider : NavigationCmdletProvider
```

Note that in this provider, the System.Management.Automation.Provider.Cmdletproviderattribute attribute includes two parameters. The first parameter specifies a user-friendly name for the provider that is used by Windows PowerShell. The second parameter specifies the Windows PowerShell specific capabilities that the provider exposes to the Windows PowerShell runtime during command processing. For this provider, there are no Windows PowerShell specific capabilities that are added.

Defining Base Functionality

As described in Design Your PS Provider, the System.Management.Automation.Provider.Navigationcmdletprovider base class derives from several other classes that provided different provider functionality. A Windows PowerShell navigation provider, therefore, must define all of the functionality provided by those classes.

To implement functionality for adding session-specific initialization information and for releasing resources that are used by the provider, see Creating a Basic PS Provider. However, most providers (including the provider described here) can use the default implementation of this functionality provided by Windows PowerShell.

To get access to the data store through a Windows PowerShell drive, you must implement the methods of the System.Management.Automation.Provider.Drivecmdletprovider base class. For more information about implementing these methods, see Creating a Windows PowerShell Drive Provider.

To manipulate the items of a data store, such as getting, setting, and clearing items, the provider must implement the methods provided by the System.Management.Automation.Provider.Itemcmdletprovider base class. For more information about implementing these methods, see Creating an Windows PowerShell Item Provider.

To get to the child items, or their names, of the data store, as well as methods that create, copy, rename, and remove items, you must implement the methods provided by the System.Management.Automation.Provider.Containercmdletprovider base class. For more information about implementing these methods, see Creating a Windows PowerShell Container Provider.

Creating a Windows PowerShell Path

Windows PowerShell navigation provider use a provider-internal Windows PowerShell path to navigate the items of the data store. To create a provider-internal path the provider must implement the System.Management.Automation.Provider.Navigationcmdletprovider.Makepath* method to supports calls from the Combine-Path cmdlet. This method combines a parent and child path into a provider-internal path, using a provider-specific path separator between the parent and child paths.

The default implementation takes paths with "/" or "\" as the path separator, normalizes the path separator to "\", combines the parent and child path parts with the separator between them, and then returns a string that contains the combined paths.

This navigation provider does not implement this method. However, the following code is the default implementation of the System.Management.Automation.Provider.Navigationcmdletprovider.Makepath* method.

Things to Remember About Implementing MakePath

The following conditions may apply to your implementation of System.Management.Automation.Provider.Navigationcmdletprovider.Makepath*:

- Your implementation of the System.Management.Automation.Provider.Navigationcmdletprovider.Makepath* method should not validate the path as a legal fully-qualified path in the provider namespace. Be aware that each parameter can only represent a part of a path, and the combined parts might not generate a fully-qualified path. For example, the System.Management.Automation.Provider.Navigationcmdletprovider.Makepath* method for the filesystem provider might receive "windows\system32" in the `parent` parameter and "abc.dll" in the `child` parameter. The method joins these values with the "\" separator and returns "windows\system32\abc.dll", which is not a fully-qualified file system path.

  > **Important**
  >
  > The path parts provided in the call to **System.Management.Automation.Provider.Navigationcmdletprovider.Makepath*** might contain characters not allowed in the provider namespace. These

characters are most likely used for wildcard expansion and the implementation of this method should not remove them.

Retrieving the Parent Path

Windows PowerShell navigation providers implement the System.Management.Automation.Provider.Navigationcmdletprovider.Getparentpath* method to retrieve the parent part of the indicated full or partial provider-specific path. The method removes the child part of the path and returns the parent path part. The `root` parameter specifies the fully-qualified path to the root of a drive. This parameter can be null or empty if a mounted drive is not in use for the retrieval operation. If a root is specified, the method must return a path to a container in the same tree as the root.

The sample navigation provider does not override this method, but uses the default implementation. It accepts paths that use both "/" and "\" as path separators. It first normalizes the path to have only "\" separators, then splits the parent path off at the last "\" and returns the parent path.

To Remember About Implementing GetParentPath

Your implementation of the System.Management.Automation.Provider.Navigationcmdletprovider.Getparentpath* method should split the path lexically on the path separator for the provider namespace. For example, the filesystem provider uses this method to look for the last "\" and returns everything to the left of the separator.

Retrieve the Child Path Name

Your navigation provider implements the System.Management.Automation.Provider.Navigationcmdletprovider.Getchildname* method to retrieve the name (leaf element) of the child of the item located at the indicated full or partial provider-specific path.

The sample navigation provider does not override this method. The default implementation is shown below. It accepts paths that use both "/" and "\" as path separators. It first normalizes the path to have only "\" separators, then splits the parent path off at the last "\" and returns the name of the child path part.

Things to Remember About Implementing GetChildName

Your implementation of the System.Management.Automation.Provider.Navigationcmdletprovider.Getchildname* method should split the path lexically on the path separator. If the supplied path contains no path separators, the method should return the path unmodified.

> **ⓘ Important**
>
> The path provided in the call to this method might contain characters that are illegal in the provider namespace. These characters are most likely used for wildcard expansion or regular expression matching, and the implementation of this method should not remove them.

Determining if an Item is a Container

The navigation provider can implement the System.Management.Automation.Provider.Navigationcmdletprovider.Isitemcontainer* method to determine if the specified path indicates a container. It returns true if the path represents a container, and false otherwise. The user needs this method to be able to use the `Test-Path` cmdlet for the supplied path.

The following code shows the System.Management.Automation.Provider.Navigationcmdletprovider.Isitemcontainer* implementation in our sample navigation provider. The method verifies that the specified path is correct and if the table exists, and returns true if the path indicates a container.

C#

```
protected override bool IsItemContainer(string path)
{
   if (PathIsDrive(path))
   {
       return true;
   }

   string[] pathChunks = ChunkPath(path);
   string tableName;
   int rowNumber;

   PathType type = GetNamesFromPath(path, out tableName, out rowNumber);

   if (type == PathType.Table)
   {
      foreach (DatabaseTableInfo ti in GetTables())
      {
```

```
            if (string.Equals(ti.Name, tableName,
StringComparison.OrdinalIgnoreCase))
            {
                return true;
            }
        } // foreach (DatabaseTableInfo...
    } // if (pathChunks...

    return false;
} // IsItemContainer
```

Things to Remember About Implementing IsItemContainer

Your navigation provider .NET class might declare provider capabilities of ExpandWildcards, Filter, Include, or Exclude, from the System.Management.Automation.Provider.Providercapabilities enumeration. In this case, the implementation of System.Management.Automation.Provider.Navigationcmdletprovider.Isitemcontainer* needs to ensure that the path passed meets requirements. To do this, the method should access the appropriate property, for example, the System.Management.Automation.Provider.Cmdletprovider.Exclude* property.

Moving an Item

In support of the `Move-Item` cmdlet, your navigation provider implements the System.Management.Automation.Provider.Navigationcmdletprovider.Moveitem* method. This method moves the item specified by the `path` parameter to the container at the path supplied in the `destination` parameter.

The sample navigation provider does not override the System.Management.Automation.Provider.Navigationcmdletprovider.Moveitem* method. The following is the default implementation.

Things to Remember About Implementing MoveItem

Your navigation provider .NET class might declare provider capabilities of ExpandWildcards, Filter, Include, or Exclude, from the System.Management.Automation.Provider.Providercapabilities enumeration. In this case, the implementation of System.Management.Automation.Provider.Navigationcmdletprovider.Moveitem* must ensure that the path passed meets requirements. To do this, the method should access the appropriate property, for example, the **CmdletProvider.Exclude** property.

By default, overrides of this method should not move objects over existing objects unless the System.Management.Automation.Provider.Cmdletprovider.Force* property is set to `true`. For example, the filesystem provider will not copy c:\temp\abc.txt over an existing c:\bar.txt file unless the System.Management.Automation.Provider.Cmdletprovider.Force* property is set to `true`. If the path specified in the `destination` parameter exists and is a container, the System.Management.Automation.Provider.Cmdletprovider.Force* property is not required. In this case, System.Management.Automation.Provider.Navigationcmdletprovider.Moveitem* should move the item indicated by the `path` parameter to the container indicated by the `destination` parameter as a child.

Your implementation of the System.Management.Automation.Provider.Navigationcmdletprovider.Moveitem* method should call System.Management.Automation.Provider.Cmdletprovider.ShouldProcess and check its return value before making any changes to the data store. This method is used to confirm execution of an operation when a change is made to system state, for example, deleting files. System.Management.Automation.Provider.Cmdletprovider.ShouldProcess sends the name of the resource to be changed to the user, with the Windows PowerShell runtime taking into account any command line settings or preference variables in determining what should be displayed to the user.

After the call to System.Management.Automation.Provider.Cmdletprovider.ShouldProcess returns `true`, the System.Management.Automation.Provider.Navigationcmdletprovider.Moveitem* method should call the System.Management.Automation.Provider.Cmdletprovider.ShouldContinue method. This method sends a message to the user to allow feedback to say if the operation should be continued. Your provider should call System.Management.Automation.Provider.Cmdletprovider.ShouldContinue as an additional check for potentially dangerous system modifications.

Attaching Dynamic Parameters to the Move-Item Cmdlet

Sometimes the `Move-Item` cmdlet requires additional parameters that are provided dynamically at runtime. To provide these dynamic parameters, the navigation provider must implement the System.Management.Automation.Provider.Navigationcmdletprovider.Moveitemdynamic

parameters* method to get the required parameter values from the item at the indicated path, and return an object that has properties and fields with parsing attributes similar to a cmdlet class or a System.Management.Automation.Runtimedefinedparameterdictionary object.

This navigation provider does not implement this method. However, the following code is the default implementation of System.Management.Automation.Provider.Navigationcmdletprovider.Moveitemdynamicparameters*.

Normalizing a Relative Path

Your navigation provider implements the System.Management.Automation.Provider.Navigationcmdletprovider.Normalizerelativepath* method to normalize the fully-qualified path indicated in the `path` parameter as being relative to the path specified by the `basePath` parameter. The method returns a string representation of the normalized path. It writes an error if the `path` parameter specifies a nonexistent path.

The sample navigation provider does not override this method. The following is the default implementation.

Things to Remember About Implementing NormalizeRelativePath

Your implementation of System.Management.Automation.Provider.Navigationcmdletprovider.Normalizerelativepath* should parse the `path` parameter, but it does not have to use purely syntactical parsing. You are encouraged to design this method to use the path to look up the path information in the data store and create a path that matches the casing and standardized path syntax.

Code Sample

For complete sample code, see AccessDbProviderSample05 Code Sample.

Defining Object Types and Formatting

It is possible for a provider to add members to existing objects or define new objects. For more information, seeExtending Object Types and Formatting.

Building the Windows PowerShell provider

For more information, see How to Register Cmdlets, Providers, and Host Applications.

Testing the Windows PowerShell provider

When your Windows PowerShell provider has been registered with Windows PowerShell, you can test it by running the supported cmdlets on the command line, including cmdlets made available by derivation. This example will test the sample navigation provider.

1. Run your new shell and use the `Set-Location` cmdlet to set the path to indicate the Access database.

   PowerShell

   ```
   Set-Location mydb:
   ```

2. Now run the `Get-Childitem` cmdlet to retrieve a list of the database items, which are the available database tables. For each table, this cmdlet also retrieves the number of table rows.

   PowerShell

   ```
   Get-ChildItem | Format-Table rowcount,name -AutoSize
   ```

   Output

   ```
   RowCount   Name
   --------   ----
        180   MSysAccessObjects
          0   MSysACEs
          1   MSysCmdbars
          0   MSysIMEXColumns
          0   MSysIMEXSpecs
          0   MSysObjects
          0   MSysQueries
          7   MSysRelationships
          8   Categories
         91   Customers
          9   Employees
       2155   Order Details
        830   Orders
         77   Products
          3   Shippers
         29   Suppliers
   ```

3. Use the `Set-Location` cmdlet again to set the location of the Employees data table.

```
PowerShell

Set-Location Employees
```

4. Let's now use the `Get-Location` cmdlet to retrieve the path to the Employees table.

```
PowerShell

Get-Location
```

```
Output

Path
----
mydb:\Employees
```

5. Now use the `Get-Childitem` cmdlet piped to the `Format-Table` cmdlet. This set of cmdlets retrieves the items for the Employees data table, which are the table rows. They are formatted as specified by the `Format-Table` cmdlet.

```
PowerShell

Get-ChildItem | Format-Table rownumber,psiscontainer,data -AutoSize
```

```
Output

RowNumber   PSIsContainer   Data
---------   --------------   ----
0           False            System.Data.DataRow
1           False            System.Data.DataRow
2           False            System.Data.DataRow
3           False            System.Data.DataRow
4           False            System.Data.DataRow
5           False            System.Data.DataRow
6           False            System.Data.DataRow
7           False            System.Data.DataRow
8           False            System.Data.DataRow
```

6. You can now run the `Get-Item` cmdlet to retrieve the items for row 0 of the Employees data table.

```
PowerShell
```

```
Get-Item 0
```

Output

```
PSPath        : AccessDB::C:\PS\Northwind.mdb\Employees\0
PSParentPath  : AccessDB::C:\PS\Northwind.mdb\Employees
PSChildName   : 0
PSDrive       : mydb
PSProvider    : System.Management.Automation.ProviderInfo
PSIsContainer : False
Data           : System.Data.DataRow
RowNumber      : 0
```

7. Use the `Get-Item` cmdlet again to retrieve the employee data for the items in row 0.

PowerShell

```
(Get-Item 0).data
```

Output

```
EmployeeID      : 1
LastName        : Davis
FirstName       : Sara
Title           : Sales Representative
TitleOfCourtesy : Ms.
BirthDate       : 12/8/1968 12:00:00 AM
HireDate        : 5/1/1992 12:00:00 AM
Address         : 4567 Main Street
                  Apt. 2A
City            : Buffalo
Region          : NY
PostalCode      : 98052
Country         : USA
HomePhone       : (206) 555-9857
Extension       : 5467
Photo           : EmpID1.bmp
Notes           : Education includes a BA in psychology from
                  Colorado State University. She also completed "The
                  Art of the Cold Call."  Nancy is a member of
                  Toastmasters International.
ReportsTo       : 2
```

See Also

Creating Windows PowerShell providers

Design Your Windows PowerShell provider

Extending Object Types and Formatting

Implement a Container Windows PowerShell provider

How to Register Cmdlets, Providers, and Host Applications

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

Creating a Windows PowerShell Content Provider

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This topic describes how to create a Windows PowerShell provider that enables the user to manipulate the contents of the items in a data store. As a consequence, a provider that can manipulate the contents of items is referred to as a Windows PowerShell content provider.

> **Note**
>
> You can download the C# source file (AccessDBSampleProvider06.cs) for this provider using the Microsoft Windows Software Development Kit for Windows Vista and .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded source files are available in the **<PowerShell Samples>** directory. For more information about other Windows PowerShell provider implementations, see **Designing Your Windows PowerShell Provider**.

Define the Windows PowerShell Content Provider Class

A Windows PowerShell content provider must create a .NET class that supports the System.Management.Automation.Provider.Icontentcmdletprovider interface. Here is the class definition for the item provider described in this section.

C#

```
[CmdletProvider("AccessDB", ProviderCapabilities.None)]
public class AccessDBProvider : NavigationCmdletProvider,
IContentCmdletProvider
```

Note that in this class definition, the System.Management.Automation.Provider.Cmdletproviderattribute attribute includes two parameters. The first parameter specifies a user-friendly name for the provider that is used by Windows PowerShell. The second parameter specifies the Windows PowerShell specific capabilities that the provider exposes to the Windows PowerShell

runtime during command processing. For this provider, there are no added Windows PowerShell specific capabilities.

Define Functionality of Base Class

As described in Design Your Windows PowerShell Provider, the System.Management.Automation.Provider.Navigationcmdletprovider class derives from several other classes that provided different provider functionality. A Windows PowerShell content provider, therefore, typically defines all of the functionality provided by those classes.

For more information about how to implement functionality for adding session-specific initialization information and for releasing resources that are used by the provider, see Creating a Basic Windows PowerShell Provider. However, most providers, including the provider described here, can use the default implementation of this functionality that is provided by Windows PowerShell.

To access the data store, the provider must implement the methods of the System.Management.Automation.Provider.Drivecmdletprovider base class. For more information about implementing these methods, see Creating a Windows PowerShell Drive Provider.

To manipulate the items of a data store, such as getting, setting, and clearing items, the provider must implement the methods provided by the System.Management.Automation.Provider.Itemcmdletprovider base class. For more information about implementing these methods, see Creating a Windows PowerShell Item Provider.

To work on multi-layer data stores, the provider must implement the methods provided by the System.Management.Automation.Provider.Containercmdletprovider base class. For more information about implementing these methods, see Creating a Windows PowerShell Container Provider.

To support recursive commands, nested containers, and relative paths, the provider must implement the System.Management.Automation.Provider.Navigationcmdletprovider base class. In addition, this Windows PowerShell content provider can attaches System.Management.Automation.Provider.Icontentcmdletprovider interface to the System.Management.Automation.Provider.Navigationcmdletprovider base class, and must therefore implement the methods provided by that class. For more information, see implementing those methods, see Implement a Navigation Windows PowerShell Provider.

Implementing a Content Reader

To read content from an item, a provider must implements a content reader class that derives from System.Management.Automation.Provider.Icontentreader. The content reader for this provider allows access to the contents of a row in a data table. The content reader class defines a **Read** method that retrieves the data from the indicated row and returns a list representing that data, a **Seek** method that moves the content reader, a **Close** method that closes the content reader, and a **Dispose** method.

C#

```
public class AccessDBContentReader : IContentReader
{
    // A provider instance is required so as to get "content"
    private AccessDBProvider provider;
    private string path;
    private long currentOffset;

    internal AccessDBContentReader(string path, AccessDBProvider provider)
    {
        this.path = path;
        this.provider = provider;
    }

    /// <summary>
    /// Read the specified number of rows from the source.
    /// </summary>
    /// <param name="readCount">The number of items to
    /// return.</param>
    /// <returns>An array of elements read.</returns>
    public IList Read(long readCount)
    {
        // Read the number of rows specified by readCount and increment
        // offset
        string tableName;
        int rowNumber;
        PathType type = provider.GetNamesFromPath(path, out tableName, out
rowNumber);

        Collection<DatabaseRowInfo> rows =
            provider.GetRows(tableName);
        Collection<DataRow> results = new Collection<DataRow>();

        if (currentOffset < 0 || currentOffset >= rows.Count)
        {
            return null;
        }

        int rowsRead = 0;

        while (rowsRead < readCount && currentOffset < rows.Count)
```

```
        {
            results.Add(rows[(int)currentOffset].Data);
            rowsRead++;
            currentOffset++;
        }

        return results;
    } // Read

    /// <summary>
    /// Moves the content reader specified number of rows from the
    /// origin
    /// </summary>
    /// <param name="offset">Number of rows to offset</param>
    /// <param name="origin">Starting row from which to offset</param>
    public void Seek(long offset, System.IO.SeekOrigin origin)
    {
        // get the number of rows in the table which will help in
        // calculating current position
        string tableName;
        int rowNumber;

        PathType type = provider.GetNamesFromPath(path, out tableName, out
rowNumber);

        if (type == PathType.Invalid)
        {
            throw new ArgumentException("Path specified must represent a
table or a row :" + path);
        }

        if (type == PathType.Table)
        {
            Collection<DatabaseRowInfo> rows = provider.GetRows(tableName);

            int numRows = rows.Count;

            if (offset > rows.Count)
            {
                throw new
                       ArgumentException(
                           "Offset cannot be greater than the number of rows
available"
                                           );
            }

            if (origin == System.IO.SeekOrigin.Begin)
            {
                // starting from Beginning with an index 0, the current
offset
                // has to be advanced to offset - 1
                currentOffset = offset - 1;
            }
            else if (origin == System.IO.SeekOrigin.End)
            {
```

```
                // starting from the end which is numRows - 1, the current
                // offset is so much less than numRows - 1
                currentOffset = numRows - 1 - offset;
            }
            else
            {
                // calculate from the previous value of current offset
                // advancing forward always
                currentOffset += offset;
            }
        } // if (type...
        else
        {
            // for row, the offset will always be set to 0
            currentOffset = 0;
        }

    } // Seek

    /// <summary>
    /// Closes the content reader, so all members are reset
    /// </summary>
    public void Close()
    {
        Dispose();
    } // Close

    /// <summary>
    /// Dispose any resources being used
    /// </summary>
    public void Dispose()
    {
        Seek(0, System.IO.SeekOrigin.Begin);

        GC.SuppressFinalize(this);
    } // Dispose
} // AccessDBContentReader
```

Implementing a Content Writer

To write content to an item, a provider must implement a content writer class derives from System.Management.Automation.Provider.Icontentwriter. The content writer class defines a **Write** method that writes the specified row content, a **Seek** method that moves the content writer, a **Close** method that closes the content writer, and a **Dispose** method.

C#

```
public class AccessDBContentWriter : IContentWriter
{
```

```
    // A provider instance is required so as to get "content"
    private AccessDBProvider provider;
    private string path;
    private long currentOffset;

    internal AccessDBContentWriter(string path, AccessDBProvider provider)
    {
        this.path = path;
        this.provider = provider;
    }

    /// <summary>
    /// Write the specified row contents in the source
    /// </summary>
    /// <param name="content"> The contents to be written to the source.
    /// </param>
    /// <returns>An array of elements which were successfully written to
    /// the source</returns>
    ///
    public IList Write(IList content)
    {
        if (content == null)
        {
            return null;
        }

        // Get the total number of rows currently available it will
        // determine how much to overwrite and how much to append at
        // the end
        string tableName;
        int rowNumber;
        PathType type = provider.GetNamesFromPath(path, out tableName, out
rowNumber);

        if (type == PathType.Table)
        {
            OdbcDataAdapter da = provider.GetAdapterForTable(tableName);
            if (da == null)
            {
                return null;
            }

            DataSet ds = provider.GetDataSetForTable(da, tableName);
            DataTable table = provider.GetDataTable(ds, tableName);

            string[] colValues = (content[0] as string).Split(',');

            // set the specified row
            DataRow row = table.NewRow();

            for (int i = 0; i < colValues.Length; i++)
            {
                if (!String.IsNullOrEmpty(colValues[i]))
                {
                    row[i] = colValues[i];
```

```
                }
            }

            //table.Rows.InsertAt(row, rowNumber);
            // Update the table
            table.Rows.Add(row);
            da.Update(ds, tableName);

        }
        else
        {
            throw new InvalidOperationException("Operation not supported.
Content can be added only for tables");
        }

        return null;
    } // Write

    /// <summary>
    /// Moves the content reader specified number of rows from the
    /// origin
    /// </summary>
    /// <param name="offset">Number of rows to offset</param>
    /// <param name="origin">Starting row from which to offset</param>
    public void Seek(long offset, System.IO.SeekOrigin origin)
    {
        // get the number of rows in the table which will help in
        // calculating current position
        string tableName;
        int rowNumber;

        PathType type = provider.GetNamesFromPath(path, out tableName, out
rowNumber);

        if (type == PathType.Invalid)
        {
            throw new ArgumentException("Path specified should represent
either a table or a row : " + path);
        }

        Collection<DatabaseRowInfo> rows =
               provider.GetRows(tableName);

        int numRows = rows.Count;

        if (offset > rows.Count)
        {
            throw new
                   ArgumentException(
                       "Offset cannot be greater than the number of rows
available"
                                            );
        }

        if (origin == System.IO.SeekOrigin.Begin)
```

```
        {
            // starting from Beginning with an index 0, the current offset
            // has to be advanced to offset - 1
            currentOffset = offset - 1;
        }
        else if (origin == System.IO.SeekOrigin.End)
        {
            // starting from the end which is numRows - 1, the current
            // offset is so much less than numRows - 1
            currentOffset = numRows - 1 - offset;
        }
        else
        {
            // calculate from the previous value of current offset
            // advancing forward always
            currentOffset += offset;
        }

    } // Seek

    /// <summary>
    /// Closes the content reader, so all members are reset
    /// </summary>
    public void Close()
    {
        Dispose();
    } // Close

    /// <summary>
    /// Dispose any resources being used
    /// </summary>
    public void Dispose()
    {
        Seek(0, System.IO.SeekOrigin.Begin);

        GC.SuppressFinalize(this);
    } // Dispose
} // AccessDBContentWriter
```

Retrieving the Content Reader

To get content from an item, the provider must implement the System.Management.Automation.Provider.Icontentcmdletprovider.Getcontentreader* to support the `Get-Content` cmdlet. This method returns the content reader for the item located at the specified path. The reader object can then be opened to read the content.

Here is the implementation of System.Management.Automation.Provider.Icontentcmdletprovider.Getcontentreader* for this method for this provider.

C#

```
public IContentReader GetContentReader(string path)
{
    string tableName;
    int rowNumber;

    PathType type = GetNamesFromPath(path, out tableName, out rowNumber);

    if (type == PathType.Invalid)
    {
        ThrowTerminatingInvalidPathException(path);
    }
    else if (type == PathType.Row)
    {
        throw new InvalidOperationException("contents can be obtained only
for tables");
    }

    return new AccessDBContentReader(path, this);
} // GetContentReader
```

C#

```
public IContentReader GetContentReader(string path)
{
    string tableName;
    int rowNumber;

    PathType type = GetNamesFromPath(path, out tableName, out rowNumber);

    if (type == PathType.Invalid)
    {
        ThrowTerminatingInvalidPathException(path);
    }
    else if (type == PathType.Row)
    {
        throw new InvalidOperationException("contents can be obtained only
for tables");
    }

    return new AccessDBContentReader(path, this);
} // GetContentReader
```

Things to Remember About Implementing GetContentReader

The following conditions may apply to an implementation of System.Management.Automation.Provider.Icontentcmdletprovider.Getcontentreader*:

- When defining the provider class, a Windows PowerShell content provider might declare provider capabilities of ExpandWildcards, Filter, Include, or Exclude, from the System.Management.Automation.Provider.Providercapabilities enumeration. In these cases, the implementation of the System.Management.Automation.Provider.Icontentcmdletprovider.Getcontentreader* method must ensure that the path passed to the method meets the requirements of the specified capabilities. To do this, the method should access the appropriate property, for example, the System.Management.Automation.Provider.Cmdletprovider.Exclude* and System.Management.Automation.Provider.Cmdletprovider.Include* properties.

- By default, overrides of this method should not retrieve a reader for objects that are hidden from the user unless the System.Management.Automation.Provider.Cmdletprovider.Force* property is set to `true`. An error should be written if the path represents an item that is hidden from the user and System.Management.Automation.Provider.Cmdletprovider.Force* is set to `false`.

Attaching Dynamic Parameters to the Get-Content Cmdlet

The `Get-Content` cmdlet might require additional parameters that are specified dynamically at runtime. To provide these dynamic parameters, the Windows PowerShell content provider must implement the System.Management.Automation.Provider.Icontentcmdletprovider.Getcontentreaderdynamicparameters* method. This method retrieves dynamic parameters for the item at the indicated path and returns an object that has properties and fields with parsing attributes similar to a cmdlet class or a System.Management.Automation.Runtimedefinedparameterdictionary object. The Windows PowerShell runtime uses the returned object to add the parameters to the cmdlet.

This Windows PowerShell container provider does not implement this method. However, the following code is the default implementation of this method.

C#

```
public object GetContentReaderDynamicParameters(string path)
{
    return null;
}
```

C#

```
public object GetContentReaderDynamicParameters(string path)
{
    return null;
}
```

Retrieving the Content Writer

To write content to an item, the provider must implement the System.Management.Automation.Provider.Icontentcmdletprovider.Getcontentwriter* to support the `Set-Content` and `Add-Content` cmdlets. This method returns the content writer for the item located at the specified path.

Here is the implementation of System.Management.Automation.Provider.Icontentcmdletprovider.Getcontentwriter* for this method.

C#

```
public IContentWriter GetContentWriter(string path)
{
    string tableName;
    int rowNumber;

    PathType type = GetNamesFromPath(path, out tableName, out rowNumber);

    if (type == PathType.Invalid)
    {
        ThrowTerminatingInvalidPathException(path);
    }
    else if (type == PathType.Row)
    {
        throw new InvalidOperationException("contents can be added only to
tables");
    }

    return new AccessDBContentWriter(path, this);
}
```

C#

```
public IContentWriter GetContentWriter(string path)
{
    string tableName;
    int rowNumber;

    PathType type = GetNamesFromPath(path, out tableName, out rowNumber);
```

```
    if (type == PathType.Invalid)
    {
        ThrowTerminatingInvalidPathException(path);
    }
    else if (type == PathType.Row)
    {
        throw new InvalidOperationException("contents can be added only to
tables");
    }

    return new AccessDBContentWriter(path, this);
}
```

Things to Remember About Implementing GetContentWriter

The following conditions may apply to your implementation of System.Management.Automation.Provider.Icontentcmdletprovider.Getcontentwriter*:

- When defining the provider class, a Windows PowerShell content provider might declare provider capabilities of ExpandWildcards, Filter, Include, or Exclude, from the System.Management.Automation.Provider.Providercapabilities enumeration. In these cases, the implementation of the System.Management.Automation.Provider.Icontentcmdletprovider.Getcontentwriter* method must ensure that the path passed to the method meets the requirements of the specified capabilities. To do this, the method should access the appropriate property, for example, the System.Management.Automation.Provider.Cmdletprovider.Exclude* and System.Management.Automation.Provider.Cmdletprovider.Include* properties.

- By default, overrides of this method should not retrieve a writer for objects that are hidden from the user unless the System.Management.Automation.Provider.Cmdletprovider.Force* property is set to `true`. An error should be written if the path represents an item that is hidden from the user and System.Management.Automation.Provider.Cmdletprovider.Force* is set to `false`.

Attaching Dynamic Parameters to the Add-Content and Set-Content Cmdlets

The `Add-Content` and `Set-Content` cmdlets might require additional dynamic parameters that are added a runtime. To provide these dynamic parameters, the Windows PowerShell content provider must implement the

System.Management.Automation.Provider.Icontentcmdletprovider.Getcontentwriterdynamicparameters* method to handle these parameters. This method retrieves dynamic parameters for the item at the indicated path and returns an object that has properties and fields with parsing attributes similar to a cmdlet class or a System.Management.Automation.Runtimedefinedparameterdictionary object. The Windows PowerShell runtime uses the returned object to add the parameters to the cmdlets.

This Windows PowerShell container provider does not implement this method. However, the following code is the default implementation of this method.

C#

```
public object GetContentWriterDynamicParameters(string path)
{
    return null;
}
```

Clearing Content

Your content provider implements the System.Management.Automation.Provider.Icontentcmdletprovider.Clearcontent* method in support of the `Clear-Content` cmdlet. This method removes the contents of the item at the specified path, but leaves the item intact.

Here is the implementation of the System.Management.Automation.Provider.Icontentcmdletprovider.Clearcontent* method for this provider.

C#

```
public void ClearContent(string path)
{
    string tableName;
    int rowNumber;

    PathType type = GetNamesFromPath(path, out tableName, out rowNumber);

    if (type != PathType.Table)
    {
        WriteError(new ErrorRecord(
            new InvalidOperationException("Operation not supported. Content
can be cleared only for table"),
                "NotValidRow", ErrorCategory.InvalidArgument,
                    path));
        return;
```

```
    }

    OdbcDataAdapter da = GetAdapterForTable(tableName);

    if (da == null)
    {
        return;
    }

    DataSet ds = GetDataSetForTable(da, tableName);
    DataTable table = GetDataTable(ds, tableName);

    // Clear contents at the specified location
    for (int i = 0; i < table.Rows.Count; i++)
    {
        table.Rows[i].Delete();
    }

    if (ShouldProcess(path, "ClearContent"))
    {
        da.Update(ds, tableName);
    }

} // ClearContent
```

Things to Remember About Implementing ClearContent

The following conditions may apply to an implementation of System.Management.Automation.Provider.Icontentcmdletprovider.Clearcontent*:

- When defining the provider class, a Windows PowerShell content provider might declare provider capabilities of ExpandWildcards, Filter, Include, or Exclude, from the System.Management.Automation.Provider.Providercapabilities enumeration. In these cases, the implementation of the System.Management.Automation.Provider.Icontentcmdletprovider.Clearcontent* method must ensure that the path passed to the method meets the requirements of the specified capabilities. To do this, the method should access the appropriate property, for example, the System.Management.Automation.Provider.Cmdletprovider.Exclude* and System.Management.Automation.Provider.Cmdletprovider.Include* properties.

- By default, overrides of this method should not clear the contents of objects that are hidden from the user unless the System.Management.Automation.Provider.Cmdletprovider.Force* property is set to `true`. An error should be written if the path represents an item that is hidden from the user and System.Management.Automation.Provider.Cmdletprovider.Force* is set to `false`.

- Your implementation of the System.Management.Automation.Provider.Icontentcmdletprovider.Clearcontent* method should call System.Management.Automation.Provider.Cmdletprovider.ShouldProcess and verify its return value before making any changes to the data store. This method is used to confirm execution of an operation when a change is made to the data store, such as clearing content. The System.Management.Automation.Provider.Cmdletprovider.ShouldProcess method sends the name of the resource to be changed to the user, with the Windows PowerShell runtime handling any command-line settings or preference variables in determining what should be displayed.

  After the call to System.Management.Automation.Provider.Cmdletprovider.ShouldProcess returns `true`, the System.Management.Automation.Provider.Icontentcmdletprovider.Clearcontent* method should call the System.Management.Automation.Provider.Cmdletprovider.ShouldContinue method. This method sends a message to the user to allow feedback to verify if the operation should be continued. The call to System.Management.Automation.Provider.Cmdletprovider.ShouldContinue allows an additional check for potentially dangerous system modifications.

Attaching Dynamic Parameters to the Clear-Content Cmdlet

The `Clear-Content` cmdlet might require additional dynamic parameters that are added at runtime. To provide these dynamic parameters, the Windows PowerShell content provider must implement the System.Management.Automation.Provider.Icontentcmdletprovider.Clearcontentdynamicparameters* method to handle these parameters. This method retrieves the parameters for the item at the indicated path. This method retrieves dynamic parameters for the item at the indicated path and returns an object that has properties and fields with parsing attributes similar to a cmdlet class or a System.Management.Automation.Runtimedefinedparameterdictionary object. The Windows PowerShell runtime uses the returned object to add the parameters to the cmdlet.

This Windows PowerShell container provider does not implement this method. However, the following code is the default implementation of this method.

C#

```
public object ClearContentDynamicParameters(string path)
{
    return null;
}
```

C#

```
public object ClearContentDynamicParameters(string path)
{
    return null;
}
```

Code Sample

For complete sample code, see AccessDbProviderSample06 Code Sample.

Defining Object Types and Formatting

When writing a provider, it may be necessary to add members to existing objects or define new objects. When this is done, you must create a Types file that Windows PowerShell can use to identify the members of the object and a Format file that defines how the object is displayed. For more information, see Extending Object Types and Formatting.

Building the Windows PowerShell Provider

See How to Register Cmdlets, Providers, and Host Applications.

Testing the Windows PowerShell Provider

When your Windows PowerShell provider has been registered with Windows PowerShell, you can test it by running the supported cmdlets on the command line. For example, test the sample content provider.

Use the `Get-Content` cmdlet to retrieve the contents of specified item in the database table at the path specified by the `Path` parameter. The `ReadCount` parameter specifies the number of items for the defined content reader to read (default 1). With the following command entry, the cmdlet retrieves two rows (items) from the table and

displays their contents. Note that the following example output uses a fictitious Access database.

PowerShell

```
Get-Content -Path mydb:\Customers -ReadCount 2
```

Output

```
ID        : 1
FirstName : Eric
LastName  : Gruber
Email     : ericgruber@fabrikam.com
Title     : President
Company   : Fabrikam
WorkPhone : (425) 555-0100
Address   : 4567 Main Street
City      : Buffalo
State     : NY
Zip       : 98052
Country   : USA
ID        : 2
FirstName : Eva
LastName  : Corets
Email     : evacorets@cohowinery.com
Title     : Sales Representative
Company   : Coho Winery
WorkPhone : (360) 555-0100
Address   : 8910 Main Street
City      : Cabmerlot
State     : WA
Zip       : 98089
Country   : USA
```

See Also

Creating Windows PowerShell providers

Design Your Windows PowerShell provider

Extending Object Types and Formatting

Implement a Navigation Windows PowerShell provider

How to Register Cmdlets, Providers, and Host Applications

Windows PowerShell SDK

Creating a Windows PowerShell Property Provider

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This topic describes how to create a provider that enables the user to manipulate the properties of items in a data store. As a consequence, this type of provider is referred to as a Windows PowerShell property provider. For example, the Registry provider provided by Windows PowerShell handles registry key values as properties of the registry key item. This type of provider must add the System.Management.Automation.Provider.Ipropertycmdletprovider interface to the implementation of the .NET class.

> **Note**
>
> Windows PowerShell provides a template file that you can use to develop a Windows PowerShell provider. The TemplateProvider.cs file is available on the Microsoft Windows Software Development Kit for Windows Vista and .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded template is available in the **<PowerShell Samples>** directory. You should make a copy of this file and use the copy for creating a new Windows PowerShell provider, removing any functionality that you do not need. For more information about other Windows PowerShell provider implementations, see **Designing Your Windows PowerShell Provider**.

> **Caution**
>
> The methods of your property provider should write any objects using the **System.Management.Automation.Provider.Cmdletprovider.Writepropertyobject*** method.

Defining the Windows PowerShell provider

A property provider must create a .NET class that supports the System.Management.Automation.Provider.Ipropertycmdletprovider interface. Here is the default class declaration from the TemplateProvider.cs file provided by Windows PowerShell.

Defining Base Functionality

The System.Management.Automation.Provider.Ipropertycmdletprovider interface can be attached to any of the provider base classes, with the exception of the System.Management.Automation.Provider.Drivecmdletprovider class. Add the base functionality that is required by the base class you are using. For more information about base classes, see Designing Your Windows PowerShell Provider.

Retrieving Properties

To retrieve properties, the provider must implement the System.Management.Automation.Provider.Ipropertycmdletprovider.Getproperty* method to support calls from the `Get-ItemProperty` cmdlet. This method retrieves the properties of the item located at the specified provider-internal path (fully-qualified).

The `providerSpecificPickList` parameter indicates which properties to retrieve. If this parameter is `null` or empty, the method should retrieve all properties. In addition, System.Management.Automation.Provider.Ipropertycmdletprovider.Getproperty* writes an instance of a System.Management.Automation.PSObject object that represents a property bag of the retrieved properties. The method should return nothing.

It is recommended that the implementation of System.Management.Automation.Provider.Ipropertycmdletprovider.Getproperty* supports the wildcard expansion of property names for each element in the pick list. To do this, use the System.Management.Automation.Wildcardpattern class to perform the wildcard pattern matching.

Here is the default implementation of System.Management.Automation.Provider.Ipropertycmdletprovider.Getproperty* from the TemplateProvider.cs file provided by Windows PowerShell.

Things to Remember About Implementing GetProperty

The following conditions may apply to your implementation of System.Management.Automation.Provider.Ipropertycmdletprovider.Getproperty*:

- When defining the provider class, a Windows PowerShell property provider might declare provider capabilities of ExpandWildcards, Filter, Include, or Exclude, from the System.Management.Automation.Provider.Providercapabilities enumeration. In these cases, the implementation of the System.Management.Automation.Provider.Ipropertycmdletprovider.Getproperty*

method needs to ensure that the path passed to the method meets the requirements of the specified capabilities. To do this, the method should access the appropriate property, for example, the System.Management.Automation.Provider.Cmdletprovider.Exclude* and System.Management.Automation.Provider.Cmdletprovider.Include* properties.

- By default, overrides of this method should not retrieve a reader for objects that are hidden from the user unless the System.Management.Automation.Provider.Cmdletprovider.Force* property is set to `true`. An error should be written if the path represents an item that is hidden from the user and System.Management.Automation.Provider.Cmdletprovider.Force* is set to `false`.

Attaching Dynamic Parameters to the Get-ItemProperty Cmdlet

The `Get-ItemProperty` cmdlet might require additional parameters that are specified dynamically at runtime. To provide these dynamic parameters, the Windows PowerShell property provider must implement the System.Management.Automation.Provider.Ipropertycmdletprovider.Getpropertydynamicparameters* method. The `path` parameter indicates a fully-qualified provider-internal path, while the `providerSpecificPickList` parameter specifies the provider-specific properties entered on the command line. This parameter might be `null` or empty if the properties are piped to the cmdlet. In this case, this method returns an object that has properties and fields with parsing attributes similar to a cmdlet class or a System.Management.Automation.Runtimedefinedparameterdictionary object. The Windows PowerShell runtime uses the returned object to add the parameters to the cmdlet.

Here is the default implementation of System.Management.Automation.Provider.Ipropertycmdletprovider.Getpropertydynamicparameters* from the TemplateProvider.cs file provided by Windows PowerShell.

Setting Properties

To set properties, the Windows PowerShell property provider must implement the System.Management.Automation.Provider.Ipropertycmdletprovider.Setproperty* method to support calls from the `Set-ItemProperty` cmdlet. This method sets one or more properties of the item at the specified path, and overwrites the supplied properties as required.

System.Management.Automation.Provider.Ipropertycmdletprovider.Setproperty* also writes an instance of a System.Management.Automation.PSObject object that represents a property bag of the updated properties.

Here is the default implementation of System.Management.Automation.Provider.Ipropertycmdletprovider.Setproperty* from the TemplateProvider.cs file provided by Windows PowerShell.

Things to Remember About Implementing Set-ItemProperty

The following conditions may apply to an implementation of System.Management.Automation.Provider.Ipropertycmdletprovider.Setproperty*:

- When defining the provider class, a Windows PowerShell property provider might declare provider capabilities of ExpandWildcards, Filter, Include, or Exclude, from the System.Management.Automation.Provider.Providercapabilities enumeration. In these cases, the implementation of the System.Management.Automation.Provider.Ipropertycmdletprovider.Setproperty* method must ensure that the path passed to the method meets the requirements of the specified capabilities. To do this, the method should access the appropriate property, for example, the System.Management.Automation.Provider.Cmdletprovider.Exclude* and System.Management.Automation.Provider.Cmdletprovider.Include* properties.

- By default, overrides of this method should not retrieve a reader for objects that are hidden from the user unless the System.Management.Automation.Provider.Cmdletprovider.Force* property is set to `true`. An error should be written if the path represents an item that is hidden from the user and System.Management.Automation.Provider.Cmdletprovider.Force* is set to `false`.

- Your implementation of the System.Management.Automation.Provider.Ipropertycmdletprovider.Setproperty* method should call System.Management.Automation.Provider.Cmdletprovider.ShouldProcess and verify its return value before making any changes to the data store. This method is used to confirm execution of an operation when a change is made to system state, for example, renaming files. System.Management.Automation.Provider.Cmdletprovider.ShouldProcess sends the name of the resource to be changed to the user, with the Windows PowerShell runtime and handling any command-line settings or preference variables in determining what should be displayed.

After the call to System.Management.Automation.Provider.Cmdletprovider.ShouldProcess returns `true`, if potentially dangerous system modifications can be made, the System.Management.Automation.Provider.Ipropertycmdletprovider.Setproperty* method should call the System.Management.Automation.Provider.Cmdletprovider.ShouldContinue method. This method sends a confirmation message to the user to allow additional feedback to indicate that the operation should be continued.

Attaching Dynamic Parameters for the Set-ItemProperty Cmdlet

The `Set-ItemProperty` cmdlet might require additional parameters that are specified dynamically at runtime. To provide these dynamic parameters, the Windows PowerShell property provider must implement the System.Management.Automation.Provider.Ipropertycmdletprovider.Setpropertydynamicparameters* method. This method returns an object that has properties and fields with parsing attributes similar to a cmdlet class or a System.Management.Automation.Runtimedefinedparameterdictionary object. The `null` value can be returned if no dynamic parameters are to be added.

Here is the default implementation of System.Management.Automation.Provider.Ipropertycmdletprovider.Getpropertydynamicparameters* from the TemplateProvider.cs file provided by Windows PowerShell.

Clearing Properties

To clear properties, the Windows PowerShell property provider must implement the System.Management.Automation.Provider.Ipropertycmdletprovider.Clearproperty* method to support calls from the `Clear-ItemProperty` cmdlet. This method sets one or more properties for the item located at the specified path.

Here is the default implementation of System.Management.Automation.Provider.Ipropertycmdletprovider.Clearproperty* from the TemplateProvider.cs file provided by Windows PowerShell.

Thing to Remember About Implementing ClearProperty

The following conditions may apply to your implementation of System.Management.Automation.Provider.Ipropertycmdletprovider.Clearproperty*:

- When defining the provider class, a Windows PowerShell property provider might declare provider capabilities of ExpandWildcards, Filter, Include, or Exclude, from the System.Management.Automation.Provider.Providercapabilities enumeration. In these cases, the implementation of the System.Management.Automation.Provider.Ipropertycmdletprovider.Clearproperty* method needs to ensure that the path passed to the method meets the requirements of the specified capabilities. To do this, the method should access the appropriate property, for example, the System.Management.Automation.Provider.Cmdletprovider.Exclude* and System.Management.Automation.Provider.Cmdletprovider.Include* properties.

- By default, overrides of this method should not retrieve a reader for objects that are hidden from the user unless the System.Management.Automation.Provider.Cmdletprovider.Force* property is set to `true`. An error should be written if the path represents an item that is hidden from the user and System.Management.Automation.Provider.Cmdletprovider.Force* is set to `false`.

- Your implementation of the System.Management.Automation.Provider.Ipropertycmdletprovider.Clearproperty* method should call System.Management.Automation.Provider.Cmdletprovider.ShouldProcess and verify its return value before making any changes to the data store. This method is used to confirm execution of an operation before a change is made to system state, such as clearing content. System.Management.Automation.Provider.Cmdletprovider.ShouldProcess sends the name of the resource to be changed to the user, with the Windows PowerShell runtime taking into account any command line settings or preference variables in determining what should be displayed.

  After the call to System.Management.Automation.Provider.Cmdletprovider.ShouldProcess returns `true`, if potentially dangerous system modifications can be made, the System.Management.Automation.Provider.Ipropertycmdletprovider.Clearproperty* method should call the System.Management.Automation.Provider.Cmdletprovider.ShouldContinue method. This method sends a confirmation message to the user to allow additional feedback to indicate that the potentially dangerous operation should be continued.

Attaching Dynamic Parameters to the Clear-ItemProperty Cmdlet

The `Clear-ItemProperty` cmdlet might require additional parameters that are specified dynamically at runtime. To provide these dynamic parameters, the Windows PowerShell property provider must implement the System.Management.Automation.Provider.Ipropertycmdletprovider.Clearpropertydynamicparameters* method. This method returns an object that has properties and fields with parsing attributes similar to a cmdlet class or a System.Management.Automation.Runtimedefinedparameterdictionary object. The `null` value can be returned if no dynamic parameters are to be added.

Here is the default implementation of System.Management.Automation.Provider.Ipropertycmdletprovider.Clearpropertydynamicparameters* from the TemplateProvider.cs file provided by Windows PowerShell.

Building the Windows PowerShell provider

See How to Register Cmdlets, Providers, and Host Applications .

See Also

Windows PowerShell provider

Design Your Windows PowerShell provider

Extending Object Types and Formatting

How to Register Cmdlets, Providers, and Host Applications

How to Create a Console Shell

Article • 09/17/2021

Windows PowerShell provides a Make-Shell tool, also referred to as the "make-kit", that is used to create a console shell that is not extensible. Shells created with this new tool cannot be extended later through a Windows PowerShell snap-in.

Syntax

Here is the syntax used to run Make-Shell from within a make-file.

```
make-shell
  -out n.exe
  -namespace ns
  [ -lib libdirectory1[,libdirectory2,..] ]
  [ -reference ca1.dll[,ca2.dll,...] ]
  [ -formatdata fd1.format.ps1xml[,fd2.format.ps1xml,...] ]
  [ -typedata td1.type.ps1xml[,td2.type.ps1xml,...] ]
  [ -source c1.cs [,c2.cs,...] ]
  [ -authorizationmanager authorizationManagerType ]
  [ -win32icon i.ico ]
  [ -initscript p.ps1 ]
  [ -builtinscript s1.ps1[,s2.ps1,...] ]
  [ -resource resourcefile.txt ]
  [ -cscflags cscFlags ]
  [ -? | -help ]
```

Parameters

Here is a brief description of the parameters of Make-Shell.

⊗ Caution

UNC paths to assemblies are not supported by Make-Shell.

Parameter	Description

Parameter	Description
-out n.exe	Required. The name of the shell to produce. The path is specified as part of this parameter. Make-shell will append ".exe" to this value if it is not specified. **Caution:** Do not create an output file with the same name as the referenced .dll file. If you attempt this, the Make-Shell tool creates a .cs file with the same name, which will overwrite the .cs file that has your cmdlet source code.
-namespace ns	Required. The namespace to use for the derived System.Management.Automation.Runspaces.Runspaceconfiguration class that the make-kit generates and compiles.
-lib libdirectory1[,libdirectory2,..]	The directories that are searched for .NET assemblies, including the Windows PowerShell assemblies, assemblies specified by the `reference` parameter, assemblies indirectly referenced by another assembly, and the .NET system assemblies.
-reference ca1.dll[,ca2.dll,...]	A comma-separated list of the assemblies to include in the shell. These assemblies includes all cmdlet and provider assemblies, as well as resource assemblies that should be loaded. If this parameter is not specified, then a shell is produced that contains only the core cmdlets and providers provided by Windows PowerShell. The assemblies can be specified using their full path, otherwise they will be searched for using the path specified by the `lib` parameter.
-formatdata fd1.format.ps1xml[,fd2.format.ps1xml,...]	A comma-separated list of format data to include in the shell. If this parameter is not specified, then a shell is produced that contains only the format data provided by Windows PowerShell.
-typedata td1.type.ps1xml[,td2.type.ps1xml,...]	A comma-separated list of type data to include in the shell. If this parameter is not specified, then a shell is produced that contains only the type data provided by Windows PowerShell.
-source c1.cs [,c2.cs,...]	The name of a file, provided by the shell developer, that contains any source code needed to build the shell. The source code file can contain any of the following source code: - The Authorization manager implementation that overrides the default authorization manager. (This could also be supplied compiled into an assembly.) - Assembly informational attribute declarations: such as the AssemblyCompanyAttribute, AssemblyCopyrightAttribute, AssemblyFileVersionAttribute, AssemblyInformationalVersionAttribute, AssemblyProductAttribute, and AssemblyTrademarkAttribute.

Parameter	Description
-authorizationmanager authorizationManagerType	The type that contains the authorization manager implementation. This can be defined in source code, or compiled into an assembly (specified by the `reference` parameter). If this parameter is not specified, the default security manager is used. The value should be the full type name, including namespaces.
-win32icon i.ico	The icon for the .exe file for the shell. If not specified, then the shell will have the icon that the c# compiler includes (if any).
-initscript p.ps1	The startup profile for the shell. The file is included "as-is"; no validity checking is done by Make-Shell.
-builtinscript s1.ps1[,s2.ps1,...]	A list of built-in scripts for the shell. These scripts are discovered before scripts in the path, and their contents cannot be changed once the shell is built. The files are included "as-is"; no validity checking is done by Make-Shell.
-resource resourcefile.txt	The .txt file containing help and banner resources for the shell. The first resource is named ShellHelp, and contains the text displayed if the shell is invoked with the `help` parameter. The second resource is named ShellBanner, and it contains the text and copyright information displayed when the shell is launched in interactive mode. If this parameter is not provided, or these resources are not present, then a generic help and banner are used.
-cscflags cscFlags	Flags that should be passed to the C# compiler (csc.exe). These are passed through unchanged. If this parameter includes spaces, it should be surrounded in double-quotes.
-? -help	Displays the copyright message and Make-Shell command line options.
-verbose	Displays detailed information while the shell is being created.

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

Windows PowerShell Concepts

Article • 10/22/2021

This section contains conceptual information that will help you understand PowerShell from a developer's viewpoint.

Topic Name	Description
about_Objects	Description of PowerShell objects. For more information, see About Object Creation
Creating Runspaces	The operating environments where commands are processed. For more information, see Runspace Class.
Extending Output Objects	How to extend PowerShell objects. For more information, see About Types.ps1xml
Registering Cmdlets	How to make modules and snap-ins available in PowerShell. For more information, see Modules and Snap-ins.
Requesting Confirmation from Cmdlets	How cmdlets and providers request feedback from the user before an action is taken.
RuntimeDefinedParameter Class	Runtime parameter declarations.
System.Management.Automation Namespace	Overview of PowerShell API namespaces.
Windows PowerShell Provider Overview	Overview about PowerShell providers that are used to access data stores.
Writing Help for PowerShell Cmdlets	How to write PowerShell cmdlet Help.

See also

PowerShell Class

PowerShell API Reference

Windows PowerShell Programmer's Guide

Writing Help for Windows PowerShell Modules

Writing a Windows PowerShell Provider

Windows PowerShell API Reference

Windows PowerShell Sample Code

Article • 09/17/2021

Windows PowerShell® samples are available through the Windows SDK. This section contains the sample code that is contained in the Windows SDK samples.

> **Note**
>
> When the Windows SDK is installed, a **Samples** directory is created in which all the Windows PowerShell samples are made available. A typical installation directory is **C:\Program Files\Microsoft SDKs\Windows\v6.0**. Start Windows PowerShell and type **"cd Samples\SysMgmt\PowerShell"** to locate the Windows PowerShell Samples directory. In this document, the Windows PowerShell Samples directory is referred to as <**PowerShell Samples**>.

Sample Code Listing

Sample Code	Description
AccessDbProviderSample01 Code Sample	This is the provider described in Creating a Basic Windows PowerShell Provider.
AccessDbProviderSample02 Code Sample	This is the provider described in Creating a Windows PowerShell Drive Provider.
AccessDbProviderSample03 Code Sample	This is the provider described in Creating a Windows PowerShell Item Provider.
AccessDbProviderSample04 Code Sample	This is the provider described in Creating a Windows PowerShell Container Provider.
AccessDbProviderSample05 Code Sample	This is the provider described in Creating a Windows PowerShell Navigation Provider.
AccessDbProviderSample06 Code Sample	This is the provider described in Creating a Windows PowerShell Content Provider.
GetProc01 Code Samples	This is the basic `Get-Process` cmdlet sample described in Creating Your First Cmdlet.
GetProc02 Code Samples	This is the `Get-Process` cmdlet sample described in Adding Parameters that Process Command-Line Input.

Sample Code	Description
GetProc03 Code Samples	This is the `Get-Process` cmdlet sample described in Adding Parameters that Process Pipeline Input.
GetProc04 Code Samples	This is the `Get-Process` cmdlet sample described in Adding Nonterminating Error Reporting to Your Cmdlet.
GetProc05 Code Samples	This `Get-Process` cmdlet is similar to the cmdlet described in Adding Nonterminating Error Reporting to Your Cmdlet.
StopProc01 Code Samples	This is the `Stop-Process` cmdlet sample described in Creating a Cmdlet That Modifies the System.
StopProcessSample04 Code Samples	This is the `Stop-Process` cmdlet sample described in Adding Parameter Sets to a Cmdlet.
Runspace01 Code Samples	These are the code samples for the runspace described in Creating a Console Application That Runs a Specified Command.
Runspace02 Code Samples	This sample uses the System.Management.Automation.Runspaceinvoke class to execute the `Get-Process` cmdlet synchronously.
RunSpace03 Code Samples	These are the code samples for the runspace described in "Creating a Console Application That Runs a Specified Script".
RunSpace04 Code Samples	This is a code sample for a runspace that uses the System.Management.Automation.Runspaceinvoke class to execute a script that generates a terminating error.
RunSpace05 Code Sample	
RunSpace06 Code Sample	
RunSpace07 Code Sample	
RunSpace08 Code Sample	
RunSpace09 Code Sample	
RunSpace10 Code Sample	This is the source code for the Runspace10 sample, which adds a cmdlet to System.Management.Automation.Runspaces.Runspaceconfiguration and then uses the modified configuration information to create the runspace.

See Also

Windows PowerShell Programmer's Guide

AccessDbProviderSample01 Code Sample

Article • 09/17/2021

The following code shows the implementation of the Windows PowerShell provider described in Creating a Basic Windows PowerShell Provider. This implementation provides methods for starting and stopping the provider, and although it does not provide a means to access a data store or to get or set the data in the data store, it does provide the basic functionality that is required by all providers.

> **Note**
>
> You can download the C# source file (AccessDBSampleProvider01.cs) for this provider by using the Windows Software Development Kit for Windows Vista and Microsoft .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded source files are available in the **<PowerShell Samples>** directory. For more information about other Windows PowerShell provider implementations, see **Designing Your Windows PowerShell Provider**.

Code Sample

C#

```
using System.Management.Automation;
using System.Management.Automation.Provider;
using System.ComponentModel;


namespace Microsoft.Samples.PowerShell.Providers
{
   #region AccessDBProvider

    /// <summary>
   /// Simple provider.
   /// </summary>
   [CmdletProvider("AccessDB", ProviderCapabilities.None)]
   public class AccessDBProvider : CmdletProvider
   {

   }
```

```
    #endregion AccessDBProvider
}
```

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

AccessDbProviderSample02 Code Sample

Article • 09/17/2021

The following code shows the implementation of the Windows PowerShell provider described in Creating a Windows PowerShell Drive Provider. This implementation creates a path, makes a connection to an Access database, and then removes the drive.

> **Note**
>
> You can download the C# source file (AccessDBSampleProvider02.cs) for this provider using the Microsoft Windows Software Development Kit for Windows Vista and Microsoft .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded source files are available in the **<PowerShell Samples>** directory. For more information about other Windows PowerShell provider implementations, see **Designing Your Windows PowerShell Provider**.

Code Sample

C#

```
using System;
using System.IO;
using System.Data;
using System.Data.Odbc;
using System.Management.Automation;
using System.Management.Automation.Provider;
using System.ComponentModel;

namespace Microsoft.Samples.PowerShell.Providers
{
   #region AccessDBProvider

    /// <summary>
   /// A PowerShell Provider which acts upon a access data store.
   /// </summary>
   /// <remarks>
   /// This example only demonstrates the drive overrides
   /// </remarks>
   [CmdletProvider("AccessDB", ProviderCapabilities.None)]
   public class AccessDBProvider : DriveCmdletProvider
   {
       #region Drive Manipulation
```

```
        /// <summary>
        /// Create a new drive.  Create a connection to the database file and
set
        /// the Connection property in the PSDriveInfo.
        /// </summary>
        /// <param name="drive">
        /// Information describing the drive to add.
        /// </param>
        /// <returns>The added drive.</returns>
        protected override PSDriveInfo NewDrive(PSDriveInfo drive)
        {
            // check if drive object is null
            if (drive == null)
            {
                WriteError(new ErrorRecord(
                    new ArgumentNullException("drive"),
                    "NullDrive",
                    ErrorCategory.InvalidArgument,
                    null)
                );

                return null;
            }

            // check if drive root is not null or empty
            // and if its an existing file
            if (String.IsNullOrEmpty(drive.Root) || (File.Exists(drive.Root)
== false))
            {
                WriteError(new ErrorRecord(
                    new ArgumentException("drive.Root"),
                    "NoRoot",
                    ErrorCategory.InvalidArgument,
                    drive)
                );

                return null;
            }

            // create a new drive and create an ODBC connection to the new
drive
            AccessDBPSDriveInfo accessDBPSDriveInfo = new
AccessDBPSDriveInfo(drive);

            OdbcConnectionStringBuilder builder = new
OdbcConnectionStringBuilder();

            builder.Driver = "Microsoft Access Driver (*.mdb)";
            builder.Add("DBQ", drive.Root);

            OdbcConnection conn = new
OdbcConnection(builder.ConnectionString);
            conn.Open();
            accessDBPSDriveInfo.Connection = conn;
```

```
            return accessDBPSDriveInfo;
        } // NewDrive

        /// <summary>
        /// Removes a drive from the provider.
        /// </summary>
        /// <param name="drive">The drive to remove.</param>
        /// <returns>The drive removed.</returns>
        protected override PSDriveInfo RemoveDrive(PSDriveInfo drive)
        {
            // check if drive object is null
            if (drive == null)
            {
                WriteError(new ErrorRecord(
                    new ArgumentNullException("drive"),
                    "NullDrive",
                    ErrorCategory.InvalidArgument,
                    drive)
                );

               return null;
            }

            // close ODBC connection to the drive
            AccessDBPSDriveInfo accessDBPSDriveInfo = drive as
AccessDBPSDriveInfo;

            if (accessDBPSDriveInfo == null)
            {
                return null;
            }
            accessDBPSDriveInfo.Connection.Close();

            return accessDBPSDriveInfo;
        } // RemoveDrive

        #endregion Drive Manipulation

    } // AccessDBProvider

    #endregion AccessDBProvider

    #region AccessDBPSDriveInfo

    /// <summary>
    /// Any state associated with the drive should be held here.
    /// In this case, it's the connection to the database.
    /// </summary>
    internal class AccessDBPSDriveInfo : PSDriveInfo
    {
        private OdbcConnection connection;

        /// <summary>
        /// ODBC connection information.
```

```
        /// </summary>
        public OdbcConnection Connection
        {
            get { return connection; }
            set { connection = value; }
        }

        /// <summary>
        /// Constructor that takes one argument
        /// </summary>
        /// <param name="driveInfo">Drive provided by this provider</param>
        public AccessDBPSDriveInfo(PSDriveInfo driveInfo)
            : base(driveInfo)
        { }

    } // class AccessDBPSDriveInfo

    #endregion AccessDBPSDriveInfo
}
```

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

AccessDbProviderSample03 Code Sample

Article • 11/05/2021

The following code shows the implementation of the Windows PowerShell provider described in Creating a Windows PowerShell Item Provider. This provider that can manipulate the data in a data store.

> **Note**
>
> You can download the C# source file (AccessDBSampleProvider03.cs) for this provider using the Microsoft Windows Software Development Kit for Windows Vista and .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded source files are available in the **<PowerShell Samples>** directory. For more information about other Windows PowerShell provider implementations, see **Designing Your Windows PowerShell Provider**.

Code Sample

C#

```
using System;
using System.IO;
using System.Data;
using System.Data.Odbc;
using System.Collections.ObjectModel;
using System.Text;
using System.Diagnostics;
using System.Text.RegularExpressions;
using System.Management.Automation;
using System.Management.Automation.Provider;
using System.ComponentModel;
using System.Globalization;

namespace Microsoft.Samples.PowerShell.Providers
{
   #region AccessDBProvider

    /// <summary>
    /// A PowerShell Provider which acts upon a access database.
    /// </summary>
    /// <remarks>
    /// This example implements the item overloads.
```

```
    /// </remarks>
   [CmdletProvider("AccessDB", ProviderCapabilities.None)]

   public class AccessDBProvider : ItemCmdletProvider
   {
      #region Drive Manipulation

       /// <summary>
       /// Create a new drive.  Create a connection to the database file and
set
       /// the Connection property in the PSDriveInfo.
       /// </summary>
       /// <param name="drive">
       /// Information describing the drive to add.
       /// </param>
       /// <returns>The added drive.</returns>
       protected override PSDriveInfo NewDrive(PSDriveInfo drive)
       {
           // check if drive object is null
           if (drive == null)
           {
               WriteError(new ErrorRecord(
                   new ArgumentNullException("drive"),
                   "NullDrive",
                   ErrorCategory.InvalidArgument,
                   null)
               );

               return null;
           }

           // check if drive root is not null or empty
           // and if its an existing file
           if (String.IsNullOrEmpty(drive.Root) || (File.Exists(drive.Root)
== false))
           {
               WriteError(new ErrorRecord(
                   new ArgumentException("drive.Root"),
                   "NoRoot",
                   ErrorCategory.InvalidArgument,
                   drive)
               );

               return null;
           }

           // create a new drive and create an ODBC connection to the new
drive
           AccessDBPSDriveInfo accessDBPSDriveInfo = new
AccessDBPSDriveInfo(drive);

           OdbcConnectionStringBuilder builder = new
OdbcConnectionStringBuilder();

           builder.Driver = "Microsoft Access Driver (*.mdb)";
```

```
            builder.Add("DBQ", drive.Root);

            OdbcConnection conn = new
OdbcConnection(builder.ConnectionString);
            conn.Open();
            accessDBPSDriveInfo.Connection = conn;

            return accessDBPSDriveInfo;
        } // NewDrive

        /// <summary>
        /// Removes a drive from the provider.
        /// </summary>
        /// <param name="drive">The drive to remove.</param>
        /// <returns>The drive removed.</returns>
        protected override PSDriveInfo RemoveDrive(PSDriveInfo drive)
        {
            // check if drive object is null
            if (drive == null)
            {
                WriteError(new ErrorRecord(
                    new ArgumentNullException("drive"),
                    "NullDrive",
                    ErrorCategory.InvalidArgument,
                    drive)
                );

                return null;
            }

            // close ODBC connection to the drive
            AccessDBPSDriveInfo accessDBPSDriveInfo = drive as
AccessDBPSDriveInfo;

            if (accessDBPSDriveInfo == null)
            {
                return null;
            }
            accessDBPSDriveInfo.Connection.Close();

            return accessDBPSDriveInfo;
        } // RemoveDrive

        #endregion Drive Manipulation

        #region Item Methods

       /// <summary>
       /// Retrieves an item using the specified path.
       /// </summary>
       /// <param name="path">The path to the item to return.</param>
       protected override void GetItem(string path)
       {
           // check if the path represented is a drive
           if (PathIsDrive(path))
```

```
            {
                WriteItemObject(this.PSDriveInfo, path, true);
                return;
            }// if (PathIsDrive...

            // Get table name and row information from the path and do
            // necessary actions
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type == PathType.Table)
            {
                DatabaseTableInfo table = GetTable(tableName);
                WriteItemObject(table, path, true);
            }
            else if (type == PathType.Row)
            {
                DatabaseRowInfo row = GetRow(tableName, rowNumber);
                WriteItemObject(row, path, false);
            }
            else
            {
                ThrowTerminatingInvalidPathException(path);
            }

        } // GetItem

        /// <summary>
        /// Set the content of a row of data specified by the supplied path
        /// parameter.
        /// </summary>
        /// <param name="path">Specifies the path to the row whose columns
        /// will be updated.</param>
        /// <param name="values">Comma separated string of values</param>
        protected override void SetItem(string path, object values)
        {
            // Get type, table name and row number from the path specified
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type != PathType.Row)
            {
                WriteError(new ErrorRecord(new NotSupportedException(
                      "SetNotSupported"), "",
                   ErrorCategory.InvalidOperation, path));

                return;
            }
```

```
            // Get in-memory representation of table
            OdbcDataAdapter da = GetAdapterForTable(tableName);

            if (da == null)
            {
                return;
            }
            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);

            if (rowNumber >= table.Rows.Count)
            {
                // The specified row number has to be available. If not
                // NewItem has to be used to add a new row
                throw new ArgumentException("Row specified is not
available");
            } // if (rowNum...

            string[] colValues = (values as string).Split(',');

            // set the specified row
            DataRow row = table.Rows[rowNumber];

            for (int i = 0; i < colValues.Length; i++)
            {
                row[i] = colValues[i];
            }

            // Update the table
            if (ShouldProcess(path, "SetItem"))
            {
                da.Update(ds, tableName);
            }

        } // SetItem

        /// <summary>
        /// Test to see if the specified item exists.
        /// </summary>
        /// <param name="path">The path to the item to verify.</param>
        /// <returns>True if the item is found.</returns>
        protected override bool ItemExists(string path)
        {
            // check if the path represented is a drive
            if (PathIsDrive(path))
            {
                return true;
            }

            // Obtain type, table name and row number from path
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);
```

```
            DatabaseTableInfo table = GetTable(tableName);

            if (type == PathType.Table)
            {
                // if specified path represents a table then
DatabaseTableInfo
                // object for the same should exist
                if (table != null)
                {
                    return true;
                }
            }
            else if (type == PathType.Row)
            {
                // if specified path represents a row then DatabaseTableInfo
should
                // exist for the table and then specified row number must be
within
                // the maximum row count in the table
                if (table != null && rowNumber < table.RowCount)
                {
                    return true;
                }
            }

            return false;

        } // ItemExists

        /// <summary>
        /// Test to see if the specified path is syntactically valid.
        /// </summary>
        /// <param name="path">The path to validate.</param>
        /// <returns>True if the specified path is valid.</returns>
        protected override bool IsValidPath(string path)
        {
            bool result = true;

            // check if the path is null or empty
            if (String.IsNullOrEmpty(path))
            {
                result = false;
            }

            // convert all separators in the path to a uniform one
            path = NormalizePath(path);

            // split the path into individual chunks
            string[] pathChunks = path.Split(pathSeparator.ToCharArray());

            foreach (string pathChunk in pathChunks)
            {
                if (pathChunk.Length == 0)
                {
```

```
                result = false;
            }
        }
        return result;
    } // IsValidPath

    #endregion Item Overloads

    #region Helper Methods

    /// <summary>
    /// Checks if a given path is actually a drive name.
    /// </summary>
    /// <param name="path">The path to check.</param>
    /// <returns>
    /// True if the path given represents a drive, false otherwise.
    /// </returns>
    private bool PathIsDrive(string path)
    {
        // Remove the drive name and first path separator.  If the
        // path is reduced to nothing, it is a drive. Also if its
        // just a drive then there wont be any path separators
        if (String.IsNullOrEmpty(
                    path.Replace(this.PSDriveInfo.Root, "")) ||
            String.IsNullOrEmpty(
                    path.Replace(this.PSDriveInfo.Root + pathSeparator,
""))

           )
        {
            return true;
        }
        else
        {
            return false;
        }
    } // PathIsDrive

    /// <summary>
    /// Breaks up the path into individual elements.
    /// </summary>
    /// <param name="path">The path to split.</param>
    /// <returns>An array of path segments.</returns>
    private string[] ChunkPath(string path)
    {
        // Normalize the path before splitting
        string normalPath = NormalizePath(path);

        // Return the path with the drive name and first path
        // separator character removed, split by the path separator.
        string pathNoDrive = normalPath.Replace(this.PSDriveInfo.Root
                                        + pathSeparator, "");

        return pathNoDrive.Split(pathSeparator.ToCharArray());
    } // ChunkPath
```

```
        /// <summary>
        /// Adapts the path, making sure the correct path separator
        /// character is used.
        /// </summary>
        /// <param name="path"></param>
        /// <returns></returns>
        private string NormalizePath(string path)
        {
            string result = path;

            if (!String.IsNullOrEmpty(path))
            {
                result = path.Replace("/", pathSeparator);
            }

            return result;
        } // NormalizePath

        /// <summary>
        /// Chunks the path and returns the table name and the row number
        /// from the path
        /// </summary>
        /// <param name="path">Path to chunk and obtain information</param>
        /// <param name="tableName">Name of the table as represented in the
        /// path</param>
        /// <param name="rowNumber">Row number obtained from the path</param>
        /// <returns>what the path represents</returns>
        private PathType GetNamesFromPath(string path, out string tableName,
out int rowNumber)
        {
            PathType retVal = PathType.Invalid;
            rowNumber = -1;
            tableName = null;

            // Check if the path specified is a drive
            if (PathIsDrive(path))
            {
                return PathType.Database;
            }

            // chunk the path into parts
            string[] pathChunks = ChunkPath(path);

            switch (pathChunks.Length)
            {
                case 1:
                    {
                        string name = pathChunks[0];

                        if (TableNameIsValid(name))
                        {
                            tableName = name;
                            retVal = PathType.Table;
                        }
```

```
                }
                break;

            case 2:
                {
                    string name = pathChunks[0];

                    if (TableNameIsValid(name))
                    {
                        tableName = name;
                    }

                    int number = SafeConvertRowNumber(pathChunks[1]);

                    if (number >= 0)
                    {
                        rowNumber = number;
                        retVal = PathType.Row;
                    }
                    else
                    {
                        WriteError(new ErrorRecord(
                            new ArgumentException("Row number is not
valid"),
                            "RowNumberNotValid",
                            ErrorCategory.InvalidArgument,
                            path));
                    }
                }
                break;

            default:
                {
                    WriteError(new ErrorRecord(
                        new ArgumentException("The path supplied has too
many segments"),
                        "PathNotValid",
                        ErrorCategory.InvalidArgument,
                        path));
                }
                break;
        } // switch(pathChunks...

        return retVal;
    } // GetNamesFromPath

    /// <summary>
    /// Throws an argument exception stating that the specified path does
    /// not represent either a table or a row
    /// </summary>
    /// <param name="path">path which is invalid</param>
    private void ThrowTerminatingInvalidPathException(string path)
    {
        StringBuilder message = new StringBuilder("Path must represent
either a table or a row :");
```

```
            message.Append(path);

            throw new ArgumentException(message.ToString());
        }

        /// <summary>
        /// Retrieve the list of tables from the database.
        /// </summary>
        /// <returns>
        /// Collection of DatabaseTableInfo objects, each object representing
        /// information about one database table
        /// </returns>
        private Collection<DatabaseTableInfo> GetTables()
        {
            Collection<DatabaseTableInfo> results =
                    new Collection<DatabaseTableInfo>();

            // using ODBC connection to the database and get the schema of
tables
            AccessDBPSDriveInfo di = this.PSDriveInfo as AccessDBPSDriveInfo;

            if (di == null)
            {
                return null;
            }

            OdbcConnection connection = di.Connection;
            DataTable dt = connection.GetSchema("Tables");
            int count;

            // iterate through all rows in the schema and create
DatabaseTableInfo
            // objects which represents a table
            foreach (DataRow dr in dt.Rows)
            {
                String tableName = dr["TABLE_NAME"] as String;
                DataColumnCollection columns = null;

                // find the number of rows in the table
                try
                {
                    String cmd = "Select count(*) from \"" + tableName + "\"";
                    OdbcCommand command = new OdbcCommand(cmd, connection);

                    count = (Int32)command.ExecuteScalar();
                }
                catch
                {
                    count = 0;
                }

                // create DatabaseTableInfo object representing the table
                DatabaseTableInfo table =
                        new DatabaseTableInfo(dr, tableName, count, columns);
```

```
                results.Add(table);
            } // foreach (DataRow...

            return results;
        } // GetTables

        /// <summary>
        /// Return row information from a specified table.
        /// </summary>
        /// <param name="tableName">The name of the database table from
        /// which to retrieve rows.</param>
        /// <returns>Collection of row information objects.</returns>
        private Collection<DatabaseRowInfo> GetRows(string tableName)
        {
            Collection<DatabaseRowInfo> results =
                        new Collection<DatabaseRowInfo>();

            // Obtain rows in the table and add it to the collection
            try
            {
                OdbcDataAdapter da = GetAdapterForTable(tableName);

                if (da == null)
                {
                    return null;
                }

                DataSet ds = GetDataSetForTable(da, tableName);
                DataTable table = GetDataTable(ds, tableName);

                int i = 0;
                foreach (DataRow row in table.Rows)
                {
                    results.Add(new DatabaseRowInfo(row,
i.ToString(CultureInfo.CurrentCulture)));
                    i++;
                } // foreach (DataRow...
            }
            catch (Exception e)
            {
                WriteError(new ErrorRecord(e, "CannotAccessSpecifiedRows",
                    ErrorCategory.InvalidOperation, tableName));
            }

            return results;

        } // GetRows

        /// <summary>
        /// Retrieve information about a single table.
        /// </summary>
        /// <param name="tableName">The table for which to retrieve
        /// data.</param>
        /// <returns>Table information.</returns>
        private DatabaseTableInfo GetTable(string tableName)
```

```
      {
          foreach (DatabaseTableInfo table in GetTables())
          {
              if (String.Equals(tableName, table.Name,
StringComparison.OrdinalIgnoreCase))
              {
                  return table;
              }
          }

          return null;
      } // GetTable

      /// <summary>
      /// Obtain a data adapter for the specified Table
      /// </summary>
      /// <param name="tableName">Name of the table to obtain the
      /// adapter for</param>
      /// <returns>Adapter object for the specified table</returns>
      /// <remarks>An adapter serves as a bridge between a DataSet (in
memory
      /// representation of table) and the data source</remarks>
      private OdbcDataAdapter GetAdapterForTable(string tableName)
      {
          OdbcDataAdapter da = null;
          AccessDBPSDriveInfo di = this.PSDriveInfo as AccessDBPSDriveInfo;

          if (di == null || !TableNameIsValid(tableName) ||
!TableIsPresent(tableName))
          {
              return null;
          }

          OdbcConnection connection = di.Connection;

          try
          {
              // Create a odbc data adpater. This can be sued to update the
              // data source with the records that will be created here
              // using data sets
              string sql = "Select * from " + tableName;
              da = new OdbcDataAdapter(new OdbcCommand(sql, connection));

              // Create a odbc command builder object. This will create sql
              // commands automatically for a single table, thus
              // eliminating the need to create new sql statements for
              // every operation to be done.
              OdbcCommandBuilder cmd = new OdbcCommandBuilder(da);

              // Open the connection if its not already open
              if (connection.State != ConnectionState.Open)
              {
                  connection.Open();
              }
          }
```

```
            catch (Exception e)
            {
                WriteError(new ErrorRecord(e, "CannotAccessSpecifiedTable",
                  ErrorCategory.InvalidOperation, tableName));
            }

            return da;
        } // GetAdapterForTable

        /// <summary>
        /// Gets the DataSet (in memory representation) for the table
        /// for the specified adapter
        /// </summary>
        /// <param name="adapter">Adapter to be used for obtaining
        /// the table</param>
        /// <param name="tableName">Name of the table for which a
        /// DataSet is required</param>
        /// <returns>The DataSet with the filled in schema</returns>
        private DataSet GetDataSetForTable(OdbcDataAdapter adapter, string
tableName)
        {
            Debug.Assert(adapter != null);

            // Create a dataset object which will provide an in-memory
            // representation of the data being worked upon in the
            // data source.
            DataSet ds = new DataSet();

            // Create a table named "Table" which will contain the same
            // schema as in the data source.
            //adapter.FillSchema(ds, SchemaType.Source);
            adapter.Fill(ds, tableName);
            ds.Locale = CultureInfo.InvariantCulture;

            return ds;
        } //GetDataSetForTable

        /// <summary>
        /// Get the DataTable object which can be used to operate on
        /// for the specified table in the data source
        /// </summary>
        /// <param name="ds">DataSet object which contains the tables
        /// schema</param>
        /// <param name="tableName">Name of the table</param>
        /// <returns>Corresponding DataTable object representing
        /// the table</returns>
        ///
        private DataTable GetDataTable(DataSet ds, string tableName)
        {
            Debug.Assert(ds != null);
            Debug.Assert(tableName != null);

            DataTable table = ds.Tables[tableName];
            table.Locale = CultureInfo.InvariantCulture;
```

```
            return table;
        } // GetDataTable

        /// <summary>
        /// Retrieves a single row from the named table.
        /// </summary>
        /// <param name="tableName">The table that contains the
        /// numbered row.</param>
        /// <param name="row">The index of the row to return.</param>
        /// <returns>The specified table row.</returns>
        private DatabaseRowInfo GetRow(string tableName, int row)
        {
            Collection<DatabaseRowInfo> di = GetRows(tableName);

            // if the row is invalid write an appropriate error else return
the
            // corresponding row information
            if (row < di.Count && row >= 0)
            {
                return di[row];
            }
            else
            {
                WriteError(new ErrorRecord(
                   new ItemNotFoundException(),
                   "RowNotFound",
                   ErrorCategory.ObjectNotFound,
                   row.ToString(CultureInfo.CurrentCulture))
                );
            }

            return null;
        } // GetRow

        /// <summary>
        /// Method to safely convert a string representation of a row number
        /// into its Int32 equivalent
        /// </summary>
        /// <param name="rowNumberAsStr">String representation of the row
        /// number</param>
        /// <remarks>If there is an exception, -1 is returned</remarks>
        private int SafeConvertRowNumber(string rowNumberAsStr)
        {
            int rowNumber = -1;
            try
            {
                rowNumber = Convert.ToInt32(rowNumberAsStr,
CultureInfo.CurrentCulture);
            }
            catch (FormatException fe)
            {
                WriteError(new ErrorRecord(fe, "RowStringFormatNotValid",
                    ErrorCategory.InvalidData, rowNumberAsStr));
            }
            catch (OverflowException oe)
```

```
            {
                WriteError(new ErrorRecord(oe,
"RowStringConversionToNumberFailed",
                    ErrorCategory.InvalidData, rowNumberAsStr));
            }

            return rowNumber;
        } // SafeConvertRowNumber

        /// <summary>
        /// Check if a table name is valid
        /// </summary>
        /// <param name="tableName">Table name to validate</param>
        /// <remarks>Helps to check for SQL injection attacks</remarks>
        private bool TableNameIsValid(string tableName)
        {
            Regex exp = new Regex(pattern, RegexOptions.Compiled |
RegexOptions.IgnoreCase);

            if (exp.IsMatch(tableName))
            {
                return true;
            }
            WriteError(new ErrorRecord(
                new ArgumentException("Table name not valid"),
"TableNameNotValid",
                    ErrorCategory.InvalidArgument, tableName));
            return false;
        } // TableNameIsValid

        /// <summary>
        /// Checks to see if the specified table is present in the
        /// database
        /// </summary>
        /// <param name="tableName">Name of the table to check</param>
        /// <returns>true, if table is present, false otherwise</returns>
        private bool TableIsPresent(string tableName)
        {
            // using ODBC connection to the database and get the schema of
tables
            AccessDBPSDriveInfo di = this.PSDriveInfo as AccessDBPSDriveInfo;
            if (di == null)
            {
                return false;
            }

            OdbcConnection connection = di.Connection;
            DataTable dt = connection.GetSchema("Tables");

            // check if the specified tableName is available
            // in the list of tables present in the database
            foreach (DataRow dr in dt.Rows)
            {
                string name = dr["TABLE_NAME"] as string;
                if (name.Equals(tableName,
```

```
StringComparison.OrdinalIgnoreCase))
                {
                    return true;
                }
            }

            WriteError(new ErrorRecord(
                new ArgumentException("Specified Table is not present in
database"), "TableNotAvailable",
                     ErrorCategory.InvalidArgument, tableName));

            return false;
        }// TableIsPresent

        #endregion Helper Methods

        #region Private Properties

        private string pathSeparator = "\\";
        private static string pattern = @"^[a-z]+[0-9]*_*$";

        private enum PathType { Database, Table, Row, Invalid };

        #endregion Private Properties
    }

     #endregion AccessDBProvider

     #region Helper Classes

    #region AccessDBPSDriveInfo

    /// <summary>
     /// Any state associated with the drive should be held here.
     /// In this case, it's the connection to the database.
     /// </summary>
     internal class AccessDBPSDriveInfo : PSDriveInfo
     {
         private OdbcConnection connection;

         /// <summary>
         /// ODBC connection information.
         /// </summary>
         public OdbcConnection Connection
         {
             get { return connection; }
             set { connection = value; }
         }

         /// <summary>
         /// Constructor that takes one argument
         /// </summary>
         /// <param name="driveInfo">Drive provided by this provider</param>
         public AccessDBPSDriveInfo(PSDriveInfo driveInfo)
             : base(driveInfo)
```

```
        { }

    } // class AccessDBPSDriveInfo

    #endregion AccessDBPSDriveInfo

    #region DatabaseTableInfo

    /// <summary>
    /// Contains information specific to the database table.
    /// Similar to the DirectoryInfo class.
    /// </summary>
    public class DatabaseTableInfo
    {
        /// <summary>
        /// Row from the "tables" schema
        /// </summary>
        public DataRow Data
        {
            get
            {
                return data;
            }
            set
            {
                data = value;
            }
        }
        private DataRow data;

        /// <summary>
        /// The table name.
        /// </summary>
        public string Name
        {
            get
            {
                return name;
            }
            set
            {
                name = value;
            }
        }
        private String name;

        /// <summary>
        /// The number of rows in the table.
        /// </summary>
        public int RowCount
        {
            get
            {
                return rowCount;
            }
```

```
            set
            {
                rowCount = value;
            }
        }
        private int rowCount;

        /// <summary>
        /// The column definitions for the table.
        /// </summary>
        public DataColumnCollection Columns
        {
            get
            {
                return columns;
            }
            set
            {
                columns = value;
            }
        }
        private DataColumnCollection columns;

        /// <summary>
        /// Constructor.
        /// </summary>
        /// <param name="row">The row definition.</param>
        /// <param name="name">The table name.</param>
        /// <param name="rowCount">The number of rows in the table.</param>
        /// <param name="columns">Information on the column tables.</param>
        public DatabaseTableInfo(DataRow row, string name, int rowCount,
                                 DataColumnCollection columns)
        {
            Name = name;
            Data = row;
            RowCount = rowCount;
            Columns = columns;
        } // DatabaseTableInfo
    } // class DatabaseTableInfo

    #endregion DatabaseTableInfo

    #region DatabaseRowInfo

    /// <summary>
    /// Contains information specific to an individual table row.
    /// Analogous to the FileInfo class.
    /// </summary>
    public class DatabaseRowInfo
    {
        /// <summary>
        /// Row data information.
        /// </summary>
        public DataRow Data
        {
```

```
            get
            {
                return data;
            }
            set
            {
                data = value;
            }
        }
        private DataRow data;

        /// <summary>
        /// The row index.
        /// </summary>
        public string RowNumber
        {
            get
            {
                return rowNumber;
            }
            set
            {
                rowNumber = value;
            }
        }
        private string rowNumber;

        /// <summary>
        /// Constructor.
        /// </summary>
        /// <param name="row">The row information.</param>
        /// <param name="name">The row index.</param>
        public DatabaseRowInfo(DataRow row, string name)
        {
            RowNumber = name;
            Data = row;
        } // DatabaseRowInfo
    } // class DatabaseRowInfo

    #endregion DatabaseRowInfo

    #endregion Helper Classes
}
```

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

AccessDbProviderSample04 Code Sample

Article • 09/17/2021

The following code shows the implementation of the Windows PowerShell provider described in Creating a Windows PowerShell Container Provider. This provider works on multi-layer data stores. For this type of data store, the top level of the store contains the root items and each subsequent level is referred to as a node of child items. By allowing the user to work on these child nodes, a user can interact hierarchically through the data store.

Code Sample

C#

```
using System;
using System.IO;
using System.Data;
using System.Data.Odbc;
using System.Data.OleDb;
using System.Diagnostics;
using System.Collections.ObjectModel;
using System.Text;
using System.Text.RegularExpressions;
using System.Management.Automation;
using System.Management.Automation.Provider;
using System.ComponentModel;
using System.Globalization;

namespace Microsoft.Samples.PowerShell.Providers
{
   #region AccessDBProvider

    /// <summary>
   /// A PowerShell Provider which acts upon an Access database
   /// </summary>
   /// <remarks>
   /// This example implements the container overloads</remarks>
   [CmdletProvider("AccessDB", ProviderCapabilities.None)]
   public class AccessDBProvider : ContainerCmdletProvider
   {

       #region Drive Manipulation

       /// <summary>
       /// Create a new drive.  Create a connection to the database file and
set
```

```
        /// the Connection property in the PSDriveInfo.
        /// </summary>
        /// <param name="drive">
        /// Information describing the drive to add.
        /// </param>
        /// <returns>The added drive.</returns>
        protected override PSDriveInfo NewDrive(PSDriveInfo drive)
        {
            // check if drive object is null
            if (drive == null)
            {
                WriteError(new ErrorRecord(
                    new ArgumentNullException("drive"),
                    "NullDrive",
                    ErrorCategory.InvalidArgument,
                    null)
                );

                return null;
            }

            // check if drive root is not null or empty
            // and if its an existing file
            if (String.IsNullOrEmpty(drive.Root) || (File.Exists(drive.Root)
== false))
            {
                WriteError(new ErrorRecord(
                    new ArgumentException("drive.Root"),
                    "NoRoot",
                    ErrorCategory.InvalidArgument,
                    drive)
                );

                return null;
            }


            // create a new drive and create an ODBC connection to the new
drive
            AccessDBPSDriveInfo accessDBPSDriveInfo = new
AccessDBPSDriveInfo(drive);

            OdbcConnectionStringBuilder builder = new
OdbcConnectionStringBuilder();

            builder.Driver = "Microsoft Access Driver (*.mdb)";
            builder.Add("DBQ", drive.Root);

            OdbcConnection conn = new
OdbcConnection(builder.ConnectionString);
            conn.Open();
            accessDBPSDriveInfo.Connection = conn;

            return accessDBPSDriveInfo;
        } // NewDrive
```

```
        /// <summary>
        /// Removes a drive from the provider.
        /// </summary>
        /// <param name="drive">The drive to remove.</param>
        /// <returns>The drive removed.</returns>
        protected override PSDriveInfo RemoveDrive(PSDriveInfo drive)
        {
            // check if drive object is null
            if (drive == null)
            {
                WriteError(new ErrorRecord(
                    new ArgumentNullException("drive"),
                    "NullDrive",
                    ErrorCategory.InvalidArgument,
                    drive)
                );

                return null;
            }

            // close ODBC connection to the drive
            AccessDBPSDriveInfo accessDBPSDriveInfo = drive as
AccessDBPSDriveInfo;

            if (accessDBPSDriveInfo == null)
            {
                return null;
            }
            accessDBPSDriveInfo.Connection.Close();

            return accessDBPSDriveInfo;
        } // RemoveDrive

        #endregion Drive Manipulation

        #region Item Methods

        /// <summary>
        /// Retrieves an item using the specified path.
        /// </summary>
        /// <param name="path">The path to the item to return.</param>
        protected override void GetItem(string path)
        {
            // check if the path represented is a drive
            if (PathIsDrive(path))
            {
                WriteItemObject(this.PSDriveInfo, path, true);
                return;
            }// if (PathIsDrive...

            // Get table name and row information from the path and do
            // necessary actions
            string tableName;
            int rowNumber;
```

```
            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type == PathType.Table)
            {
                DatabaseTableInfo table = GetTable(tableName);
                WriteItemObject(table, path, true);
            }
            else if (type == PathType.Row)
            {
                DatabaseRowInfo row = GetRow(tableName, rowNumber);
                WriteItemObject(row, path, false);
            }
            else
            {
                ThrowTerminatingInvalidPathException(path);
            }

        } // GetItem

        /// <summary>
        /// Set the content of a row of data specified by the supplied path
        /// parameter.
        /// </summary>
        /// <param name="path">Specifies the path to the row whose columns
        /// will be updated.</param>
        /// <param name="values">Comma separated string of values</param>
        protected override void SetItem(string path, object values)
        {
            // Get type, table name and row number from the path specified
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type != PathType.Row)
            {
                WriteError(new ErrorRecord(new NotSupportedException(
                      "SetNotSupported"), "",
                   ErrorCategory.InvalidOperation, path));

                return;
            }

            // Get in-memory representation of table
            OdbcDataAdapter da = GetAdapterForTable(tableName);

            if (da == null)
            {
                return;
            }
            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);
```

```
            if (rowNumber >= table.Rows.Count)
            {
                // The specified row number has to be available. If not
                // NewItem has to be used to add a new row
                throw new ArgumentException("Row specified is not
available");
            } // if (rowNum...

            string[] colValues = (values as string).Split(',');

            // set the specified row
            DataRow row = table.Rows[rowNumber];

            for (int i = 0; i < colValues.Length; i++)
            {
                row[i] = colValues[i];
            }

            // Update the table
            if (ShouldProcess(path, "SetItem"))
            {
                da.Update(ds, tableName);
            }

        } // SetItem

        /// <summary>
        /// Test to see if the specified item exists.
        /// </summary>
        /// <param name="path">The path to the item to verify.</param>
        /// <returns>True if the item is found.</returns>
        protected override bool ItemExists(string path)
        {
            // check if the path represented is a drive
            if (PathIsDrive(path))
            {
                return true;
            }

            // Obtain type, table name and row number from path
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            DatabaseTableInfo table = GetTable(tableName);

            if (type == PathType.Table)
            {
                // if specified path represents a table then
DatabaseTableInfo
                // object for the same should exist
                if (table != null)
```

```
                {
                    return true;
                }
            }
            else if (type == PathType.Row)
            {
                // if specified path represents a row then DatabaseTableInfo
should
                // exist for the table and then specified row number must be
within
                // the maximum row count in the table
                if (table != null && rowNumber < table.RowCount)
                {
                    return true;
                }
            }

            return false;

        } // ItemExists

        /// <summary>
        /// Test to see if the specified path is syntactically valid.
        /// </summary>
        /// <param name="path">The path to validate.</param>
        /// <returns>True if the specified path is valid.</returns>
        protected override bool IsValidPath(string path)
        {
            bool result = true;

            // check if the path is null or empty
            if (String.IsNullOrEmpty(path))
            {
                result = false;
            }

            // convert all separators in the path to a uniform one
            path = NormalizePath(path);

            // split the path into individual chunks
            string[] pathChunks = path.Split(pathSeparator.ToCharArray());

            foreach (string pathChunk in pathChunks)
            {
                if (pathChunk.Length == 0)
                {
                    result = false;
                }
            }
            return result;
        } // IsValidPath

        #endregion Item Overloads

        #region Container Overloads
```

```
        /// <summary>
        /// Return either the tables in the database or the datarows
        /// </summary>
        /// <param name="path">The path to the parent</param>
        /// <param name="recurse">True to return all child items recursively.
        /// </param>
        protected override void GetChildItems(string path, bool recurse)
        {
            // If path represented is a drive then the children in the path
are
            // tables. Hence all tables in the drive represented will have to
be
            // returned
            if (PathIsDrive(path))
            {
                foreach (DatabaseTableInfo table in GetTables())
                {
                    WriteItemObject(table, path, true);

                    // if the specified item exists and recurse has been set
then
                    // all child items within it have to be obtained as well
                    if (ItemExists(path) && recurse)
                    {
                        GetChildItems(path + pathSeparator + table.Name,
recurse);
                    }
                } // foreach (DatabaseTableInfo...
            } // if (PathIsDrive...
            else
            {
                // Get the table name, row number and type of path from the
                // path specified
                string tableName;
                int rowNumber;

                PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

                if (type == PathType.Table)
                {
                    // Obtain all the rows within the table
                    foreach (DatabaseRowInfo row in GetRows(tableName))
                    {
                        WriteItemObject(row, path + pathSeparator +
row.RowNumber,
                                        false);
                    } // foreach (DatabaseRowInfo...
                }
                else if (type == PathType.Row)
                {
                    // In this case the user has directly specified a row,
hence
                    // just give that particular row
```

```
                    DatabaseRowInfo row = GetRow(tableName, rowNumber);
                    WriteItemObject(row, path + pathSeparator +
row.RowNumber,
                                    false);
                }
                else
                {
                    // In this case, the path specified is not valid
                    ThrowTerminatingInvalidPathException(path);
                }
            } // else
        } // GetChildItems

        /// <summary>
        /// Return the names of all child items.
        /// </summary>
        /// <param name="path">The root path.</param>
        /// <param name="returnContainers">Not used.</param>
        protected override void GetChildNames(string path,
                                      ReturnContainers returnContainers)
        {
            // If the path represented is a drive, then the child items are
            // tables. get the names of all the tables in the drive.
            if (PathIsDrive(path))
            {
                foreach (DatabaseTableInfo table in GetTables())
                {
                    WriteItemObject(table.Name, path, true);
                } // foreach (DatabaseTableInfo...
            } // if (PathIsDrive...
            else
            {
                // Get type, table name and row number from path specified
                string tableName;
                int rowNumber;

                PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

                if (type == PathType.Table)
                {
                    // Get all the rows in the table and then write out the
                    // row numbers.
                    foreach (DatabaseRowInfo row in GetRows(tableName))
                    {
                        WriteItemObject(row.RowNumber, path, false);
                    } // foreach (DatabaseRowInfo...
                }
                else if (type == PathType.Row)
                {
                    // In this case the user has directly specified a row,
hence
                    // just give that particular row
                    DatabaseRowInfo row = GetRow(tableName, rowNumber);
```

```
                    WriteItemObject(row.RowNumber, path, false);
                }
                else
                {
                    ThrowTerminatingInvalidPathException(path);
                }
            } // else
        } // GetChildNames

        /// <summary>
        /// Determines if the specified path has child items.
        /// </summary>
        /// <param name="path">The path to examine.</param>
        /// <returns>
        /// True if the specified path has child items.
        /// </returns>
        protected override bool HasChildItems(string path)
        {
            if (PathIsDrive(path))
            {
                return true;
            }

            return (ChunkPath(path).Length == 1);
        } // HasChildItems

        /// <summary>
        /// Creates a new item at the specified path.
        /// </summary>
        ///
        /// <param name="path">
        /// The path to the new item.
        /// </param>
        ///
        /// <param name="type">
        /// Type for the object to create. "Table" for creating a new table
and
        /// "Row" for creating a new row in a table.
        /// </param>
        ///
        /// <param name="newItemValue">
        /// Object for creating new instance of a type at the specified path.
For
        /// creating a "Table" the object parameter is ignored and for
creating
        /// a "Row" the object must be of type string which will contain
comma
        /// separated values of the rows to insert.
        /// </param>
        protected override void NewItem(string path, string type,
                                        object newItemValue)
        {
            string tableName;
            int rowNumber;
```

```
            PathType pt = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (pt == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(path);
            }

            // Check if type is either "table" or "row", if not throw an
            // exception
            if (!String.Equals(type, "table",
StringComparison.OrdinalIgnoreCase)
                && !String.Equals(type, "row",
StringComparison.OrdinalIgnoreCase))
            {
                WriteError(new ErrorRecord
                                    (new ArgumentException("Type must be either
a table or row"),
                                        "CannotCreateSpecifiedObject",
                                           ErrorCategory.InvalidArgument,
                                                path
                                     )
                                );

                throw new ArgumentException("This provider can only create
items of type \"table\" or \"row\"");
            }

            // Path type is the type of path of the container. So if a drive
            // is specified, then a table can be created under it and if a
table
            // is specified, then a row can be created under it. For the sake
of
            // completeness, if a row is specified, then if the row specified
by
            // the path does not exist, a new row is created. However, the
row
            // number may not match as the row numbers only get incremented
based
            // on the number of rows

            if (PathIsDrive(path))
            {
                if (String.Equals(type, "table",
StringComparison.OrdinalIgnoreCase))
                {
                    // Execute command using ODBC connection to create a
table
                    try
                    {
                        // create the table using an sql statement
                        string newTableName = newItemValue.ToString();

                        if (!TableNameIsValid(newTableName))
                        {
```

```
                        return;
                    }
                    string sql = "create table " + newTableName
                                                 + " (ID INT)";

                    // Create the table using the Odbc connection from
the
                    // drive.
                    AccessDBPSDriveInfo di = this.PSDriveInfo as
AccessDBPSDriveInfo;

                    if (di == null)
                    {
                        return;
                    }
                    OdbcConnection connection = di.Connection;

                    if (ShouldProcess(newTableName, "create"))
                    {
                        OdbcCommand cmd = new OdbcCommand(sql,
connection);

                        cmd.ExecuteScalar();
                    }
                }
                catch (Exception ex)
                {
                    WriteError(new ErrorRecord(ex,
"CannotCreateSpecifiedTable",
                                ErrorCategory.InvalidOperation, path)
                                );
                }
            } // if (String...
            else if (String.Equals(type, "row",
StringComparison.OrdinalIgnoreCase))
            {
                throw new
                    ArgumentException("A row cannot be created under a
database, specify a path that represents a Table");
            }
        }// if (PathIsDrive...
        else
        {
            if (String.Equals(type, "table",
StringComparison.OrdinalIgnoreCase))
            {
                if (rowNumber < 0)
                {
                    throw new
                        ArgumentException("A table cannot be created
within another table, specify a path that represents a database");
                }
                else
                {
                    throw new
                        ArgumentException("A table cannot be created
```

```
inside a row, specify a path that represents a database");
                    }
                } //if (String.Equals....
                // if path specified is a row, create a new row
                else if (String.Equals(type, "row",
StringComparison.OrdinalIgnoreCase))
                {
                    // The user is required to specify the values to be
inserted
                    // into the table in a single string separated by commas
                    string value = newItemValue as string;

                    if (String.IsNullOrEmpty(value))
                    {
                        throw new
                            ArgumentException("Value argument must have comma
separated values of each column in a row");
                    }
                    string[] rowValues = value.Split(',');

                    OdbcDataAdapter da = GetAdapterForTable(tableName);

                    if (da == null)
                    {
                        return;
                    }

                    DataSet ds = GetDataSetForTable(da, tableName);
                    DataTable table = GetDataTable(ds, tableName);

                    if (rowValues.Length != table.Columns.Count)
                    {
                        string message =
                             String.Format(CultureInfo.CurrentCulture,
                                           "The table has {0} columns and
the value specified must have so many comma separated values",
                                               table.Columns.Count);

                        throw new ArgumentException(message);
                    }

                    if (!Force && (rowNumber >=0 && rowNumber <
table.Rows.Count))
                    {
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                                      "The row {0} already
exists. To create a new row specify row number as {1}, or specify path to a
table, or use the -Force parameter",
                                                          rowNumber,
table.Rows.Count);

                        throw new ArgumentException(message);
                    }
```

```
                    if (rowNumber > table.Rows.Count)
                    {
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                                "To create a new row specify row
number as {0}, or specify path to a table",
                                                    table.Rows.Count);

                        throw new ArgumentException(message);
                    }

                    // Create a new row and update the row with the input
                    // provided by the user
                    DataRow row = table.NewRow();
                    for (int i = 0; i < rowValues.Length; i++)
                    {
                        row[i] = rowValues[i];
                    }
                    table.Rows.Add(row);

                    if (ShouldProcess(tableName, "update rows"))
                    {
                        // Update the table from memory back to the data
source
                        da.Update(ds, tableName);
                    }

                }// else if (String...
            }// else ...

        } // NewItem

        /// <summary>
        /// Copies an item at the specified path to the location specified
        /// </summary>
        ///
        /// <param name="path">
        /// Path of the item to copy
        /// </param>
        ///
        /// <param name="copyPath">
        /// Path of the item to copy to
        /// </param>
        ///
        /// <param name="recurse">
        /// Tells the provider to recurse subcontainers when copying
        /// </param>
        ///
        protected override void CopyItem(string path, string copyPath, bool
recurse)
        {
            string tableName, copyTableName;
            int rowNumber, copyRowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
```

```
rowNumber);
            PathType copyType = GetNamesFromPath(copyPath, out copyTableName,
out copyRowNumber);

            if (type == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(path);
            }

            if (type == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(copyPath);
            }

            // Get the table and the table to copy to
            OdbcDataAdapter da = GetAdapterForTable(tableName);
            if (da == null)
            {
                return;
            }

            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);

            OdbcDataAdapter cda = GetAdapterForTable(copyTableName);
            if (cda == null)
            {
                return;
            }

            DataSet cds = GetDataSetForTable(cda, copyTableName);
            DataTable copyTable = GetDataTable(cds, copyTableName);

            // if source represents a table
            if (type == PathType.Table)
            {
                // if copyPath does not represent a table
                if (copyType != PathType.Table)
                {
                    ArgumentException e = new ArgumentException("Table can
only be copied on to another table location");

                    WriteError(new ErrorRecord(e, "PathNotValid",
                        ErrorCategory.InvalidArgument, copyPath));

                    throw e;
                }

                // if table already exists then force parameter should be set
                // to force a copy
                if (!Force && GetTable(copyTableName) != null)
                {
                    throw new ArgumentException("Specified path already
exists");
                }
```

```
                for (int i = 0; i < table.Rows.Count; i++)
                {
                    DataRow row = table.Rows[i];
                    DataRow copyRow = copyTable.NewRow();

                    copyRow.ItemArray = row.ItemArray;
                    copyTable.Rows.Add(copyRow);
                }
            } // if (type == ...
            // if source represents a row
            else
            {
                if (copyType == PathType.Row)
                {
                    if (!Force && (copyRowNumber < copyTable.Rows.Count))
                    {
                        throw new ArgumentException("Specified path already
exists.");
                    }

                    DataRow row = table.Rows[rowNumber];
                    DataRow copyRow = null;

                    if (copyRowNumber < copyTable.Rows.Count)
                    {
                        // copy to an existing row
                        copyRow = copyTable.Rows[copyRowNumber];
                        copyRow.ItemArray = row.ItemArray;
                        copyRow[0] = GetNextID(copyTable);
                    }
                    else if (copyRowNumber == copyTable.Rows.Count)
                    {
                        // copy to the next row in the table that will
                        // be created
                        copyRow = copyTable.NewRow();
                        copyRow.ItemArray = row.ItemArray;
                        copyRow[0] = GetNextID(copyTable);
                        copyTable.Rows.Add(copyRow);
                    }
                    else
                    {
                        // attempting to copy to a nonexistent row or a row
                        // that cannot be created now - throw an exception
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                                "The item cannot be specified
to the copied row. Specify row number as {0}, or specify a path to the
table.",
                                                        table.Rows.Count);

                        throw new ArgumentException(message);
                    }
                }
                else
```

```
                {
                    // destination path specified represents a table,
                    // create a new row and copy the item
                    DataRow copyRow = copyTable.NewRow();
                    copyRow.ItemArray = table.Rows[rowNumber].ItemArray;
                    copyRow[0] = GetNextID(copyTable);
                    copyTable.Rows.Add(copyRow);
                }
            }

            if (ShouldProcess(copyTableName, "CopyItems"))
            {
                cda.Update(cds, copyTableName);
            }

        } //CopyItem

        /// <summary>
        /// Removes (deletes) the item at the specified path
        /// </summary>
        ///
        /// <param name="path">
        /// The path to the item to remove.
        /// </param>
        ///
        /// <param name="recurse">
        /// True if all children in a subtree should be removed, false if
only
        /// the item at the specified path should be removed. Is applicable
        /// only for container (table) items. Its ignored otherwise (even if
        /// specified).
        /// </param>
        ///
        /// <remarks>
        /// There are no elements in this store which are hidden from the
user.
        /// Hence this method will not check for the presence of the Force
        /// parameter
        /// </remarks>
        ///
        protected override void RemoveItem(string path, bool recurse)
        {
            string tableName;
            int rowNumber = 0;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type == PathType.Table)
            {
                // if recurse flag has been specified, delete all the rows as
well
                if (recurse)
                {
                    OdbcDataAdapter da = GetAdapterForTable(tableName);
```

```
                if (da == null)
                {
                    return;
                }

                DataSet ds = GetDataSetForTable(da, tableName);
                DataTable table = GetDataTable(ds, tableName);

                for (int i = 0; i < table.Rows.Count; i++)
                {
                    table.Rows[i].Delete();
                }

                if (ShouldProcess(path, "RemoveItem"))
                {
                    da.Update(ds, tableName);
                    RemoveTable(tableName);
                }
            }//if (recurse...
            else
            {
                // Remove the table
                if (ShouldProcess(path, "RemoveItem"))
                {
                    RemoveTable(tableName);
                }
            }
        }
        else if (type == PathType.Row)
        {
            OdbcDataAdapter da = GetAdapterForTable(tableName);
            if (da == null)
            {
                return;
            }

            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);

            table.Rows[rowNumber].Delete();

            if (ShouldProcess(path, "RemoveItem"))
            {
                da.Update(ds, tableName);
            }
        }
        else
        {
            ThrowTerminatingInvalidPathException(path);
        }

    } // RemoveItem

    #endregion Container Overloads
```

```
        #region Helper Methods

      /// <summary>
      /// Checks if a given path is actually a drive name.
      /// </summary>
      /// <param name="path">The path to check.</param>
      /// <returns>
      /// True if the path given represents a drive, false otherwise.
      /// </returns>
      private bool PathIsDrive(string path)
      {
          // Remove the drive name and first path separator.  If the
          // path is reduced to nothing, it is a drive. Also if its
          // just a drive then there wont be any path separators
          if (String.IsNullOrEmpty(
                      path.Replace(this.PSDriveInfo.Root, "")) ||
              String.IsNullOrEmpty(
                      path.Replace(this.PSDriveInfo.Root + pathSeparator,
""))

              )
          {
              return true;
          }
          else
          {
              return false;
          }
       } // PathIsDrive

       /// <summary>
       /// Breaks up the path into individual elements.
       /// </summary>
       /// <param name="path">The path to split.</param>
       /// <returns>An array of path segments.</returns>
       private string[] ChunkPath(string path)
       {
           // Normalize the path before splitting
           string normalPath = NormalizePath(path);

           // Return the path with the drive name and first path
           // separator character removed, split by the path separator.
           string pathNoDrive = normalPath.Replace(this.PSDriveInfo.Root
                                       + pathSeparator, "");

           return pathNoDrive.Split(pathSeparator.ToCharArray());
       } // ChunkPath

       /// <summary>
       /// Adapts the path, making sure the correct path separator
       /// character is used.
       /// </summary>
       /// <param name="path"></param>
       /// <returns></returns>
       private string NormalizePath(string path)
```

```
        {
            string result = path;

            if (!String.IsNullOrEmpty(path))
            {
                result = path.Replace("/", pathSeparator);
            }

            return result;
        } // NormalizePath

        /// <summary>
        /// Chunks the path and returns the table name and the row number
        /// from the path
        /// </summary>
        /// <param name="path">Path to chunk and obtain information</param>
        /// <param name="tableName">Name of the table as represented in the
        /// path</param>
        /// <param name="rowNumber">Row number obtained from the path</param>
        /// <returns>what the path represents</returns>
        private PathType GetNamesFromPath(string path, out string tableName,
out int rowNumber)
        {
            PathType retVal = PathType.Invalid;
            rowNumber = -1;
            tableName = null;

            // Check if the path specified is a drive
            if (PathIsDrive(path))
            {
                return PathType.Database;
            }

            // chunk the path into parts
            string[] pathChunks = ChunkPath(path);

            switch (pathChunks.Length)
            {
                case 1:
                    {
                        string name = pathChunks[0];

                        if (TableNameIsValid(name))
                        {
                            tableName = name;
                            retVal = PathType.Table;
                        }
                    }
                    break;

                case 2:
                    {
                        string name = pathChunks[0];

                        if (TableNameIsValid(name))
```

```
                        {
                            tableName = name;
                        }

                        int number = SafeConvertRowNumber(pathChunks[1]);

                        if (number >= 0)
                        {
                            rowNumber = number;
                            retVal = PathType.Row;
                        }
                        else
                        {
                            WriteError(new ErrorRecord(
                                new ArgumentException("Row number is not
valid"),
                                "RowNumberNotValid",
                                ErrorCategory.InvalidArgument,
                                path));
                        }
                    }
                    break;

                default:
                    {
                        WriteError(new ErrorRecord(
                            new ArgumentException("The path supplied has too
many segments"),
                            "PathNotValid",
                            ErrorCategory.InvalidArgument,
                            path));
                    }
                    break;
            } // switch(pathChunks...

            return retVal;
        } // GetNamesFromPath

        /// <summary>
        /// Throws an argument exception stating that the specified path does
        /// not represent either a table or a row
        /// </summary>
        /// <param name="path">path which is invalid</param>
        private void ThrowTerminatingInvalidPathException(string path)
        {
            StringBuilder message = new StringBuilder("Path must represent
either a table or a row :");
            message.Append(path);

            throw new ArgumentException(message.ToString());
        }

        /// <summary>
        /// Retrieve the list of tables from the database.
        /// </summary>
```

```
        /// <returns>
        /// Collection of DatabaseTableInfo objects, each object representing
        /// information about one database table
        /// </returns>
        private Collection<DatabaseTableInfo> GetTables()
        {
            Collection<DatabaseTableInfo> results =
                    new Collection<DatabaseTableInfo>();

            // using ODBC connection to the database and get the schema of
tables
            AccessDBPSDriveInfo di = this.PSDriveInfo as AccessDBPSDriveInfo;

            if (di == null)
            {
                return null;
            }

            OdbcConnection connection = di.Connection;
            DataTable dt = connection.GetSchema("Tables");
            int count;

            // iterate through all rows in the schema and create
DatabaseTableInfo
            // objects which represents a table
            foreach (DataRow dr in dt.Rows)
            {
                String tableName = dr["TABLE_NAME"] as String;
                DataColumnCollection columns = null;

                // find the number of rows in the table
                try
                {
                    String cmd = "Select count(*) from \"" + tableName +
"\"";
                    OdbcCommand command = new OdbcCommand(cmd, connection);

                    count = (Int32)command.ExecuteScalar();
                }
                catch
                {
                    count = 0;
                }

                // create DatabaseTableInfo object representing the table
                DatabaseTableInfo table =
                        new DatabaseTableInfo(dr, tableName, count, columns);

                results.Add(table);
            } // foreach (DataRow...

            return results;
        } // GetTables

        /// <summary>
```

```
        /// Return row information from a specified table.
        /// </summary>
        /// <param name="tableName">The name of the database table from
        /// which to retrieve rows.</param>
        /// <returns>Collection of row information objects.</returns>
        private Collection<DatabaseRowInfo> GetRows(string tableName)
        {
            Collection<DatabaseRowInfo> results =
                        new Collection<DatabaseRowInfo>();

            // Obtain rows in the table and add it to the collection
            try
            {
                OdbcDataAdapter da = GetAdapterForTable(tableName);

                if (da == null)
                {
                    return null;
                }

                DataSet ds = GetDataSetForTable(da, tableName);
                DataTable table = GetDataTable(ds, tableName);

                int i = 0;
                foreach (DataRow row in table.Rows)
                {
                    results.Add(new DatabaseRowInfo(row,
i.ToString(CultureInfo.CurrentCulture)));
                    i++;
                } // foreach (DataRow...
            }
            catch (Exception e)
            {
                WriteError(new ErrorRecord(e, "CannotAccessSpecifiedRows",
                    ErrorCategory.InvalidOperation, tableName));
            }

            return results;

        } // GetRows

        /// <summary>
        /// Retrieve information about a single table.
        /// </summary>
        /// <param name="tableName">The table for which to retrieve
        /// data.</param>
        /// <returns>Table information.</returns>
        private DatabaseTableInfo GetTable(string tableName)
        {
            foreach (DatabaseTableInfo table in GetTables())
            {
                if (String.Equals(tableName, table.Name,
StringComparison.OrdinalIgnoreCase))
                {
                    return table;
```

```
                }
            }

            return null;
        } // GetTable

        /// <summary>
        /// Removes the specified table from the database
        /// </summary>
        /// <param name="tableName">Name of the table to remove</param>
        private void RemoveTable(string tableName)
        {
            // validate if tablename is valid and if table is present
            if (String.IsNullOrEmpty(tableName) ||
!TableNameIsValid(tableName) || !TableIsPresent(tableName))
            {
                return;
            }

            // Execute command using ODBC connection to remove a table
            try
            {
                // delete the table using an sql statement
                string sql = "drop table " + tableName;

                AccessDBPSDriveInfo di = this.PSDriveInfo as
AccessDBPSDriveInfo;

                if (di == null)
                {
                    return;
                }
                OdbcConnection connection = di.Connection;

                OdbcCommand cmd = new OdbcCommand(sql, connection);
                cmd.ExecuteScalar();
            }
            catch (Exception ex)
            {
                WriteError(new ErrorRecord(ex, "CannotRemoveSpecifiedTable",
                          ErrorCategory.InvalidOperation, null)
                          );
            }

        } // RemoveTable

        /// <summary>
        /// Obtain a data adapter for the specified Table
        /// </summary>
        /// <param name="tableName">Name of the table to obtain the
        /// adapter for</param>
        /// <returns>Adapter object for the specified table</returns>
        /// <remarks>An adapter serves as a bridge between a DataSet (in
memory
        /// representation of table) and the data source</remarks>
```

```
        private OdbcDataAdapter GetAdapterForTable(string tableName)
        {
            OdbcDataAdapter da = null;
            AccessDBPSDriveInfo di = this.PSDriveInfo as AccessDBPSDriveInfo;

            if (di == null || !TableNameIsValid(tableName)
||!TableIsPresent(tableName))
            {
                return null;
            }

            OdbcConnection connection = di.Connection;

            try
            {
                // Create a odbc data adpater. This can be sued to update the
                // data source with the records that will be created here
                // using data sets
                string sql = "Select * from " + tableName;
                da = new OdbcDataAdapter(new OdbcCommand(sql, connection));

                // Create a odbc command builder object. This will create sql
                // commands automatically for a single table, thus
                // eliminating the need to create new sql statements for
                // every operation to be done.
                OdbcCommandBuilder cmd = new OdbcCommandBuilder(da);

                // Set the delete cmd for the table here
                sql = "Delete from " + tableName + " where ID = ?";
                da.DeleteCommand = new OdbcCommand(sql, connection);

                // Specify a DeleteCommand parameter based on the "ID"
                // column
                da.DeleteCommand.Parameters.Add(new OdbcParameter());
                da.DeleteCommand.Parameters[0].SourceColumn = "ID";

                // Create an InsertCommand based on the sql string
                // Insert into "tablename" values (?,?,?)" where
                // ? represents a column in the table. Note that
                // the number of ? will be equal to the number of
                // columnds
                DataSet ds = new DataSet();

                da.FillSchema(ds, SchemaType.Source);
                ds.Locale = CultureInfo.InvariantCulture;

                sql = "Insert into " + tableName + " values ( ";
                for (int i = 0; i < ds.Tables["Table"].Columns.Count; i++)
                {
                    sql += "?, ";
                }
                sql = sql.Substring(0, sql.Length - 2);
                sql += ")";
                da.InsertCommand = new OdbcCommand(sql, connection);
```

```
                // Create parameters for the InsertCommand based on the
                // captions of each column
                for (int i = 0; i < ds.Tables["Table"].Columns.Count; i++)
                {
                    da.InsertCommand.Parameters.Add(new OdbcParameter());
                    da.InsertCommand.Parameters[i].SourceColumn =
                                    ds.Tables["Table"].Columns[i].Caption;

                }

                // Open the connection if its not already open
                if (connection.State != ConnectionState.Open)
                {
                    connection.Open();
                }
            }
            catch (Exception e)
            {
                WriteError(new ErrorRecord(e, "CannotAccessSpecifiedTable",
                  ErrorCategory.InvalidOperation, tableName));
            }

            return da;
        } // GetAdapterForTable

        /// <summary>
        /// Gets the DataSet (in memory representation) for the table
        /// for the specified adapter
        /// </summary>
        /// <param name="adapter">Adapter to be used for obtaining
        /// the table</param>
        /// <param name="tableName">Name of the table for which a
        /// DataSet is required</param>
        /// <returns>The DataSet with the filled in schema</returns>
        private DataSet GetDataSetForTable(OdbcDataAdapter adapter, string
tableName)
        {
            Debug.Assert(adapter != null);

            // Create a dataset object which will provide an in-memory
            // representation of the data being worked upon in the
            // data source.
            DataSet ds = new DataSet();

            // Create a table named "Table" which will contain the same
            // schema as in the data source.
            //adapter.FillSchema(ds, SchemaType.Source);
            adapter.Fill(ds, tableName);
            ds.Locale = CultureInfo.InvariantCulture;

            return ds;
        } //GetDataSetForTable

        /// <summary>
        /// Get the DataTable object which can be used to operate on
```

```
        /// for the specified table in the data source
        /// </summary>
        /// <param name="ds">DataSet object which contains the tables
        /// schema</param>
        /// <param name="tableName">Name of the table</param>
        /// <returns>Corresponding DataTable object representing
        /// the table</returns>
        ///
        private DataTable GetDataTable(DataSet ds, string tableName)
        {
            Debug.Assert(ds != null);
            Debug.Assert(tableName != null);

            DataTable table = ds.Tables[tableName];
            table.Locale = CultureInfo.InvariantCulture;

            return table;
        } // GetDataTable

        /// <summary>
        /// Retrieves a single row from the named table.
        /// </summary>
        /// <param name="tableName">The table that contains the
        /// numbered row.</param>
        /// <param name="row">The index of the row to return.</param>
        /// <returns>The specified table row.</returns>
        private DatabaseRowInfo GetRow(string tableName, int row)
        {
            Collection<DatabaseRowInfo> di = GetRows(tableName);

            // if the row is invalid write an appropriate error else return
the
            // corresponding row information
            if (row < di.Count && row >= 0)
            {
                return di[row];
            }
            else
            {
                WriteError(new ErrorRecord(
                   new ItemNotFoundException(),
                   "RowNotFound",
                   ErrorCategory.ObjectNotFound,
                   row.ToString(CultureInfo.CurrentCulture))
                );
            }

            return null;
        } // GetRow

        /// <summary>
        /// Method to safely convert a string representation of a row number
        /// into its Int32 equivalent
        /// </summary>
        /// <param name="rowNumberAsStr">String representation of the row
```

```
        /// number</param>
        /// <remarks>If there is an exception, -1 is returned</remarks>
        private int SafeConvertRowNumber(string rowNumberAsStr)
        {
            int rowNumber = -1;
            try
            {
                rowNumber = Convert.ToInt32(rowNumberAsStr,
CultureInfo.CurrentCulture);
            }
            catch (FormatException fe)
            {
                WriteError(new ErrorRecord(fe, "RowStringFormatNotValid",
                    ErrorCategory.InvalidData, rowNumberAsStr));
            }
            catch (OverflowException oe)
            {
                WriteError(new ErrorRecord(oe,
"RowStringConversionToNumberFailed",
                    ErrorCategory.InvalidData, rowNumberAsStr));
            }

            return rowNumber;
        } // SafeConvertRowNumber

        /// <summary>
        /// Check if a table name is valid
        /// </summary>
        /// <param name="tableName">Table name to validate</param>
        /// <remarks>Helps to check for SQL injection attacks</remarks>
        private bool TableNameIsValid(string tableName)
        {
            Regex exp = new Regex(pattern, RegexOptions.Compiled |
RegexOptions.IgnoreCase);

            if (exp.IsMatch(tableName))
            {
                return true;
            }
            WriteError(new ErrorRecord(
                new ArgumentException("Table name not valid"),
"TableNameNotValid",
                    ErrorCategory.InvalidArgument, tableName));
            return false;
        } // TableNameIsValid

        /// <summary>
        /// Checks to see if the specified table is present in the
        /// database
        /// </summary>
        /// <param name="tableName">Name of the table to check</param>
        /// <returns>true, if table is present, false otherwise</returns>
        private bool TableIsPresent(string tableName)
        {
            // using ODBC connection to the database and get the schema of
```

```
tables
            AccessDBPSDriveInfo di = this.PSDriveInfo as AccessDBPSDriveInfo;
            if (di == null)
            {
                return false;
            }

            OdbcConnection connection = di.Connection;
            DataTable dt = connection.GetSchema("Tables");

            // check if the specified tableName is available
            // in the list of tables present in the database
            foreach (DataRow dr in dt.Rows)
            {
                string name = dr["TABLE_NAME"] as string;
                if (name.Equals(tableName,
StringComparison.OrdinalIgnoreCase))
                {
                    return true;
                }
            }

            WriteError(new ErrorRecord(
                new ArgumentException("Specified Table is not present in
database"), "TableNotAvailable",
                     ErrorCategory.InvalidArgument, tableName));

            return false;
        }// TableIsPresent

        /// <summary>
        /// Gets the next available ID in the table
        /// </summary>
        /// <param name="table">DataTable object representing the table to
        /// search for ID</param>
        /// <returns>next available id</returns>
        private int GetNextID(DataTable table)
        {
            int big = 0;
            int id = 0;

            for (int i = 0; i < table.Rows.Count; i++)
            {
                DataRow row = table.Rows[i];

                object o = row["ID"];

                if (o.GetType().Name.Equals("Int16"))
                {
                    id = (int)(short)o;
                }
                else
                {
                    id = (int)o;
                }
```

```
                if (big < id)
                {
                    big = id;
                }
            }

            big++;
            return big;
        }

        #endregion Helper Methods

        #region Private Properties

        private string pathSeparator = "\\";
        private static string pattern = @"^[a-z]+[0-9]*_*$";

        private enum PathType { Database, Table, Row, Invalid };

        #endregion Private Properties
    }

    #endregion AccessDBProvider

    #region Helper Classes

    #region AccessDBPSDriveInfo

    /// <summary>
    /// Any state associated with the drive should be held here.
    /// In this case, it's the connection to the database.
    /// </summary>
    internal class AccessDBPSDriveInfo : PSDriveInfo
    {
        private OdbcConnection connection;

        /// <summary>
        /// ODBC connection information.
        /// </summary>
        public OdbcConnection Connection
        {
            get { return connection; }
            set { connection = value; }
        }

        /// <summary>
        /// Constructor that takes one argument
        /// </summary>
        /// <param name="driveInfo">Drive provided by this provider</param>
        public AccessDBPSDriveInfo(PSDriveInfo driveInfo)
            : base(driveInfo)
        { }

    } // class AccessDBPSDriveInfo
```

```
#endregion AccessDBPSDriveInfo

#region DatabaseTableInfo

/// <summary>
/// Contains information specific to the database table.
/// Similar to the DirectoryInfo class.
/// </summary>
public class DatabaseTableInfo
{
    /// <summary>
    /// Row from the "tables" schema
    /// </summary>
    public DataRow Data
    {
        get
        {
            return data;
        }
        set
        {
            data = value;
        }
    }
    private DataRow data;

    /// <summary>
    /// The table name.
    /// </summary>
    public string Name
    {
        get
        {
            return name;
        }
        set
        {
            name = value;
        }
    }
    private String name;

    /// <summary>
    /// The number of rows in the table.
    /// </summary>
    public int RowCount
    {
        get
        {
            return rowCount;
        }
        set
        {
            rowCount = value;
```

```
        }
    }
    private int rowCount;

    /// <summary>
    /// The column definitions for the table.
    /// </summary>
    public DataColumnCollection Columns
    {
        get
        {
            return columns;
        }
        set
        {
            columns = value;
        }
    }
    private DataColumnCollection columns;

    /// <summary>
    /// Constructor.
    /// </summary>
    /// <param name="row">The row definition.</param>
    /// <param name="name">The table name.</param>
    /// <param name="rowCount">The number of rows in the table.</param>
    /// <param name="columns">Information on the column tables.</param>
    public DatabaseTableInfo(DataRow row, string name, int rowCount,
                    DataColumnCollection columns)
    {
        Name = name;
        Data = row;
        RowCount = rowCount;
        Columns = columns;
    } // DatabaseTableInfo
} // class DatabaseTableInfo

#endregion DatabaseTableInfo

#region DatabaseRowInfo

/// <summary>
/// Contains information specific to an individual table row.
/// Analogous to the FileInfo class.
/// </summary>
public class DatabaseRowInfo
{
    /// <summary>
    /// Row data information.
    /// </summary>
    public DataRow Data
    {
        get
        {
            return data;
```

```
            }
            set
            {
                data = value;
            }
        }
        private DataRow data;

        /// <summary>
        /// The row index.
        /// </summary>
        public string RowNumber
        {
            get
            {
                return rowNumber;
            }
            set
            {
                rowNumber = value;
            }
        }
        private string rowNumber;

        /// <summary>
        /// Constructor.
        /// </summary>
        /// <param name="row">The row information.</param>
        /// <param name="name">The row index.</param>
        public DatabaseRowInfo(DataRow row, string name)
        {
            RowNumber = name;
            Data = row;
        } // DatabaseRowInfo
    } // class DatabaseRowInfo

    #endregion DatabaseRowInfo

    #endregion Helper Classes
}
```

See Also

Windows PowerShell SDK

AccessDbProviderSample05 Code Sample

Article • 09/17/2021

The following code shows the implementation of the Windows PowerShell navigation provider described in Creating a Windows PowerShell Navigation Provider. This provider supports recursive commands, nested containers, and relative paths that allow it to navigate the data store.

Code Sample

C#

```
using System;
using System.IO;
using System.Data;
using System.Data.Odbc;
using System.Diagnostics;
using System.Collections.ObjectModel;
using System.Text;
using System.Text.RegularExpressions;
using System.Management.Automation;
using System.Management.Automation.Provider;
using System.ComponentModel;
using System.Globalization;

namespace Microsoft.Samples.PowerShell.Providers
{
   #region AccessDBProvider

    /// <summary>
   /// This example implements the navigation methods.
   /// </summary>
   [CmdletProvider("AccessDB", ProviderCapabilities.None)]
   public class AccessDBProvider : NavigationCmdletProvider
   {

      #region Drive Manipulation

       /// <summary>
       /// Create a new drive.  Create a connection to the database file and
set
       /// the Connection property in the PSDriveInfo.
       /// </summary>
       /// <param name="drive">
       /// Information describing the drive to add.
       /// </param>
       /// <returns>The added drive.</returns>
```

```
        protected override PSDriveInfo NewDrive(PSDriveInfo drive)
        {
            // check if drive object is null
            if (drive == null)
            {
                WriteError(new ErrorRecord(
                    new ArgumentNullException("drive"),
                    "NullDrive",
                    ErrorCategory.InvalidArgument,
                    null)
                );

                return null;
            }

            // check if drive root is not null or empty
            // and if its an existing file
            if (String.IsNullOrEmpty(drive.Root) || (File.Exists(drive.Root)
== false))
            {
                WriteError(new ErrorRecord(
                    new ArgumentException("drive.Root"),
                    "NoRoot",
                    ErrorCategory.InvalidArgument,
                    drive)
                );

                return null;
            }


            // create a new drive and create an ODBC connection to the new
drive
            AccessDBPSDriveInfo accessDBPSDriveInfo = new
AccessDBPSDriveInfo(drive);

            OdbcConnectionStringBuilder builder = new
OdbcConnectionStringBuilder();

            builder.Driver = "Microsoft Access Driver (*.mdb)";
            builder.Add("DBQ", drive.Root);

            OdbcConnection conn = new
OdbcConnection(builder.ConnectionString);
            conn.Open();
            accessDBPSDriveInfo.Connection = conn;

            return accessDBPSDriveInfo;
        } // NewDrive

        /// <summary>
        /// Removes a drive from the provider.
        /// </summary>
        /// <param name="drive">The drive to remove.</param>
        /// <returns>The drive removed.</returns>
```

```
        protected override PSDriveInfo RemoveDrive(PSDriveInfo drive)
        {
            // check if drive object is null
            if (drive == null)
            {
                WriteError(new ErrorRecord(
                    new ArgumentNullException("drive"),
                    "NullDrive",
                    ErrorCategory.InvalidArgument,
                    drive)
                );

                return null;
            }

            // close ODBC connection to the drive
            AccessDBPSDriveInfo accessDBPSDriveInfo = drive as
AccessDBPSDriveInfo;

            if (accessDBPSDriveInfo == null)
            {
                return null;
            }
            accessDBPSDriveInfo.Connection.Close();

            return accessDBPSDriveInfo;
        } // RemoveDrive

        #endregion Drive Manipulation

       #region Item Methods

        /// <summary>
        /// Retrieves an item using the specified path.
        /// </summary>
        /// <param name="path">The path to the item to return.</param>
        protected override void GetItem(string path)
        {
            // check if the path represented is a drive
            if (PathIsDrive(path))
            {
                WriteItemObject(this.PSDriveInfo, path, true);
                return;
            }// if (PathIsDrive...

            // Get table name and row information from the path and do
            // necessary actions
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type == PathType.Table)
            {
```

```
                DatabaseTableInfo table = GetTable(tableName);
                WriteItemObject(table, path, true);
            }
            else if (type == PathType.Row)
            {
                DatabaseRowInfo row = GetRow(tableName, rowNumber);
                WriteItemObject(row, path, false);
            }
            else
            {
                ThrowTerminatingInvalidPathException(path);
            }

        } // GetItem

        /// <summary>
        /// Set the content of a row of data specified by the supplied path
        /// parameter.
        /// </summary>
        /// <param name="path">Specifies the path to the row whose columns
        /// will be updated.</param>
        /// <param name="values">Comma separated string of values</param>
        protected override void SetItem(string path, object values)
        {
            // Get type, table name and row number from the path specified
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type != PathType.Row)
            {
                WriteError(new ErrorRecord(new NotSupportedException(
                      "SetNotSupported"), "",
                   ErrorCategory.InvalidOperation, path));

                return;
            }

            // Get in-memory representation of table
            OdbcDataAdapter da = GetAdapterForTable(tableName);

            if (da == null)
            {
                return;
            }
            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);

            if (rowNumber >= table.Rows.Count)
            {
                // The specified row number has to be available. If not
                // NewItem has to be used to add a new row
                throw new ArgumentException("Row specified is not
```

```
available");
            } // if (rowNum...

            string[] colValues = (values as string).Split(',');

            // set the specified row
            DataRow row = table.Rows[rowNumber];

            for (int i = 0; i < colValues.Length; i++)
            {
                row[i] = colValues[i];
            }

            // Update the table
            if (ShouldProcess(path, "SetItem"))
            {
                da.Update(ds, tableName);
            }

        } // SetItem

        /// <summary>
        /// Test to see if the specified item exists.
        /// </summary>
        /// <param name="path">The path to the item to verify.</param>
        /// <returns>True if the item is found.</returns>
        protected override bool ItemExists(string path)
        {
            // check if the path represented is a drive
            if (PathIsDrive(path))
            {
                return true;
            }

            // Obtain type, table name and row number from path
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            DatabaseTableInfo table = GetTable(tableName);

            if (type == PathType.Table)
            {
                // if specified path represents a table then
DatabaseTableInfo
                // object for the same should exist
                if (table != null)
                {
                    return true;
                }
            }
            else if (type == PathType.Row)
            {
```

```
                // if specified path represents a row then DatabaseTableInfo
should
                // exist for the table and then specified row number must be
within
                // the maximum row count in the table
                if (table != null && rowNumber < table.RowCount)
                {
                    return true;
                }
            }

            return false;

        } // ItemExists

        /// <summary>
        /// Test to see if the specified path is syntactically valid.
        /// </summary>
        /// <param name="path">The path to validate.</param>
        /// <returns>True if the specified path is valid.</returns>
        protected override bool IsValidPath(string path)
        {
            bool result = true;

            // check if the path is null or empty
            if (String.IsNullOrEmpty(path))
            {
                result = false;
            }

            // convert all separators in the path to a uniform one
            path = NormalizePath(path);

            // split the path into individual chunks
            string[] pathChunks = path.Split(pathSeparator.ToCharArray());

            foreach (string pathChunk in pathChunks)
            {
                if (pathChunk.Length == 0)
                {
                    result = false;
                }
            }
            return result;
        } // IsValidPath

        #endregion Item Overloads

      #region Container Overloads

        /// <summary>
        /// Return either the tables in the database or the datarows
        /// </summary>
        /// <param name="path">The path to the parent</param>
        /// <param name="recurse">True to return all child items recursively.
```

```
        /// </param>
        protected override void GetChildItems(string path, bool recurse)
        {
            // If path represented is a drive then the children in the path
are
            // tables. Hence all tables in the drive represented will have to
be
            // returned
            if (PathIsDrive(path))
            {
                foreach (DatabaseTableInfo table in GetTables())
                {
                    WriteItemObject(table, path, true);

                    // if the specified item exists and recurse has been set
then
                    // all child items within it have to be obtained as well
                    if (ItemExists(path) && recurse)
                    {
                        GetChildItems(path + pathSeparator + table.Name,
recurse);
                    }
                } // foreach (DatabaseTableInfo...
            } // if (PathIsDrive...
            else
            {
                // Get the table name, row number and type of path from the
                // path specified
                string tableName;
                int rowNumber;

                PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

                if (type == PathType.Table)
                {
                    // Obtain all the rows within the table
                    foreach (DatabaseRowInfo row in GetRows(tableName))
                    {
                        WriteItemObject(row, path + pathSeparator +
row.RowNumber,
                                        false);
                    } // foreach (DatabaseRowInfo...
                }
                else if (type == PathType.Row)
                {
                    // In this case the user has directly specified a row,
hence
                    // just give that particular row
                    DatabaseRowInfo row = GetRow(tableName, rowNumber);
                    WriteItemObject(row, path + pathSeparator +
row.RowNumber,
                                    false);
                }
                else
```

```
                {
                    // In this case, the path specified is not valid
                    ThrowTerminatingInvalidPathException(path);
                }
            } // else
        } // GetChildItems

        /// <summary>
        /// Return the names of all child items.
        /// </summary>
        /// <param name="path">The root path.</param>
        /// <param name="returnContainers">Not used.</param>
        protected override void GetChildNames(string path,
                                              ReturnContainers returnContainers)
        {
            // If the path represented is a drive, then the child items are
            // tables. get the names of all the tables in the drive.
            if (PathIsDrive(path))
            {
                foreach (DatabaseTableInfo table in GetTables())
                {
                    WriteItemObject(table.Name, path, true);
                } // foreach (DatabaseTableInfo...
            } // if (PathIsDrive...
            else
            {
                // Get type, table name and row number from path specified
                string tableName;
                int rowNumber;

                PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

                if (type == PathType.Table)
                {
                    // Get all the rows in the table and then write out the
                    // row numbers.
                    foreach (DatabaseRowInfo row in GetRows(tableName))
                    {
                        WriteItemObject(row.RowNumber, path, false);
                    } // foreach (DatabaseRowInfo...
                }
                else if (type == PathType.Row)
                {
                    // In this case the user has directly specified a row,
hence
                    // just give that particular row
                    DatabaseRowInfo row = GetRow(tableName, rowNumber);

                    WriteItemObject(row.RowNumber, path, false);
                }
                else
                {
                    ThrowTerminatingInvalidPathException(path);
                }
```

```
            } // else
        } // GetChildNames

        /// <summary>
        /// Determines if the specified path has child items.
        /// </summary>
        /// <param name="path">The path to examine.</param>
        /// <returns>
        /// True if the specified path has child items.
        /// </returns>
        protected override bool HasChildItems(string path)
        {
            if (PathIsDrive(path))
            {
                return true;
            }

            return (ChunkPath(path).Length == 1);
        } // HasChildItems

        /// <summary>
        /// Creates a new item at the specified path.
        /// </summary>
        ///
        /// <param name="path">
        /// The path to the new item.
        /// </param>
        ///
        /// <param name="type">
        /// Type for the object to create. "Table" for creating a new table
and
        /// "Row" for creating a new row in a table.
        /// </param>
        ///
        /// <param name="newItemValue">
        /// Object for creating new instance of a type at the specified path.
For
        /// creating a "Table" the object parameter is ignored and for
creating
        /// a "Row" the object must be of type string which will contain
comma
        /// separated values of the rows to insert.
        /// </param>
        protected override void NewItem(string path, string type,
                                        object newItemValue)
        {
            string tableName;
            int rowNumber;

            PathType pt = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (pt == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(path);
```

```
            }

            // Check if type is either "table" or "row", if not throw an
            // exception
            if (!String.Equals(type, "table",
StringComparison.OrdinalIgnoreCase)
                && !String.Equals(type, "row",
StringComparison.OrdinalIgnoreCase))
            {
                WriteError(new ErrorRecord
                                (new ArgumentException("Type must be either
a table or row"),
                                    "CannotCreateSpecifiedObject",
                                       ErrorCategory.InvalidArgument,
                                            path
                                 )
                           );

                throw new ArgumentException("This provider can only create
items of type \"table\" or \"row\"");
            }

            // Path type is the type of path of the container. So if a drive
            // is specified, then a table can be created under it and if a
table
            // is specified, then a row can be created under it. For the sake
of
            // completeness, if a row is specified, then if the row specified
by
            // the path does not exist, a new row is created. However, the
row
            // number may not match as the row numbers only get incremented
based
            // on the number of rows

            if (PathIsDrive(path))
            {
                if (String.Equals(type, "table",
StringComparison.OrdinalIgnoreCase))
                {
                    // Execute command using ODBC connection to create a
table
                    try
                    {
                        // create the table using an sql statement
                        string newTableName = newItemValue.ToString();
                        string sql = "create table " + newTableName
                                             + " (ID INT)";

                        // Create the table using the Odbc connection from
the
                        // drive.
                        AccessDBPSDriveInfo di = this.PSDriveInfo as
AccessDBPSDriveInfo;
```

```
                        if (di == null)
                        {
                            return;
                        }
                        OdbcConnection connection = di.Connection;

                        if (ShouldProcess(newTableName, "create"))
                        {
                            OdbcCommand cmd = new OdbcCommand(sql,
connection);
                            cmd.ExecuteScalar();
                        }
                    }
                    catch (Exception ex)
                    {
                        WriteError(new ErrorRecord(ex,
"CannotCreateSpecifiedTable",
                                    ErrorCategory.InvalidOperation, path)
                                    );
                    }
                } // if (String...
                else if (String.Equals(type, "row",
StringComparison.OrdinalIgnoreCase))
                {
                    throw new
                        ArgumentException("A row cannot be created under a
database, specify a path that represents a Table");
                }
            }// if (PathIsDrive...
            else
            {
                if (String.Equals(type, "table",
StringComparison.OrdinalIgnoreCase))
                {
                    if (rowNumber < 0)
                    {
                        throw new
                            ArgumentException("A table cannot be created
within another table, specify a path that represents a database");
                    }
                    else
                    {
                        throw new
                            ArgumentException("A table cannot be created
inside a row, specify a path that represents a database");
                    }
                } //if (String.Equals....
                // if path specified is a row, create a new row
                else if (String.Equals(type, "row",
StringComparison.OrdinalIgnoreCase))
                {
                    // The user is required to specify the values to be
inserted
                    // into the table in a single string separated by commas
                    string value = newItemValue as string;
```

```
                    if (String.IsNullOrEmpty(value))
                    {
                        throw new
                            ArgumentException("Value argument must have comma
separated values of each column in a row");
                    }
                    string[] rowValues = value.Split(',');

                    OdbcDataAdapter da = GetAdapterForTable(tableName);

                    if (da == null)
                    {
                        return;
                    }

                    DataSet ds = GetDataSetForTable(da, tableName);
                    DataTable table = GetDataTable(ds, tableName);

                    if (rowValues.Length != table.Columns.Count)
                    {
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                                "The table has {0} columns and
the value specified must have so many comma separated values",
                                                    table.Columns.Count);

                        throw new ArgumentException(message);
                    }

                    if (!Force && (rowNumber >= 0 && rowNumber <
table.Rows.Count))
                    {
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                                "The row {0} already exists. To
create a new row specify row number as {1}, or specify path to a table, or
use the -Force parameter",
                                                    rowNumber,
table.Rows.Count);

                        throw new ArgumentException(message);
                    }

                    if (rowNumber > table.Rows.Count)
                    {
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                                "To create a new row specify row
number as {0}, or specify path to a table",
                                                    table.Rows.Count);

                        throw new ArgumentException(message);
                    }
```

```
                    // Create a new row and update the row with the input
                    // provided by the user
                    DataRow row = table.NewRow();
                    for (int i = 0; i < rowValues.Length; i++)
                    {
                        row[i] = rowValues[i];
                    }
                    table.Rows.Add(row);

                    if (ShouldProcess(tableName, "update rows"))
                    {
                        // Update the table from memory back to the data
source
                        da.Update(ds, tableName);
                    }

                }// else if (String...
            }// else ...

        } // NewItem

        /// <summary>
        /// Copies an item at the specified path to the location specified
        /// </summary>
        ///
        /// <param name="path">
        /// Path of the item to copy
        /// </param>
        ///
        /// <param name="copyPath">
        /// Path of the item to copy to
        /// </param>
        ///
        /// <param name="recurse">
        /// Tells the provider to recurse subcontainers when copying
        /// </param>
        ///
        protected override void CopyItem(string path, string copyPath, bool
recurse)
        {
            string tableName, copyTableName;
            int rowNumber, copyRowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);
            PathType copyType = GetNamesFromPath(copyPath, out copyTableName,
out copyRowNumber);

            if (type == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(path);
            }

            if (type == PathType.Invalid)
            {
```

```
                ThrowTerminatingInvalidPathException(copyPath);
            }

            // Get the table and the table to copy to
            OdbcDataAdapter da = GetAdapterForTable(tableName);
            if (da == null)
            {
                return;
            }

            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);

            OdbcDataAdapter cda = GetAdapterForTable(copyTableName);
            if (cda == null)
            {
                return;
            }

            DataSet cds = GetDataSetForTable(cda, copyTableName);
            DataTable copyTable = GetDataTable(cds, copyTableName);

            // if source represents a table
            if (type == PathType.Table)
            {
                // if copyPath does not represent a table
                if (copyType != PathType.Table)
                {
                    ArgumentException e = new ArgumentException("Table can
only be copied on to another table location");

                    WriteError(new ErrorRecord(e, "PathNotValid",
                        ErrorCategory.InvalidArgument, copyPath));

                    throw e;
                }

                // if table already exists then force parameter should be set
                // to force a copy
                if (!Force && GetTable(copyTableName) != null)
                {
                    throw new ArgumentException("Specified path already
exists");
                }

                for (int i = 0; i < table.Rows.Count; i++)
                {
                    DataRow row = table.Rows[i];
                    DataRow copyRow = copyTable.NewRow();

                    copyRow.ItemArray = row.ItemArray;
                    copyTable.Rows.Add(copyRow);
                }
            } // if (type == ...
            // if source represents a row
```

```
            else
            {
                if (copyType == PathType.Row)
                {
                    if (!Force && (copyRowNumber < copyTable.Rows.Count))
                    {
                        throw new ArgumentException("Specified path already
exists.");
                    }

                    DataRow row = table.Rows[rowNumber];
                    DataRow copyRow = null;

                    if (copyRowNumber < copyTable.Rows.Count)
                    {
                        // copy to an existing row
                        copyRow = copyTable.Rows[copyRowNumber];
                        copyRow.ItemArray = row.ItemArray;
                        copyRow[0] = GetNextID(copyTable);
                    }
                    else if (copyRowNumber == copyTable.Rows.Count)
                    {
                        // copy to the next row in the table that will
                        // be created
                        copyRow = copyTable.NewRow();
                        copyRow.ItemArray = row.ItemArray;
                        copyRow[0] = GetNextID(copyTable);
                        copyTable.Rows.Add(copyRow);
                    }
                    else
                    {
                        // attempting to copy to a nonexistent row or a row
                        // that cannot be created now - throw an exception
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                                "The item cannot be specified to
the copied row. Specify row number as {0}, or specify a path to the table.",
                                                    table.Rows.Count);

                        throw new ArgumentException(message);
                    }
                }
                else
                {
                    // destination path specified represents a table,
                    // create a new row and copy the item
                    DataRow copyRow = copyTable.NewRow();
                    copyRow.ItemArray = table.Rows[rowNumber].ItemArray;
                    copyRow[0] = GetNextID(copyTable);
                    copyTable.Rows.Add(copyRow);
                }
            }

            if (ShouldProcess(copyTableName, "CopyItems"))
            {
```

```
                cda.Update(cds, copyTableName);
            }

        } //CopyItem

        /// <summary>
        /// Removes (deletes) the item at the specified path
        /// </summary>
        ///
        /// <param name="path">
        /// The path to the item to remove.
        /// </param>
        ///
        /// <param name="recurse">
        /// True if all children in a subtree should be removed, false if
only
        /// the item at the specified path should be removed. Is applicable
        /// only for container (table) items. Its ignored otherwise (even if
        /// specified).
        /// </param>
        ///
        /// <remarks>
        /// There are no elements in this store which are hidden from the
user.
        /// Hence this method will not check for the presence of the Force
        /// parameter
        /// </remarks>
        ///
        protected override void RemoveItem(string path, bool recurse)
        {
            string tableName;
            int rowNumber = 0;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type == PathType.Table)
            {
                // if recurse flag has been specified, delete all the rows as
well
                if (recurse)
                {
                    OdbcDataAdapter da = GetAdapterForTable(tableName);
                    if (da == null)
                    {
                        return;
                    }

                    DataSet ds = GetDataSetForTable(da, tableName);
                    DataTable table = GetDataTable(ds, tableName);

                    for (int i = 0; i < table.Rows.Count; i++)
                    {
                        table.Rows[i].Delete();
                    }
```

```
                if (ShouldProcess(path, "RemoveItem"))
                {
                    da.Update(ds, tableName);
                    RemoveTable(tableName);
                }
            }//if (recurse...
            else
            {
                // Remove the table
                if (ShouldProcess(path, "RemoveItem"))
                {
                    RemoveTable(tableName);
                }
            }
        }
        else if (type == PathType.Row)
        {
            OdbcDataAdapter da = GetAdapterForTable(tableName);
            if (da == null)
            {
                return;
            }

            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);

            table.Rows[rowNumber].Delete();

            if (ShouldProcess(path, "RemoveItem"))
            {
                da.Update(ds, tableName);
            }
        }
        else
        {
            ThrowTerminatingInvalidPathException(path);
        }

    } // RemoveItem

    #endregion Container Overloads

    #region Navigation

    /// <summary>
    /// Determine if the path specified is that of a container.
    /// </summary>
    /// <param name="path">The path to check.</param>
    /// <returns>True if the path specifies a container.</returns>
    protected override bool IsItemContainer(string path)
    {
       if (PathIsDrive(path))
       {
           return true;
```

```
        }

        string[] pathChunks = ChunkPath(path);
        string tableName;
        int rowNumber;

        PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

        if (type == PathType.Table)
        {
           foreach (DatabaseTableInfo ti in GetTables())
           {
               if (string.Equals(ti.Name, tableName,
StringComparison.OrdinalIgnoreCase))
               {
                   return true;
               }
           } // foreach (DatabaseTableInfo...
        } // if (pathChunks...

        return false;
     } // IsItemContainer

      /// <summary>
      /// Get the name of the leaf element in the specified path
      /// </summary>
      ///
      /// <param name="path">
      /// The full or partial provider specific path
      /// </param>
      ///
      /// <returns>
      /// The leaf element in the path
      /// </returns>
      protected override string GetChildName(string path)
      {
          if (PathIsDrive(path))
          {
              return path;
          }

          string tableName;
          int rowNumber;

          PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

          if (type == PathType.Table)
          {
              return tableName;
          }
          else if (type == PathType.Row)
          {
              return rowNumber.ToString(CultureInfo.CurrentCulture);
```

```
            }
            else
            {
                ThrowTerminatingInvalidPathException(path);
            }

            return null;
        }

        /// <summary>
        /// Removes the child segment of the path and returns the remaining
        /// parent portion
        /// </summary>
        ///
        /// <param name="path">
        /// A full or partial provider specific path. The path may be to an
        /// item that may or may not exist.
        /// </param>
        ///
        /// <param name="root">
        /// The fully qualified path to the root of a drive. This parameter
        /// may be null or empty if a mounted drive is not in use for this
        /// operation.  If this parameter is not null or empty the result
        /// of the method should not be a path to a container that is a
        /// parent or in a different tree than the root.
        /// </param>
        ///
        /// <returns></returns>

        protected override string GetParentPath(string path, string root)
        {
            // If root is specified then the path has to contain
            // the root. If not nothing should be returned
            if (!String.IsNullOrEmpty(root))
            {
                if (!path.Contains(root))
                {
                    return null;
                }
            }

            return path.Substring(0, path.LastIndexOf(pathSeparator,
StringComparison.OrdinalIgnoreCase));
        }

        /// <summary>
        /// Joins two strings with a provider specific path separator.
        /// </summary>
        ///
        /// <param name="parent">
        /// The parent segment of a path to be joined with the child.
        /// </param>
        ///
        /// <param name="child">
        /// The child segment of a path to be joined with the parent.
```

```
        /// </param>
        ///
        /// <returns>
        /// A string that represents the parent and child segments of the
path
        /// joined by a path separator.
        /// </returns>

        protected override string MakePath(string parent, string child)
        {
            string result;

            string normalParent = NormalizePath(parent);
            normalParent = RemoveDriveFromPath(normalParent);
            string normalChild = NormalizePath(child);
            normalChild = RemoveDriveFromPath(normalChild);

            if (String.IsNullOrEmpty(normalParent) &&
String.IsNullOrEmpty(normalChild))
            {
                result = String.Empty;
            }
            else if (String.IsNullOrEmpty(normalParent) &&
!String.IsNullOrEmpty(normalChild))
            {
                result = normalChild;
            }
            else if (!String.IsNullOrEmpty(normalParent) &&
String.IsNullOrEmpty(normalChild))
            {
                if (normalParent.EndsWith(pathSeparator,
StringComparison.OrdinalIgnoreCase))
                {
                    result = normalParent;
                }
                else
                {
                    result = normalParent + pathSeparator;
                }
            } // else if (!String...
            else
            {
                if (!normalParent.Equals(String.Empty) &&
                    !normalParent.EndsWith(pathSeparator,
StringComparison.OrdinalIgnoreCase))
                {
                    result = normalParent + pathSeparator;
                }
                else
                {
                    result = normalParent;
                }

                if (normalChild.StartsWith(pathSeparator,
StringComparison.OrdinalIgnoreCase))
```

```
                {
                    result += normalChild.Substring(1);
                }
                else
                {
                    result += normalChild;
                }
            } // else

            return result;
        } // MakePath

        /// <summary>
        /// Normalizes the path that was passed in and returns the normalized
        /// path as a relative path to the basePath that was passed.
        /// </summary>
        ///
        /// <param name="path">
        /// A fully qualified provider specific path to an item.  The item
        /// should exist or the provider should write out an error.
        /// </param>
        ///
        /// <param name="basepath">
        /// The path that the return value should be relative to.
        /// </param>
        ///
        /// <returns>
        /// A normalized path that is relative to the basePath that was
        /// passed.  The provider should parse the path parameter, normalize
        /// the path, and then return the normalized path relative to the
        /// basePath.
        /// </returns>

        protected override string NormalizeRelativePath(string path,
                                                         string basepath)
        {
            // Normalize the paths first
            string normalPath = NormalizePath(path);
            normalPath = RemoveDriveFromPath(normalPath);
            string normalBasePath = NormalizePath(basepath);
            normalBasePath = RemoveDriveFromPath(normalBasePath);

            if (String.IsNullOrEmpty(normalBasePath))
            {
                return normalPath;
            }
            else
            {
                if (!normalPath.Contains(normalBasePath))
                {
                    return null;
                }

                return normalPath.Substring(normalBasePath.Length +
pathSeparator.Length);
```

```
            }
        }

        /// <summary>
        /// Moves the item specified by the path to the specified destination
        /// </summary>
        ///
        /// <param name="path">
        /// The path to the item to be moved
        /// </param>
        ///
        /// <param name="destination">
        /// The path of the destination container
        /// </param>

        protected override void MoveItem(string path, string destination)
        {
            // Get type, table name and rowNumber from the path
            string tableName, destTableName;
            int rowNumber, destRowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            PathType destType = GetNamesFromPath(destination, out
destTableName,
                                        out destRowNumber);

            if (type == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(path);
            }

            if (destType == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(destination);
            }

            if (type == PathType.Table)
            {
                ArgumentException e = new ArgumentException("Move not
supported for tables");

                WriteError(new ErrorRecord(e, "MoveNotSupported",
                    ErrorCategory.InvalidArgument, path));

                throw e;
            }
            else
            {
                OdbcDataAdapter da = GetAdapterForTable(tableName);
                if (da == null)
                {
                    return;
                }
```

```
            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);

            OdbcDataAdapter dda = GetAdapterForTable(destTableName);
            if (dda == null)
            {
                return;
            }

            DataSet dds = GetDataSetForTable(dda, destTableName);
            DataTable destTable = GetDataTable(dds, destTableName);
            DataRow row = table.Rows[rowNumber];

            if (destType == PathType.Table)
            {
                DataRow destRow = destTable.NewRow();

                destRow.ItemArray = row.ItemArray;
            }
            else
            {
                DataRow destRow = destTable.Rows[destRowNumber];

                destRow.ItemArray = row.ItemArray;
            }

            // Update the changes
            if (ShouldProcess(path, "MoveItem"))
            {
                WriteItemObject(row, path, false);
                dda.Update(dds, destTableName);
            }
        }
    }

#endregion Navigation

#region Helper Methods

/// <summary>
/// Checks if a given path is actually a drive name.
/// </summary>
/// <param name="path">The path to check.</param>
/// <returns>
/// True if the path given represents a drive, false otherwise.
/// </returns>
private bool PathIsDrive(string path)
{
    // Remove the drive name and first path separator.  If the
    // path is reduced to nothing, it is a drive. Also if its
    // just a drive then there wont be any path separators
    if (String.IsNullOrEmpty(
                path.Replace(this.PSDriveInfo.Root, "")) ||
        String.IsNullOrEmpty(
```

```
                        path.Replace(this.PSDriveInfo.Root + pathSeparator,
""))

                )
            {
                return true;
            }
            else
            {
                return false;
            }
        } // PathIsDrive

        /// <summary>
        /// Breaks up the path into individual elements.
        /// </summary>
        /// <param name="path">The path to split.</param>
        /// <returns>An array of path segments.</returns>
        private string[] ChunkPath(string path)
        {
            // Normalize the path before splitting
            string normalPath = NormalizePath(path);

            // Return the path with the drive name and first path
            // separator character removed, split by the path separator.
            string pathNoDrive = normalPath.Replace(this.PSDriveInfo.Root
                                        + pathSeparator, "");

            return pathNoDrive.Split(pathSeparator.ToCharArray());
        } // ChunkPath

        /// <summary>
        /// Adapts the path, making sure the correct path separator
        /// character is used.
        /// </summary>
        /// <param name="path"></param>
        /// <returns></returns>
        private string NormalizePath(string path)
        {
            string result = path;

            if (!String.IsNullOrEmpty(path))
            {
                result = path.Replace("/", pathSeparator);
            }

            return result;
        } // NormalizePath

        /// <summary>
        /// Ensures that the drive is removed from the specified path
        /// </summary>
        ///
        /// <param name="path">Path from which drive needs to be
removed</param>
```

```
        /// <returns>Path with drive information removed</returns>
        private string RemoveDriveFromPath(string path)
        {
            string result = path;
            string root;

            if (this.PSDriveInfo == null)
            {
                root = String.Empty;
            }
            else
            {
                root = this.PSDriveInfo.Root;
            }

            if (result == null)
            {
                result = String.Empty;
            }

            if (result.Contains(root))
            {
                result = result.Substring(result.IndexOf(root,
StringComparison.OrdinalIgnoreCase) + root.Length);
            }

            return result;
        }

        /// <summary>
        /// Chunks the path and returns the table name and the row number
        /// from the path
        /// </summary>
        /// <param name="path">Path to chunk and obtain information</param>
        /// <param name="tableName">Name of the table as represented in the
        /// path</param>
        /// <param name="rowNumber">Row number obtained from the path</param>
        /// <returns>what the path represents</returns>
        private PathType GetNamesFromPath(string path, out string tableName,
out int rowNumber)
        {
            PathType retVal = PathType.Invalid;
            rowNumber = -1;
            tableName = null;

            // Check if the path specified is a drive
            if (PathIsDrive(path))
            {
                return PathType.Database;
            }

            // chunk the path into parts
            string[] pathChunks = ChunkPath(path);

            switch (pathChunks.Length)
```

```
            {
                case 1:
                    {
                        string name = pathChunks[0];

                        if (TableNameIsValid(name))
                        {
                            tableName = name;
                            retVal = PathType.Table;
                        }
                    }
                    break;

                case 2:
                    {
                        string name = pathChunks[0];

                        if (TableNameIsValid(name))
                        {
                            tableName = name;
                        }

                        int number = SafeConvertRowNumber(pathChunks[1]);

                        if (number >= 0)
                        {
                            rowNumber = number;
                            retVal = PathType.Row;
                        }
                        else
                        {
                            WriteError(new ErrorRecord(
                                new ArgumentException("Row number is not
valid"),
                                "RowNumberNotValid",
                                ErrorCategory.InvalidArgument,
                                path));
                        }
                    }
                    break;

                default:
                    {
                        WriteError(new ErrorRecord(
                            new ArgumentException("The path supplied has too
many segments"),
                            "PathNotValid",
                            ErrorCategory.InvalidArgument,
                            path));
                    }
                    break;
            } // switch(pathChunks...

            return retVal;
        } // GetNamesFromPath
```

```
        /// <summary>
        /// Throws an argument exception stating that the specified path does
        /// not represent either a table or a row
        /// </summary>
        /// <param name="path">path which is invalid</param>
        private void ThrowTerminatingInvalidPathException(string path)
        {
            StringBuilder message = new StringBuilder("Path must represent
either a table or a row :");
            message.Append(path);

            throw new ArgumentException(message.ToString());
        }

        /// <summary>
        /// Retrieve the list of tables from the database.
        /// </summary>
        /// <returns>
        /// Collection of DatabaseTableInfo objects, each object representing
        /// information about one database table
        /// </returns>
        private Collection<DatabaseTableInfo> GetTables()
        {
            Collection<DatabaseTableInfo> results =
                    new Collection<DatabaseTableInfo>();

            // using ODBC connection to the database and get the schema of
tables
            AccessDBPSDriveInfo di = this.PSDriveInfo as AccessDBPSDriveInfo;

            if (di == null)
            {
                return null;
            }

            OdbcConnection connection = di.Connection;
            DataTable dt = connection.GetSchema("Tables");
            int count;

            // iterate through all rows in the schema and create
DatabaseTableInfo
            // objects which represents a table
            foreach (DataRow dr in dt.Rows)
            {
                String tableName = dr["TABLE_NAME"] as String;
                DataColumnCollection columns = null;

                // find the number of rows in the table
                try
                {
                    String cmd = "Select count(*) from \"" + tableName + "\"";
                    OdbcCommand command = new OdbcCommand(cmd, connection);

                    count = (Int32)command.ExecuteScalar();
```

```
                }
                catch
                {
                    count = 0;
                }

                // create DatabaseTableInfo object representing the table
                DatabaseTableInfo table =
                        new DatabaseTableInfo(dr, tableName, count, columns);

                results.Add(table);
            } // foreach (DataRow...

            return results;
        } // GetTables

        /// <summary>
        /// Return row information from a specified table.
        /// </summary>
        /// <param name="tableName">The name of the database table from
        /// which to retrieve rows.</param>
        /// <returns>Collection of row information objects.</returns>
        private Collection<DatabaseRowInfo> GetRows(string tableName)
        {
            Collection<DatabaseRowInfo> results =
                        new Collection<DatabaseRowInfo>();

            // Obtain rows in the table and add it to the collection
            try
            {
                OdbcDataAdapter da = GetAdapterForTable(tableName);

                if (da == null)
                {
                    return null;
                }

                DataSet ds = GetDataSetForTable(da, tableName);
                DataTable table = GetDataTable(ds, tableName);

                int i = 0;
                foreach (DataRow row in table.Rows)
                {
                    results.Add(new DatabaseRowInfo(row,
i.ToString(CultureInfo.CurrentCulture)));
                    i++;
                } // foreach (DataRow...
            }
            catch (Exception e)
            {
                WriteError(new ErrorRecord(e, "CannotAccessSpecifiedRows",
                    ErrorCategory.InvalidOperation, tableName));
            }

            return results;
```

```
        } // GetRows

        /// <summary>
        /// Retrieve information about a single table.
        /// </summary>
        /// <param name="tableName">The table for which to retrieve
        /// data.</param>
        /// <returns>Table information.</returns>
        private DatabaseTableInfo GetTable(string tableName)
        {
            foreach (DatabaseTableInfo table in GetTables())
            {
                if (String.Equals(tableName, table.Name,
StringComparison.OrdinalIgnoreCase))
                {
                    return table;
                }
            }

            return null;
        } // GetTable

        /// <summary>
        /// Removes the specified table from the database
        /// </summary>
        /// <param name="tableName">Name of the table to remove</param>
        private void RemoveTable(string tableName)
        {
            // validate if tablename is valid and if table is present
            if (String.IsNullOrEmpty(tableName) ||
!TableNameIsValid(tableName) || !TableIsPresent(tableName))
            {
                return;
            }

            // Execute command using ODBC connection to remove a table
            try
            {
                // delete the table using an sql statement
                string sql = "drop table " + tableName;

                AccessDBPSDriveInfo di = this.PSDriveInfo as
AccessDBPSDriveInfo;

                if (di == null)
                {
                    return;
                }
                OdbcConnection connection = di.Connection;

                OdbcCommand cmd = new OdbcCommand(sql, connection);
                cmd.ExecuteScalar();
            }
            catch (Exception ex)
```

```
            {
                WriteError(new ErrorRecord(ex, "CannotRemoveSpecifiedTable",
                          ErrorCategory.InvalidOperation, null)
                          );
            }

        } // RemoveTable

        /// <summary>
        /// Obtain a data adapter for the specified Table
        /// </summary>
        /// <param name="tableName">Name of the table to obtain the
        /// adapter for</param>
        /// <returns>Adapter object for the specified table</returns>
        /// <remarks>An adapter serves as a bridge between a DataSet (in
memory
        /// representation of table) and the data source</remarks>
        private OdbcDataAdapter GetAdapterForTable(string tableName)
        {
            OdbcDataAdapter da = null;
            AccessDBPSDriveInfo di = this.PSDriveInfo as AccessDBPSDriveInfo;

            if (di == null || !TableNameIsValid(tableName) ||
!TableIsPresent(tableName))
            {
                return null;
            }

            OdbcConnection connection = di.Connection;

            try
            {
                // Create a odbc data adpater. This can be sued to update the
                // data source with the records that will be created here
                // using data sets
                string sql = "Select * from " + tableName;
                da = new OdbcDataAdapter(new OdbcCommand(sql, connection));

                // Create a odbc command builder object. This will create sql
                // commands automatically for a single table, thus
                // eliminating the need to create new sql statements for
                // every operation to be done.
                OdbcCommandBuilder cmd = new OdbcCommandBuilder(da);

                // Set the delete cmd for the table here
                sql = "Delete from " + tableName + " where ID = ?";
                da.DeleteCommand = new OdbcCommand(sql, connection);

                // Specify a DeleteCommand parameter based on the "ID"
                // column
                da.DeleteCommand.Parameters.Add(new OdbcParameter());
                da.DeleteCommand.Parameters[0].SourceColumn = "ID";

                // Create an InsertCommand based on the sql string
                // Insert into "tablename" values (?,?,?)" where
```

```
                // ? represents a column in the table. Note that
                // the number of ? will be equal to the number of
                // columnds
                DataSet ds = new DataSet();

                da.FillSchema(ds, SchemaType.Source);
                ds.Locale = CultureInfo.InvariantCulture;

                sql = "Insert into " + tableName + " values ( ";
                for (int i = 0; i < ds.Tables["Table"].Columns.Count; i++)
                {
                    sql += "?, ";
                }
                sql = sql.Substring(0, sql.Length - 2);
                sql += ")";
                da.InsertCommand = new OdbcCommand(sql, connection);

                // Create parameters for the InsertCommand based on the
                // captions of each column
                for (int i = 0; i < ds.Tables["Table"].Columns.Count; i++)
                {
                    da.InsertCommand.Parameters.Add(new OdbcParameter());
                    da.InsertCommand.Parameters[i].SourceColumn =
                                    ds.Tables["Table"].Columns[i].Caption;

                }

                // Open the connection if its not already open
                if (connection.State != ConnectionState.Open)
                {
                    connection.Open();
                }
            }
            catch (Exception e)
            {
                WriteError(new ErrorRecord(e, "CannotAccessSpecifiedTable",
                  ErrorCategory.InvalidOperation, tableName));
            }

            return da;
        } // GetAdapterForTable

        /// <summary>
        /// Gets the DataSet (in memory representation) for the table
        /// for the specified adapter
        /// </summary>
        /// <param name="adapter">Adapter to be used for obtaining
        /// the table</param>
        /// <param name="tableName">Name of the table for which a
        /// DataSet is required</param>
        /// <returns>The DataSet with the filled in schema</returns>
        private DataSet GetDataSetForTable(OdbcDataAdapter adapter, string
tableName)
        {
            Debug.Assert(adapter != null);
```

```
            // Create a dataset object which will provide an in-memory
            // representation of the data being worked upon in the
            // data source.
            DataSet ds = new DataSet();

            // Create a table named "Table" which will contain the same
            // schema as in the data source.
            //adapter.FillSchema(ds, SchemaType.Source);
            adapter.Fill(ds, tableName);
            ds.Locale = CultureInfo.InvariantCulture;

            return ds;
        } //GetDataSetForTable

        /// <summary>
        /// Get the DataTable object which can be used to operate on
        /// for the specified table in the data source
        /// </summary>
        /// <param name="ds">DataSet object which contains the tables
        /// schema</param>
        /// <param name="tableName">Name of the table</param>
        /// <returns>Corresponding DataTable object representing
        /// the table</returns>
        ///
        private DataTable GetDataTable(DataSet ds, string tableName)
        {
            Debug.Assert(ds != null);
            Debug.Assert(tableName != null);

            DataTable table = ds.Tables[tableName];
            table.Locale = CultureInfo.InvariantCulture;

            return table;
        } // GetDataTable

        /// <summary>
        /// Retrieves a single row from the named table.
        /// </summary>
        /// <param name="tableName">The table that contains the
        /// numbered row.</param>
        /// <param name="row">The index of the row to return.</param>
        /// <returns>The specified table row.</returns>
        private DatabaseRowInfo GetRow(string tableName, int row)
        {
            Collection<DatabaseRowInfo> di = GetRows(tableName);

            // if the row is invalid write an appropriate error else return
the
            // corresponding row information
            if (row < di.Count && row >= 0)
            {
                return di[row];
            }
            else
```

```
            {
                WriteError(new ErrorRecord(
                   new ItemNotFoundException(),
                   "RowNotFound",
                   ErrorCategory.ObjectNotFound,
                   row.ToString(CultureInfo.CurrentCulture))
                );
            }

            return null;
        } // GetRow

        /// <summary>
        /// Method to safely convert a string representation of a row number
        /// into its Int32 equivalent
        /// </summary>
        /// <param name="rowNumberAsStr">String representation of the row
        /// number</param>
        /// <remarks>If there is an exception, -1 is returned</remarks>
        private int SafeConvertRowNumber(string rowNumberAsStr)
        {
            int rowNumber = -1;
            try
            {
                rowNumber = Convert.ToInt32(rowNumberAsStr,
CultureInfo.CurrentCulture);
            }
            catch (FormatException fe)
            {
                WriteError(new ErrorRecord(fe, "RowStringFormatNotValid",
                    ErrorCategory.InvalidData, rowNumberAsStr));
            }
            catch (OverflowException oe)
            {
                WriteError(new ErrorRecord(oe,
"RowStringConversionToNumberFailed",
                    ErrorCategory.InvalidData, rowNumberAsStr));
            }

            return rowNumber;
        } // SafeConvertRowNumber

        /// <summary>
        /// Check if a table name is valid
        /// </summary>
        /// <param name="tableName">Table name to validate</param>
        /// <remarks>Helps to check for SQL injection attacks</remarks>
        private bool TableNameIsValid(string tableName)
        {
            Regex exp = new Regex(pattern, RegexOptions.Compiled |
RegexOptions.IgnoreCase);

            if (exp.IsMatch(tableName))
            {
                return true;
```

```
            }
            WriteError(new ErrorRecord(
                new ArgumentException("Table name not valid"),
"TableNameNotValid",
                    ErrorCategory.InvalidArgument, tableName));
            return false;
        } // TableNameIsValid

        /// <summary>
        /// Checks to see if the specified table is present in the
        /// database
        /// </summary>
        /// <param name="tableName">Name of the table to check</param>
        /// <returns>true, if table is present, false otherwise</returns>
        private bool TableIsPresent(string tableName)
        {
            // using ODBC connection to the database and get the schema of
tables
            AccessDBPSDriveInfo di = this.PSDriveInfo as AccessDBPSDriveInfo;
            if (di == null)
            {
                return false;
            }

            OdbcConnection connection = di.Connection;
            DataTable dt = connection.GetSchema("Tables");

            // check if the specified tableName is available
            // in the list of tables present in the database
            foreach (DataRow dr in dt.Rows)
            {
                string name = dr["TABLE_NAME"] as string;
                if (name.Equals(tableName,
StringComparison.OrdinalIgnoreCase))
                {
                    return true;
                }
            }

            WriteError(new ErrorRecord(
                new ArgumentException("Specified Table is not present in
database"), "TableNotAvailable",
                    ErrorCategory.InvalidArgument, tableName));

            return false;
        }// TableIsPresent

        /// <summary>
        /// Gets the next available ID in the table
        /// </summary>
        /// <param name="table">DataTable object representing the table to
        /// search for ID</param>
        /// <returns>next available id</returns>
        private int GetNextID(DataTable table)
        {
```

```
            int big = 0;

            for (int i = 0; i < table.Rows.Count; i++)
            {
                DataRow row = table.Rows[i];

                int id = (int)row["ID"];

                if (big < id)
                {
                    big = id;
                }
            }

            big++;
            return big;
        }

        #endregion Helper Methods

        #region Private Properties

        private string pathSeparator = "\\";
        private static string pattern = @"^[a-z]+[0-9]*_*$";

         private enum PathType { Database, Table, Row, Invalid };

        #endregion Private Properties

    } // AccessDBProvider

     #endregion AccessDBProvider

    #region Helper Classes

    #region AccessDBPSDriveInfo

    /// <summary>
    /// Any state associated with the drive should be held here.
    /// In this case, it's the connection to the database.
    /// </summary>
    internal class AccessDBPSDriveInfo : PSDriveInfo
    {
        private OdbcConnection connection;

        /// <summary>
        /// ODBC connection information.
        /// </summary>
        public OdbcConnection Connection
        {
            get { return connection; }
            set { connection = value; }
        }

        /// <summary>
```

```
        /// Constructor that takes one argument
        /// </summary>
        /// <param name="driveInfo">Drive provided by this provider</param>
        public AccessDBPSDriveInfo(PSDriveInfo driveInfo)
            : base(driveInfo)
        { }

    } // class AccessDBPSDriveInfo

    #endregion AccessDBPSDriveInfo

    #region DatabaseTableInfo

    /// <summary>
    /// Contains information specific to the database table.
    /// Similar to the DirectoryInfo class.
    /// </summary>
    public class DatabaseTableInfo
    {
        /// <summary>
        /// Row from the "tables" schema
        /// </summary>
        public DataRow Data
        {
            get
            {
                return data;
            }
            set
            {
                data = value;
            }
        }
        private DataRow data;

        /// <summary>
        /// The table name.
        /// </summary>
        public string Name
        {
            get
            {
                return name;
            }
            set
            {
                name = value;
            }
        }
        private String name;

        /// <summary>
        /// The number of rows in the table.
        /// </summary>
        public int RowCount
```

```
        {
            get
            {
                return rowCount;
            }
            set
            {
                rowCount = value;
            }
        }
        private int rowCount;

        /// <summary>
        /// The column definitions for the table.
        /// </summary>
        public DataColumnCollection Columns
        {
            get
            {
                return columns;
            }
            set
            {
                columns = value;
            }
        }
        private DataColumnCollection columns;

        /// <summary>
        /// Constructor.
        /// </summary>
        /// <param name="row">The row definition.</param>
        /// <param name="name">The table name.</param>
        /// <param name="rowCount">The number of rows in the table.</param>
        /// <param name="columns">Information on the column tables.</param>
        public DatabaseTableInfo(DataRow row, string name, int rowCount,
                                 DataColumnCollection columns)
        {
            Name = name;
            Data = row;
            RowCount = rowCount;
            Columns = columns;
        } // DatabaseTableInfo
    } // class DatabaseTableInfo

    #endregion DatabaseTableInfo

    #region DatabaseRowInfo

    /// <summary>
    /// Contains information specific to an individual table row.
    /// Analogous to the FileInfo class.
    /// </summary>
    public class DatabaseRowInfo
    {
```

```
        /// <summary>
        /// Row data information.
        /// </summary>
        public DataRow Data
        {
            get
            {
                return data;
            }
            set
            {
                data = value;
            }
        }
        private DataRow data;

        /// <summary>
        /// The row index.
        /// </summary>
        public string RowNumber
        {
            get
            {
                return rowNumber;
            }
            set
            {
                rowNumber = value;
            }
        }
        private string rowNumber;

        /// <summary>
        /// Constructor.
        /// </summary>
        /// <param name="row">The row information.</param>
        /// <param name="name">The row index.</param>
        public DatabaseRowInfo(DataRow row, string name)
        {
            RowNumber = name;
            Data = row;
        } // DatabaseRowInfo
    } // class DatabaseRowInfo

    #endregion DatabaseRowInfo

    #endregion Helper Classes
}
```

See Also

Windows PowerShell SDK

AccessDbProviderSample06 Code Sample

Article • 09/17/2021

The following code shows the implementation of the Windows PowerShell content provider described in Creating a Windows PowerShell Content Provider. This provider enables the user to manipulate the contents of the items in a data store.

> **Note**
>
> You can download the C# source file (AccessDBSampleProvider06.cs) for this provider by using the Microsoft Windows Software Development Kit for Windows Vista and Microsoft .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded source files are available in the **<PowerShell Samples>** directory. For more information about other Windows PowerShell provider implementations, see **Designing Your Windows PowerShell Provider**.

Code Sample

C#

```
using System;
using System.IO;
using System.Data;
using System.Data.Odbc;
using System.Diagnostics;
using System.Collections;
using System.Collections.ObjectModel;
using System.Management.Automation;
using System.Management.Automation.Provider;
using System.Text;
using System.Text.RegularExpressions;
using System.ComponentModel;
using System.Globalization;

namespace Microsoft.Samples.PowerShell.Providers
{
   #region AccessDBProvider

   /// <summary>
   /// This example implements the content methods.
   /// </summary>
   [CmdletProvider("AccessDB", ProviderCapabilities.None)]
```

```
   public class AccessDBProvider : NavigationCmdletProvider,
IContentCmdletProvider
   {

       #region Drive Manipulation

        /// <summary>
        /// Create a new drive.  Create a connection to the database file
and set
        /// the Connection property in the PSDriveInfo.
        /// </summary>
        /// <param name="drive">
        /// Information describing the drive to add.
        /// </param>
        /// <returns>The added drive.</returns>
        protected override PSDriveInfo NewDrive(PSDriveInfo drive)
        {
            // check if drive object is null
            if (drive == null)
            {
                WriteError(new ErrorRecord(
                    new ArgumentNullException("drive"),
                    "NullDrive",
                    ErrorCategory.InvalidArgument,
                    null)
                );

                return null;
            }

            // check if drive root is not null or empty
            // and if its an existing file
            if (String.IsNullOrEmpty(drive.Root) || (File.Exists(drive.Root)
== false))
            {
                WriteError(new ErrorRecord(
                    new ArgumentException("drive.Root"),
                    "NoRoot",
                    ErrorCategory.InvalidArgument,
                    drive)
                );

                return null;
            }

            // create a new drive and create an ODBC connection to the new
drive
            AccessDBPSDriveInfo accessDBPSDriveInfo = new
AccessDBPSDriveInfo(drive);

            OdbcConnectionStringBuilder builder = new
OdbcConnectionStringBuilder();

            builder.Driver = "Microsoft Access Driver (*.mdb)";
            builder.Add("DBQ", drive.Root);
```

```
            OdbcConnection conn = new
OdbcConnection(builder.ConnectionString);
            conn.Open();
            accessDBPSDriveInfo.Connection = conn;

            return accessDBPSDriveInfo;
        } // NewDrive

        /// <summary>
        /// Removes a drive from the provider.
        /// </summary>
        /// <param name="drive">The drive to remove.</param>
        /// <returns>The drive removed.</returns>
        protected override PSDriveInfo RemoveDrive(PSDriveInfo drive)
        {
            // check if drive object is null
            if (drive == null)
            {
                WriteError(new ErrorRecord(
                    new ArgumentNullException("drive"),
                    "NullDrive",
                    ErrorCategory.InvalidArgument,
                    drive)
                );

                return null;
            }

            // close ODBC connection to the drive
            AccessDBPSDriveInfo accessDBPSDriveInfo = drive as
AccessDBPSDriveInfo;

            if (accessDBPSDriveInfo == null)
            {
                return null;
            }
            accessDBPSDriveInfo.Connection.Close();

            return accessDBPSDriveInfo;
        } // RemoveDrive

        #endregion Drive Manipulation

       #region Item Methods

        /// <summary>
        /// Retrieves an item using the specified path.
        /// </summary>
        /// <param name="path">The path to the item to return.</param>
        protected override void GetItem(string path)
        {
            // check if the path represented is a drive
            if (PathIsDrive(path))
            {
```

```
                WriteItemObject(this.PSDriveInfo, path, true);
                return;
            }// if (PathIsDrive...

            // Get table name and row information from the path and do
            // necessary actions
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type == PathType.Table)
            {
                DatabaseTableInfo table = GetTable(tableName);
                WriteItemObject(table, path, true);
            }
            else if (type == PathType.Row)
            {
                DatabaseRowInfo row = GetRow(tableName, rowNumber);
                WriteItemObject(row, path, false);
            }
            else
            {
                ThrowTerminatingInvalidPathException(path);
            }

        } // GetItem

        /// <summary>
        /// Set the content of a row of data specified by the supplied path
        /// parameter.
        /// </summary>
        /// <param name="path">Specifies the path to the row whose columns
        /// will be updated.</param>
        /// <param name="values">Comma separated string of values</param>
        protected override void SetItem(string path, object values)
        {
            // Get type, table name and row number from the path specified
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type != PathType.Row)
            {
                WriteError(new ErrorRecord(new NotSupportedException(
                      "SetNotSupported"), "",
                   ErrorCategory.InvalidOperation, path));

                return;
            }

            // Get in-memory representation of table
```

```
            OdbcDataAdapter da = GetAdapterForTable(tableName);

            if (da == null)
            {
                return;
            }
            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);

            if (rowNumber >= table.Rows.Count)
            {
                // The specified row number has to be available. If not
                // NewItem has to be used to add a new row
                throw new ArgumentException("Row specified is not
available");
            } // if (rowNum...

            string[] colValues = (values as string).Split(',');

            // set the specified row
            DataRow row = table.Rows[rowNumber];

            for (int i = 0; i < colValues.Length; i++)
            {
                row[i] = colValues[i];
            }

            // Update the table
            if (ShouldProcess(path, "SetItem"))
            {
                da.Update(ds, tableName);
            }

        } // SetItem

        /// <summary>
        /// Test to see if the specified item exists.
        /// </summary>
        /// <param name="path">The path to the item to verify.</param>
        /// <returns>True if the item is found.</returns>
        protected override bool ItemExists(string path)
        {
            // check if the path represented is a drive
            if (PathIsDrive(path))
            {
                return true;
            }

            // Obtain type, table name and row number from path
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);
```

```
            DatabaseTableInfo table = GetTable(tableName);

            if (type == PathType.Table)
            {
                // if specified path represents a table then
DatabaseTableInfo
                // object for the same should exist
                if (table != null)
                {
                    return true;
                }
            }
            else if (type == PathType.Row)
            {
                // if specified path represents a row then DatabaseTableInfo
should
                // exist for the table and then specified row number must be
within
                // the maximum row count in the table
                if (table != null && rowNumber < table.RowCount)
                {
                    return true;
                }
            }

            return false;

        } // ItemExists

        /// <summary>
        /// Test to see if the specified path is syntactically valid.
        /// </summary>
        /// <param name="path">The path to validate.</param>
        /// <returns>True if the specified path is valid.</returns>
        protected override bool IsValidPath(string path)
        {
            bool result = true;

            // check if the path is null or empty
            if (String.IsNullOrEmpty(path))
            {
                result = false;
            }

            // convert all separators in the path to a uniform one
            path = NormalizePath(path);

            // split the path into individual chunks
            string[] pathChunks = path.Split(pathSeparator.ToCharArray());

            foreach (string pathChunk in pathChunks)
            {
                if (pathChunk.Length == 0)
                {
                    result = false;
```

```
                }
            }
            return result;
        } // IsValidPath

        #endregion Item Overloads

       #region Container Overloads

        /// <summary>
        /// Return either the tables in the database or the datarows
        /// </summary>
        /// <param name="path">The path to the parent</param>
        /// <param name="recurse">True to return all child items
recursively.
        /// </param>
        protected override void GetChildItems(string path, bool recurse)
        {
            // If path represented is a drive then the children in the path
are
            // tables. Hence all tables in the drive represented will have
to be
            // returned
            if (PathIsDrive(path))
            {
                foreach (DatabaseTableInfo table in GetTables())
                {
                    WriteItemObject(table, path, true);

                    // if the specified item exists and recurse has been set
then
                    // all child items within it have to be obtained as well
                    if (ItemExists(path) && recurse)
                    {
                        GetChildItems(path + pathSeparator + table.Name,
recurse);
                    }
                } // foreach (DatabaseTableInfo...
            } // if (PathIsDrive...
            else
            {
                // Get the table name, row number and type of path from the
                // path specified
                string tableName;
                int rowNumber;

                PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

                if (type == PathType.Table)
                {
                    // Obtain all the rows within the table
                    foreach (DatabaseRowInfo row in GetRows(tableName))
                    {
                        WriteItemObject(row, path + pathSeparator +
```

```
row.RowNumber,
                                    false);
                    } // foreach (DatabaseRowInfo...
                }
                else if (type == PathType.Row)
                {
                    // In this case the user has directly specified a row,
hence
                    // just give that particular row
                    DatabaseRowInfo row = GetRow(tableName, rowNumber);
                    WriteItemObject(row, path + pathSeparator +
row.RowNumber,
                                    false);
                }
                else
                {
                    // In this case, the path specified is not valid
                    ThrowTerminatingInvalidPathException(path);
                }
            } // else
        } // GetChildItems

        /// <summary>
        /// Return the names of all child items.
        /// </summary>
        /// <param name="path">The root path.</param>
        /// <param name="returnContainers">Not used.</param>
        protected override void GetChildNames(string path,
                                              ReturnContainers returnContainers)
        {
            // If the path represented is a drive, then the child items are
            // tables. get the names of all the tables in the drive.
            if (PathIsDrive(path))
            {
                foreach (DatabaseTableInfo table in GetTables())
                {
                    WriteItemObject(table.Name, path, true);
                } // foreach (DatabaseTableInfo...
            } // if (PathIsDrive...
            else
            {
                // Get type, table name and row number from path specified
                string tableName;
                int rowNumber;

                PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

                if (type == PathType.Table)
                {
                    // Get all the rows in the table and then write out the
                    // row numbers.
                    foreach (DatabaseRowInfo row in GetRows(tableName))
                    {
                        WriteItemObject(row.RowNumber, path, false);
```

```
                    } // foreach (DatabaseRowInfo...
                }
                else if (type == PathType.Row)
                {
                    // In this case the user has directly specified a row,
hence
                    // just give that particular row
                    DatabaseRowInfo row = GetRow(tableName, rowNumber);

                    WriteItemObject(row.RowNumber, path, false);
                }
                else
                {
                    ThrowTerminatingInvalidPathException(path);
                }
            } // else
        } // GetChildNames

        /// <summary>
        /// Determines if the specified path has child items.
        /// </summary>
        /// <param name="path">The path to examine.</param>
        /// <returns>
        /// True if the specified path has child items.
        /// </returns>
        protected override bool HasChildItems(string path)
        {
            if (PathIsDrive(path))
            {
                return true;
            }

            return (ChunkPath(path).Length == 1);
        } // HasChildItems

        /// <summary>
        /// Creates a new item at the specified path.
        /// </summary>
        ///
        /// <param name="path">
        /// The path to the new item.
        /// </param>
        ///
        /// <param name="type">
        /// Type for the object to create. "Table" for creating a new table
and
        /// "Row" for creating a new row in a table.
        /// </param>
        ///
        /// <param name="newItemValue">
        /// Object for creating new instance of a type at the specified
path. For
        /// creating a "Table" the object parameter is ignored and for
creating
        /// a "Row" the object must be of type string which will contain
```

```
comma
        /// separated values of the rows to insert.
        /// </param>
        protected override void NewItem(string path, string type,
                                        object newItemValue)
        {
            string tableName;
            int rowNumber;

            PathType pt = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (pt == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(path);
            }

            // Check if type is either "table" or "row", if not throw an
            // exception
            if (!String.Equals(type, "table",
StringComparison.OrdinalIgnoreCase)
                && !String.Equals(type, "row",
StringComparison.OrdinalIgnoreCase))
            {
                WriteError(new ErrorRecord
                                    (new ArgumentException("Type must be
either a table or row"),
                                        "CannotCreateSpecifiedObject",
                                           ErrorCategory.InvalidArgument,
                                                path
                                     )
                           );

                throw new ArgumentException("This provider can only create
items of type \"table\" or \"row\"");
            }

            // Path type is the type of path of the container. So if a drive
            // is specified, then a table can be created under it and if a
table
            // is specified, then a row can be created under it. For the
sake of
            // completeness, if a row is specified, then if the row
specified by
            // the path does not exist, a new row is created. However, the
row
            // number may not match as the row numbers only get incremented
based
            // on the number of rows

            if (PathIsDrive(path))
            {
                if (String.Equals(type, "table",
StringComparison.OrdinalIgnoreCase))
                {
```

```
                    // Execute command using ODBC connection to create a
table
                    try
                    {
                        // create the table using an sql statement
                        string newTableName = newItemValue.ToString();
                        string sql = "create table " + newTableName
                                              + " (ID INT)";

                        // Create the table using the Odbc connection from
the
                        // drive.
                        AccessDBPSDriveInfo di = this.PSDriveInfo as
AccessDBPSDriveInfo;

                        if (di == null)
                        {
                            return;
                        }
                        OdbcConnection connection = di.Connection;

                        if (ShouldProcess(newTableName, "create"))
                        {
                            OdbcCommand cmd = new OdbcCommand(sql,
connection);

                            cmd.ExecuteScalar();
                        }
                    }
                    catch (Exception ex)
                    {
                        WriteError(new ErrorRecord(ex,
"CannotCreateSpecifiedTable",
                                    ErrorCategory.InvalidOperation, path)
                                    );
                    }
                } // if (String...
                else if (String.Equals(type, "row",
StringComparison.OrdinalIgnoreCase))
                {
                    throw new
                        ArgumentException("A row cannot be created under a
database, specify a path that represents a Table");
                }
            }// if (PathIsDrive...
            else
            {
                if (String.Equals(type, "table",
StringComparison.OrdinalIgnoreCase))
                {
                    if (rowNumber < 0)
                    {
                        throw new
                            ArgumentException("A table cannot be created
within another table, specify a path that represents a database");
                    }
```

```
                    else
                    {
                        throw new
                            ArgumentException("A table cannot be created
inside a row, specify a path that represents a database");
                    }
                } //if (String.Equals....
                // if path specified is a row, create a new row
                else if (String.Equals(type, "row",
StringComparison.OrdinalIgnoreCase))
                {
                    // The user is required to specify the values to be
inserted
                    // into the table in a single string separated by commas
                    string value = newItemValue as string;

                    if (String.IsNullOrEmpty(value))
                    {
                        throw new
                            ArgumentException("Value argument must have
comma separated values of each column in a row");
                    }
                    string[] rowValues = value.Split(',');

                    OdbcDataAdapter da = GetAdapterForTable(tableName);

                    if (da == null)
                    {
                        return;
                    }

                    DataSet ds = GetDataSetForTable(da, tableName);
                    DataTable table = GetDataTable(ds, tableName);

                    if (rowValues.Length != table.Columns.Count)
                    {
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                                "The table has {0} columns and
the value specified must have so many comma separated values",
                                                    table.Columns.Count);

                        throw new ArgumentException(message);
                    }

                    if (!Force && (rowNumber >= 0 && rowNumber <
table.Rows.Count))
                    {
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                                "The row {0} already exists. To
create a new row specify row number as {1}, or specify path to a table, or
use the -Force parameter",
                                                    rowNumber,
table.Rows.Count);
```

```
                        throw new ArgumentException(message);
                    }

                    if (rowNumber > table.Rows.Count)
                    {
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                                "To create a new row specify row
number as {0}, or specify path to a table",
                                                    table.Rows.Count);

                        throw new ArgumentException(message);
                    }

                    // Create a new row and update the row with the input
                    // provided by the user
                    DataRow row = table.NewRow();
                    for (int i = 0; i < rowValues.Length; i++)
                    {
                        row[i] = rowValues[i];
                    }
                    table.Rows.Add(row);

                    if (ShouldProcess(tableName, "update rows"))
                    {
                        // Update the table from memory back to the data
source
                        da.Update(ds, tableName);
                    }

                }// else if (String...
            }// else ...

        } // NewItem

        /// <summary>
        /// Copies an item at the specified path to the location specified
        /// </summary>
        ///
        /// <param name="path">
        /// Path of the item to copy
        /// </param>
        ///
        /// <param name="copyPath">
        /// Path of the item to copy to
        /// </param>
        ///
        /// <param name="recurse">
        /// Tells the provider to recurse subcontainers when copying
        /// </param>
        ///
        protected override void CopyItem(string path, string copyPath, bool
recurse)
        {
```

```
            string tableName, copyTableName;
            int rowNumber, copyRowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);
            PathType copyType = GetNamesFromPath(copyPath, out
copyTableName, out copyRowNumber);

            if (type == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(path);
            }

            if (type == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(copyPath);
            }

            // Get the table and the table to copy to
            OdbcDataAdapter da = GetAdapterForTable(tableName);
            if (da == null)
            {
                return;
            }

            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);

            OdbcDataAdapter cda = GetAdapterForTable(copyTableName);
            if (cda == null)
            {
                return;
            }

            DataSet cds = GetDataSetForTable(cda, copyTableName);
            DataTable copyTable = GetDataTable(cds, copyTableName);

            // if source represents a table
            if (type == PathType.Table)
            {
                // if copyPath does not represent a table
                if (copyType != PathType.Table)
                {
                    ArgumentException e = new ArgumentException("Table can
only be copied on to another table location");

                    WriteError(new ErrorRecord(e, "PathNotValid",
                        ErrorCategory.InvalidArgument, copyPath));

                    throw e;
                }

                // if table already exists then force parameter should be
set
                // to force a copy
```

```
                if (!Force && GetTable(copyTableName) != null)
                {
                    throw new ArgumentException("Specified path already
exists");
                }

                for (int i = 0; i < table.Rows.Count; i++)
                {
                    DataRow row = table.Rows[i];
                    DataRow copyRow = copyTable.NewRow();

                    copyRow.ItemArray = row.ItemArray;
                    copyTable.Rows.Add(copyRow);
                }
            } // if (type == ...
            // if source represents a row
            else
            {
                if (copyType == PathType.Row)
                {
                    if (!Force && (copyRowNumber < copyTable.Rows.Count))
                    {
                        throw new ArgumentException("Specified path already
exists.");
                    }

                    DataRow row = table.Rows[rowNumber];
                    DataRow copyRow = null;

                    if (copyRowNumber < copyTable.Rows.Count)
                    {
                        // copy to an existing row
                        copyRow = copyTable.Rows[copyRowNumber];
                        copyRow.ItemArray = row.ItemArray;
                        copyRow[0] = GetNextID(copyTable);
                    }
                    else if (copyRowNumber == copyTable.Rows.Count)
                    {
                        // copy to the next row in the table that will
                        // be created
                        copyRow = copyTable.NewRow();
                        copyRow.ItemArray = row.ItemArray;
                        copyRow[0] = GetNextID(copyTable);
                        copyTable.Rows.Add(copyRow);
                    }
                    else
                    {
                        // attempting to copy to a nonexistent row or a row
                        // that cannot be created now - throw an exception
                        string message =
String.Format(CultureInfo.CurrentCulture,
                                                "The item cannot be specified to
the copied row. Specify row number as {0}, or specify a path to the table.",
                                                    table.Rows.Count);
```

```
                    throw new ArgumentException(message);
                }
            }
            else
            {
                // destination path specified represents a table,
                // create a new row and copy the item
                DataRow copyRow = copyTable.NewRow();
                copyRow.ItemArray = table.Rows[rowNumber].ItemArray;
                copyRow[0] = GetNextID(copyTable);
                copyTable.Rows.Add(copyRow);
            }
        }

        if (ShouldProcess(copyTableName, "CopyItems"))
        {
            cda.Update(cds, copyTableName);
        }

    } //CopyItem

    /// <summary>
    /// Removes (deletes) the item at the specified path
    /// </summary>
    ///
    /// <param name="path">
    /// The path to the item to remove.
    /// </param>
    ///
    /// <param name="recurse">
    /// True if all children in a subtree should be removed, false if
only
    /// the item at the specified path should be removed. Is applicable
    /// only for container (table) items. Its ignored otherwise (even if
    /// specified).
    /// </param>
    ///
    /// <remarks>
    /// There are no elements in this store which are hidden from the
user.
    /// Hence this method will not check for the presence of the Force
    /// parameter
    /// </remarks>
    ///
    protected override void RemoveItem(string path, bool recurse)
    {
        string tableName;
        int rowNumber = 0;

        PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

        if (type == PathType.Table)
        {
            // if recurse flag has been specified, delete all the rows
```

```
as well
                if (recurse)
                {
                    OdbcDataAdapter da = GetAdapterForTable(tableName);
                    if (da == null)
                    {
                        return;
                    }

                    DataSet ds = GetDataSetForTable(da, tableName);
                    DataTable table = GetDataTable(ds, tableName);

                    for (int i = 0; i < table.Rows.Count; i++)
                    {
                        table.Rows[i].Delete();
                    }

                    if (ShouldProcess(path, "RemoveItem"))
                    {
                        da.Update(ds, tableName);
                        RemoveTable(tableName);
                    }
                }//if (recurse...
                else
                {
                    // Remove the table
                    if (ShouldProcess(path, "RemoveItem"))
                    {
                        RemoveTable(tableName);
                    }
                }
            }
            else if (type == PathType.Row)
            {
                OdbcDataAdapter da = GetAdapterForTable(tableName);
                if (da == null)
                {
                    return;
                }

                DataSet ds = GetDataSetForTable(da, tableName);
                DataTable table = GetDataTable(ds, tableName);

                table.Rows[rowNumber].Delete();

                if (ShouldProcess(path, "RemoveItem"))
                {
                    da.Update(ds, tableName);
                }
            }
            else
            {
                ThrowTerminatingInvalidPathException(path);
            }
```

```
        } // RemoveItem

        #endregion Container Overloads

       #region Navigation

        /// <summary>
        /// Determine if the path specified is that of a container.
        /// </summary>
        /// <param name="path">The path to check.</param>
        /// <returns>True if the path specifies a container.</returns>
        protected override bool IsItemContainer(string path)
        {
            if (PathIsDrive(path))
            {
                return true;
            }

            string[] pathChunks = ChunkPath(path);
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type == PathType.Table)
            {
                foreach (DatabaseTableInfo ti in GetTables())
                {
                    if (string.Equals(ti.Name, tableName,
StringComparison.OrdinalIgnoreCase))
                    {
                        return true;
                    }
                } // foreach (DatabaseTableInfo...
            } // if (pathChunks...

            return false;
        } // IsItemContainer

        /// <summary>
        /// Get the name of the leaf element in the specified path
        /// </summary>
        ///
        /// <param name="path">
        /// The full or partial provider specific path
        /// </param>
        ///
        /// <returns>
        /// The leaf element in the path
        /// </returns>
        protected override string GetChildName(string path)
        {
            if (PathIsDrive(path))
            {
```

```
                return path;
            }

            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type == PathType.Table)
            {
                return tableName;
            }
            else if (type == PathType.Row)
            {
                return rowNumber.ToString(CultureInfo.CurrentCulture);
            }
            else
            {
                ThrowTerminatingInvalidPathException(path);
            }

            return null;
        }

        /// <summary>
        /// Removes the child segment of the path and returns the remaining
        /// parent portion
        /// </summary>
        ///
        /// <param name="path">
        /// A full or partial provider specific path. The path may be to an
        /// item that may or may not exist.
        /// </param>
        ///
        /// <param name="root">
        /// The fully qualified path to the root of a drive. This parameter
        /// may be null or empty if a mounted drive is not in use for this
        /// operation.  If this parameter is not null or empty the result
        /// of the method should not be a path to a container that is a
        /// parent or in a different tree than the root.
        /// </param>
        ///
        /// <returns></returns>

        protected override string GetParentPath(string path, string root)
        {
            // If root is specified then the path has to contain
            // the root. If not nothing should be returned
            if (!String.IsNullOrEmpty(root))
            {
                if (!path.Contains(root))
                {
                    return null;
                }
```

```
            }

            return path.Substring(0, path.LastIndexOf(pathSeparator,
StringComparison.OrdinalIgnoreCase));
        }

        /// <summary>
        /// Joins two strings with a provider specific path separator.
        /// </summary>
        ///
        /// <param name="parent">
        /// The parent segment of a path to be joined with the child.
        /// </param>
        ///
        /// <param name="child">
        /// The child segment of a path to be joined with the parent.
        /// </param>
        ///
        /// <returns>
        /// A string that represents the parent and child segments of the
path
        /// joined by a path separator.
        /// </returns>

        protected override string MakePath(string parent, string child)
        {
            string result;

            string normalParent = NormalizePath(parent);
            normalParent = RemoveDriveFromPath(normalParent);
            string normalChild = NormalizePath(child);
            normalChild = RemoveDriveFromPath(normalChild);

            if (String.IsNullOrEmpty(normalParent) &&
String.IsNullOrEmpty(normalChild))
            {
                result = String.Empty;
            }
            else if (String.IsNullOrEmpty(normalParent) &&
!String.IsNullOrEmpty(normalChild))
            {
                result = normalChild;
            }
            else if (!String.IsNullOrEmpty(normalParent) &&
String.IsNullOrEmpty(normalChild))
            {
                if (normalParent.EndsWith(pathSeparator,
StringComparison.OrdinalIgnoreCase))
                {
                    result = normalParent;
                }
                else
                {
                    result = normalParent + pathSeparator;
                }
```

```
            } // else if (!String...
            else
            {
                if (!normalParent.Equals(String.Empty,
StringComparison.OrdinalIgnoreCase) &&
                    !normalParent.EndsWith(pathSeparator,
StringComparison.OrdinalIgnoreCase))
                {
                    result = normalParent + pathSeparator;
                }
                else
                {
                    result = normalParent;
                }

                if (normalChild.StartsWith(pathSeparator,
StringComparison.OrdinalIgnoreCase))
                {
                    result += normalChild.Substring(1);
                }
                else
                {
                    result += normalChild;
                }
            } // else

            return result;
        } // MakePath

        /// <summary>
        /// Normalizes the path that was passed in and returns the
normalized
        /// path as a relative path to the basePath that was passed.
        /// </summary>
        ///
        /// <param name="path">
        /// A fully qualified provider specific path to an item.  The item
        /// should exist or the provider should write out an error.
        /// </param>
        ///
        /// <param name="basepath">
        /// The path that the return value should be relative to.
        /// </param>
        ///
        /// <returns>
        /// A normalized path that is relative to the basePath that was
        /// passed.  The provider should parse the path parameter, normalize
        /// the path, and then return the normalized path relative to the
        /// basePath.
        /// </returns>

        protected override string NormalizeRelativePath(string path,
                                                         string
basepath)
        {
```

```
            // Normalize the paths first
            string normalPath = NormalizePath(path);
            normalPath = RemoveDriveFromPath(normalPath);
            string normalBasePath = NormalizePath(basepath);
            normalBasePath = RemoveDriveFromPath(normalBasePath);

            if (String.IsNullOrEmpty(normalBasePath))
            {
                return normalPath;
            }
            else
            {
                if (!normalPath.Contains(normalBasePath))
                {
                    return null;
                }

                return normalPath.Substring(normalBasePath.Length +
pathSeparator.Length);
            }
        }

        /// <summary>
        /// Moves the item specified by the path to the specified
destination
        /// </summary>
        ///
        /// <param name="path">
        /// The path to the item to be moved
        /// </param>
        ///
        /// <param name="destination">
        /// The path of the destination container
        /// </param>

        protected override void MoveItem(string path, string destination)
        {
            // Get type, table name and rowNumber from the path
            string tableName, destTableName;
            int rowNumber, destRowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            PathType destType = GetNamesFromPath(destination, out
destTableName,
                                    out destRowNumber);

            if (type == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(path);
            }

            if (destType == PathType.Invalid)
            {
```

```
                ThrowTerminatingInvalidPathException(destination);
            }

            if (type == PathType.Table)
            {
                ArgumentException e = new ArgumentException("Move not
supported for tables");

                WriteError(new ErrorRecord(e, "MoveNotSupported",
                    ErrorCategory.InvalidArgument, path));

                throw e;
            }
            else
            {
                OdbcDataAdapter da = GetAdapterForTable(tableName);
                if (da == null)
                {
                    return;
                }

                DataSet ds = GetDataSetForTable(da, tableName);
                DataTable table = GetDataTable(ds, tableName);

                OdbcDataAdapter dda = GetAdapterForTable(destTableName);
                if (dda == null)
                {
                    return;
                }

                DataSet dds = GetDataSetForTable(dda, destTableName);
                DataTable destTable = GetDataTable(dds, destTableName);
                DataRow row = table.Rows[rowNumber];

                if (destType == PathType.Table)
                {
                    DataRow destRow = destTable.NewRow();

                    destRow.ItemArray = row.ItemArray;
                }
                else
                {
                    DataRow destRow = destTable.Rows[destRowNumber];

                    destRow.ItemArray = row.ItemArray;
                }

                // Update the changes
                if (ShouldProcess(path, "MoveItem"))
                {
                    WriteItemObject(row, path, false);
                    dda.Update(dds, destTableName);
                }
            }
        }
```

```
        #endregion Navigation

        #region Helper Methods

        /// <summary>
        /// Checks if a given path is actually a drive name.
        /// </summary>
        /// <param name="path">The path to check.</param>
        /// <returns>
        /// True if the path given represents a drive, false otherwise.
        /// </returns>
        private bool PathIsDrive(string path)
        {
            // Remove the drive name and first path separator.  If the
            // path is reduced to nothing, it is a drive. Also if its
            // just a drive then there wont be any path separators
            if (String.IsNullOrEmpty(
                        path.Replace(this.PSDriveInfo.Root, "")) ||
                String.IsNullOrEmpty(
                        path.Replace(this.PSDriveInfo.Root + pathSeparator,
""))

               )
            {
                return true;
            }
            else
            {
                return false;
            }
        } // PathIsDrive

        /// <summary>
        /// Breaks up the path into individual elements.
        /// </summary>
        /// <param name="path">The path to split.</param>
        /// <returns>An array of path segments.</returns>
        private string[] ChunkPath(string path)
        {
            // Normalize the path before splitting
            string normalPath = NormalizePath(path);

            // Return the path with the drive name and first path
            // separator character removed, split by the path separator.
            string pathNoDrive = normalPath.Replace(this.PSDriveInfo.Root
                                        + pathSeparator, "");

            return pathNoDrive.Split(pathSeparator.ToCharArray());
        } // ChunkPath

        /// <summary>
        /// Adapts the path, making sure the correct path separator
        /// character is used.
        /// </summary>
```

```
        /// <param name="path"></param>
        /// <returns></returns>
        private string NormalizePath(string path)
        {
            string result = path;

            if (!String.IsNullOrEmpty(path))
            {
                result = path.Replace("/", pathSeparator);
            }

            return result;
        } // NormalizePath

        /// <summary>
        /// Ensures that the drive is removed from the specified path
        /// </summary>
        ///
        /// <param name="path">Path from which drive needs to be
removed</param>
        /// <returns>Path with drive information removed</returns>
        private string RemoveDriveFromPath(string path)
        {
            string result = path;
            string root;

            if (this.PSDriveInfo == null)
            {
                root = String.Empty;
            }
            else
            {
                root = this.PSDriveInfo.Root;
            }

            if (result == null)
            {
                result = String.Empty;
            }

            if (result.Contains(root))
            {
                result = result.Substring(result.IndexOf(root,
StringComparison.OrdinalIgnoreCase) + root.Length);
            }

            return result;
        }

        /// <summary>
        /// Chunks the path and returns the table name and the row number
        /// from the path
        /// </summary>
        /// <param name="path">Path to chunk and obtain information</param>
        /// <param name="tableName">Name of the table as represented in the
```

```
        /// path</param>
        /// <param name="rowNumber">Row number obtained from the
path</param>
        /// <returns>what the path represents</returns>
        public PathType GetNamesFromPath(string path, out string tableName,
out int rowNumber)
        {
            PathType retVal = PathType.Invalid;
            rowNumber = -1;
            tableName = null;

            // Check if the path specified is a drive
            if (PathIsDrive(path))
            {
                return PathType.Database;
            }

            // chunk the path into parts
            string[] pathChunks = ChunkPath(path);

            switch (pathChunks.Length)
            {
                case 1:
                    {
                        string name = pathChunks[0];

                        if (TableNameIsValid(name))
                        {
                            tableName = name;
                            retVal = PathType.Table;
                        }
                    }
                    break;

                case 2:
                    {
                        string name = pathChunks[0];

                        if (TableNameIsValid(name))
                        {
                            tableName = name;
                        }

                        int number = SafeConvertRowNumber(pathChunks[1]);

                        if (number >= 0)
                        {
                            rowNumber = number;
                            retVal = PathType.Row;
                        }
                        else
                        {
                            WriteError(new ErrorRecord(
                                new ArgumentException("Row number is not
valid"),
```

```
                                "RowNumberNotValid",
                                ErrorCategory.InvalidArgument,
                                path));
                        }
                    }
                    break;

                default:
                    {
                        WriteError(new ErrorRecord(
                            new ArgumentException("The path supplied has too
many segments"),
                            "PathNotValid",
                            ErrorCategory.InvalidArgument,
                            path));
                    }
                    break;
            } // switch(pathChunks...

            return retVal;
        } // GetNamesFromPath

        /// <summary>
        /// Throws an argument exception stating that the specified path
does
        /// not represent either a table or a row
        /// </summary>
        /// <param name="path">path which is invalid</param>
        private void ThrowTerminatingInvalidPathException(string path)
        {
            StringBuilder message = new StringBuilder("Path must represent
either a table or a row :");
            message.Append(path);

            throw new ArgumentException(message.ToString());
        }

        /// <summary>
        /// Retrieve the list of tables from the database.
        /// </summary>
        /// <returns>
        /// Collection of DatabaseTableInfo objects, each object
representing
        /// information about one database table
        /// </returns>
        internal Collection<DatabaseTableInfo> GetTables()
        {
            Collection<DatabaseTableInfo> results =
                    new Collection<DatabaseTableInfo>();

            // using ODBC connection to the database and get the schema of
tables
            AccessDBPSDriveInfo di = this.PSDriveInfo as
AccessDBPSDriveInfo;
```

```
            if (di == null)
            {
                return null;
            }

            OdbcConnection connection = di.Connection;
            DataTable dt = connection.GetSchema("Tables");
            int count;

            // iterate through all rows in the schema and create
DatabaseTableInfo
            // objects which represents a table
            foreach (DataRow dr in dt.Rows)
            {
                String tableName = dr["TABLE_NAME"] as String;
                DataColumnCollection columns = null;

                // find the number of rows in the table
                try
                {
                    String cmd = "Select count(*) from \"" + tableName +
"\"";
                    OdbcCommand command = new OdbcCommand(cmd, connection);

                    count = (Int32)command.ExecuteScalar();
                }
                catch
                {
                    count = 0;
                }

                // create DatabaseTableInfo object representing the table
                DatabaseTableInfo table =
                        new DatabaseTableInfo(dr, tableName, count,
columns);

                results.Add(table);
            } // foreach (DataRow...

            return results;
        } // GetTables

        /// <summary>
        /// Return row information from a specified table.
        /// </summary>
        /// <param name="tableName">The name of the database table from
        /// which to retrieve rows.</param>
        /// <returns>Collection of row information objects.</returns>
        public Collection<DatabaseRowInfo> GetRows(string tableName)
        {
            Collection<DatabaseRowInfo> results =
                        new Collection<DatabaseRowInfo>();

            // Obtain rows in the table and add it to the collection
            try
```

```
            {
                OdbcDataAdapter da = GetAdapterForTable(tableName);

                if (da == null)
                {
                    return null;
                }

                DataSet ds = GetDataSetForTable(da, tableName);
                DataTable table = GetDataTable(ds, tableName);

                int i = 0;
                foreach (DataRow row in table.Rows)
                {
                    results.Add(new DatabaseRowInfo(row,
i.ToString(CultureInfo.CurrentCulture)));
                    i++;
                } // foreach (DataRow...
            }
            catch (Exception e)
            {
                WriteError(new ErrorRecord(e, "CannotAccessSpecifiedRows",
                    ErrorCategory.InvalidOperation, tableName));
            }

            return results;

        } // GetRows

        /// <summary>
        /// Retrieve information about a single table.
        /// </summary>
        /// <param name="tableName">The table for which to retrieve
        /// data.</param>
        /// <returns>Table information.</returns>
        private DatabaseTableInfo GetTable(string tableName)
        {
            foreach (DatabaseTableInfo table in GetTables())
            {
                if (String.Equals(tableName, table.Name,
StringComparison.OrdinalIgnoreCase))
                {
                    return table;
                }
            }

            return null;
        } // GetTable

        /// <summary>
        /// Removes the specified table from the database
        /// </summary>
        /// <param name="tableName">Name of the table to remove</param>
        private void RemoveTable(string tableName)
        {
```

```
            // validate if tablename is valid and if table is present
            if (String.IsNullOrEmpty(tableName) ||
!TableNameIsValid(tableName) || !TableIsPresent(tableName))
            {
                return;
            }

            // Execute command using ODBC connection to remove a table
            try
            {
                // delete the table using an sql statement
                string sql = "drop table " + tableName;

                AccessDBPSDriveInfo di = this.PSDriveInfo as
AccessDBPSDriveInfo;

                if (di == null)
                {
                    return;
                }
                OdbcConnection connection = di.Connection;

                OdbcCommand cmd = new OdbcCommand(sql, connection);
                cmd.ExecuteScalar();
            }
            catch (Exception ex)
            {
                WriteError(new ErrorRecord(ex, "CannotRemoveSpecifiedTable",
                          ErrorCategory.InvalidOperation, null)
                          );
            }

        } // RemoveTable

        /// <summary>
        /// Obtain a data adapter for the specified Table
        /// </summary>
        /// <param name="tableName">Name of the table to obtain the
        /// adapter for</param>
        /// <returns>Adapter object for the specified table</returns>
        /// <remarks>An adapter serves as a bridge between a DataSet (in
memory
        /// representation of table) and the data source</remarks>
        internal OdbcDataAdapter GetAdapterForTable(string tableName)
        {
            OdbcDataAdapter da = null;
            AccessDBPSDriveInfo di = this.PSDriveInfo as
AccessDBPSDriveInfo;

            if (di == null || !TableNameIsValid(tableName) ||
!TableIsPresent(tableName))
            {
                return null;
            }
```

```
            OdbcConnection connection = di.Connection;

            try
            {
                // Create a odbc data adpater. This can be sued to update
the
                // data source with the records that will be created here
                // using data sets
                string sql = "Select * from " + tableName;
                da = new OdbcDataAdapter(new OdbcCommand(sql, connection));

                // Create a odbc command builder object. This will create
sql
                // commands automatically for a single table, thus
                // eliminating the need to create new sql statements for
                // every operation to be done.
                OdbcCommandBuilder cmd = new OdbcCommandBuilder(da);

                // Set the delete cmd for the table here
                sql = "Delete from " + tableName + " where ID = ?";
                da.DeleteCommand = new OdbcCommand(sql, connection);

                // Specify a DeleteCommand parameter based on the "ID"
                // column
                da.DeleteCommand.Parameters.Add(new OdbcParameter());
                da.DeleteCommand.Parameters[0].SourceColumn = "ID";

                // Create an InsertCommand based on the sql string
                // Insert into "tablename" values (?,?,?)" where
                // ? represents a column in the table. Note that
                // the number of ? will be equal to the number of
                // columnds
                DataSet ds = new DataSet();
                ds.Locale = CultureInfo.InvariantCulture;

                da.FillSchema(ds, SchemaType.Source);

                sql = "Insert into " + tableName + " values ( ";
                for (int i = 0; i < ds.Tables["Table"].Columns.Count; i++)
                {
                    sql += "?, ";
                }
                sql = sql.Substring(0, sql.Length - 2);
                sql += ")";
                da.InsertCommand = new OdbcCommand(sql, connection);

                // Create parameters for the InsertCommand based on the
                // captions of each column
                for (int i = 0; i < ds.Tables["Table"].Columns.Count; i++)
                {
                    da.InsertCommand.Parameters.Add(new OdbcParameter());
                    da.InsertCommand.Parameters[i].SourceColumn =
                                    ds.Tables["Table"].Columns[i].Caption;

                }
```

```
                // Open the connection if its not already open
                if (connection.State != ConnectionState.Open)
                {
                    connection.Open();
                }
            }
            catch (Exception e)
            {
                WriteError(new ErrorRecord(e, "CannotAccessSpecifiedTable",
                  ErrorCategory.InvalidOperation, tableName));
            }

            return da;
        } // GetAdapterForTable

        /// <summary>
        /// Gets the DataSet (in memory representation) for the table
        /// for the specified adapter
        /// </summary>
        /// <param name="adapter">Adapter to be used for obtaining
        /// the table</param>
        /// <param name="tableName">Name of the table for which a
        /// DataSet is required</param>
        /// <returns>The DataSet with the filled in schema</returns>
        internal DataSet GetDataSetForTable(OdbcDataAdapter adapter, string
tableName)
        {
            Debug.Assert(adapter != null);

            // Create a dataset object which will provide an in-memory
            // representation of the data being worked upon in the
            // data source.
            DataSet ds = new DataSet();

            // Create a table named "Table" which will contain the same
            // schema as in the data source.
            //adapter.FillSchema(ds, SchemaType.Source);
            adapter.Fill(ds, tableName);
            ds.Locale = CultureInfo.InvariantCulture;

            return ds;
        } //GetDataSetForTable

        /// <summary>
        /// Get the DataTable object which can be used to operate on
        /// for the specified table in the data source
        /// </summary>
        /// <param name="ds">DataSet object which contains the tables
        /// schema</param>
        /// <param name="tableName">Name of the table</param>
        /// <returns>Corresponding DataTable object representing
        /// the table</returns>
        ///
        internal DataTable GetDataTable(DataSet ds, string tableName)
```

```
        {
            Debug.Assert(ds != null);
            Debug.Assert(tableName != null);

            DataTable table = ds.Tables[tableName];
            table.Locale = CultureInfo.InvariantCulture;

            return table;
        } // GetDataTable

        /// <summary>
        /// Retrieves a single row from the named table.
        /// </summary>
        /// <param name="tableName">The table that contains the
        /// numbered row.</param>
        /// <param name="row">The index of the row to return.</param>
        /// <returns>The specified table row.</returns>
        private DatabaseRowInfo GetRow(string tableName, int row)
        {
            Collection<DatabaseRowInfo> di = GetRows(tableName);

            // if the row is invalid write an appropriate error else return
the
            // corresponding row information
            if (row < di.Count && row >= 0)
            {
                return di[row];
            }
            else
            {
                WriteError(new ErrorRecord(
                   new ItemNotFoundException(),
                   "RowNotFound",
                   ErrorCategory.ObjectNotFound,
                   row.ToString(CultureInfo.CurrentCulture))
                );
            }

            return null;
        } // GetRow

        /// <summary>
        /// Method to safely convert a string representation of a row number
        /// into its Int32 equivalent
        /// </summary>
        /// <param name="rowNumberAsStr">String representation of the row
        /// number</param>
        /// <remarks>If there is an exception, -1 is returned</remarks>
        private int SafeConvertRowNumber(string rowNumberAsStr)
        {
            int rowNumber = -1;
            try
            {
                rowNumber = Convert.ToInt32(rowNumberAsStr,
CultureInfo.CurrentCulture);
```

```
            }
            catch (FormatException fe)
            {
                WriteError(new ErrorRecord(fe, "RowStringFormatNotValid",
                    ErrorCategory.InvalidData, rowNumberAsStr));
            }
            catch (OverflowException oe)
            {
                WriteError(new ErrorRecord(oe,
"RowStringConversionToNumberFailed",
                    ErrorCategory.InvalidData, rowNumberAsStr));
            }

            return rowNumber;
        } // 1


       /// <summary>
       /// Check if a table name is valid
       /// </summary>
       /// <param name="tableName">Table name to validate</param>
       /// <remarks>Helps to check for SQL injection attacks</remarks>
       private bool TableNameIsValid(string tableName)
       {
           Regex exp = new Regex(pattern, RegexOptions.Compiled |
RegexOptions.IgnoreCase);

           if (exp.IsMatch(tableName))
           {
               return true;
           }
           WriteError(new ErrorRecord(
               new ArgumentException("Table name not valid"),
"TableNameNotValid",
                   ErrorCategory.InvalidArgument, tableName));
           return false;
       } // TableNameIsValid

       /// <summary>
       /// Checks to see if the specified table is present in the
       /// database
       /// </summary>
       /// <param name="tableName">Name of the table to check</param>
       /// <returns>true, if table is present, false otherwise</returns>
       private bool TableIsPresent(string tableName)
       {
           // using ODBC connection to the database and get the schema of
tables
           AccessDBPSDriveInfo di = this.PSDriveInfo as AccessDBPSDriveInfo;
           if (di == null)
           {
               return false;
           }

           OdbcConnection connection = di.Connection;
```

```
            DataTable dt = connection.GetSchema("Tables");

            // check if the specified tableName is available
            // in the list of tables present in the database
            foreach (DataRow dr in dt.Rows)
            {
                string name = dr["TABLE_NAME"] as string;
                if (name.Equals(tableName,
StringComparison.OrdinalIgnoreCase))
                {
                    return true;
                }
            }

            WriteError(new ErrorRecord(
                new ArgumentException("Specified Table is not present in
database"), "TableNotAvailable",
                      ErrorCategory.InvalidArgument, tableName));

            return false;
        }// TableIsPresent

        /// <summary>
        /// Gets the next available ID in the table
        /// </summary>
        /// <param name="table">DataTable object representing the table to
        /// search for ID</param>
        /// <returns>next available id</returns>
        private int GetNextID(DataTable table)
        {
            int big = 0;

            for (int i = 0; i < table.Rows.Count; i++)
            {
                DataRow row = table.Rows[i];

                int id = (int)row["ID"];

                if (big < id)
                {
                    big = id;
                }
            }

            big++;
            return big;
        }
        #endregion Helper Methods

        #region Content Methods

        /// <summary>
        /// Clear the contents at the specified location. In this case,
clearing
        /// the item amounts to clearing a row
```

```
        /// </summary>
        /// <param name="path">The path to the content to clear.</param>
        public void ClearContent(string path)
        {
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type != PathType.Table)
            {
                WriteError(new ErrorRecord(
                    new InvalidOperationException("Operation not supported.
Content can be cleared only for table"),
                        "NotValidRow", ErrorCategory.InvalidArgument,
                            path));
                return;
            }

            OdbcDataAdapter da = GetAdapterForTable(tableName);

            if (da == null)
            {
                return;
            }

            DataSet ds = GetDataSetForTable(da, tableName);
            DataTable table = GetDataTable(ds, tableName);

            // Clear contents at the specified location
            for (int i = 0; i < table.Rows.Count; i++)
            {
                table.Rows[i].Delete();
            }

            if (ShouldProcess(path, "ClearContent"))
            {
                da.Update(ds, tableName);
            }

        } // ClearContent

        /// <summary>
        /// Not implemented.
        /// </summary>
        /// <param name="path"></param>
        /// <returns></returns>
        public object ClearContentDynamicParameters(string path)
        {
            return null;
        }

        /// <summary>
        /// Get a reader at the path specified.
```

```
        /// </summary>
        /// <param name="path">The path from which to read.</param>
        /// <returns>A content reader used to read the data.</returns>
        public IContentReader GetContentReader(string path)
        {
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(path);
            }
            else if (type == PathType.Row)
            {
                throw new InvalidOperationException("contents can be obtained
only for tables");
            }

            return new AccessDBContentReader(path, this);
        } // GetContentReader

        /// <summary>
        /// Not implemented.
        /// </summary>
        /// <param name="path"></param>
        /// <returns></returns>
        public object GetContentReaderDynamicParameters(string path)
        {
            return null;
        }

        /// <summary>
        /// Get an object used to write content.
        /// </summary>
        /// <param name="path">The root path at which to write.</param>
        /// <returns>A content writer for writing.</returns>
        public IContentWriter GetContentWriter(string path)
        {
            string tableName;
            int rowNumber;

            PathType type = GetNamesFromPath(path, out tableName, out
rowNumber);

            if (type == PathType.Invalid)
            {
                ThrowTerminatingInvalidPathException(path);
            }
            else if (type == PathType.Row)
            {
                throw new InvalidOperationException("contents can be added
only to tables");
```

```
            }

            return new AccessDBContentWriter(path, this);
        }

        /// <summary>
        /// Not implemented.
        /// </summary>
        /// <param name="path"></param>
        /// <returns></returns>
        public object GetContentWriterDynamicParameters(string path)
        {
            return null;
        }

        #endregion Content Methods

        #region Private Properties

        private string pathSeparator = "\\";
        private static string pattern = @"^[a-z]+[0-9]*_*$";

        #endregion Private Properties

    } // AccessDBProvider

    #endregion AccessDBProvider

     #region Helper Classes

    #region Public Enumerations

    /// <summary>
    /// Type of item represented by the path
    /// </summary>
    public enum PathType
    {
        /// <summary>
        /// Represents a database
        /// </summary>
        Database,
        /// <summary>
        /// Represents a table
        /// </summary>
        Table,
        /// <summary>
        /// Represents a row
        /// </summary>
        Row,
        /// <summary>
        /// Represents an invalid path
        /// </summary>
        Invalid
    };
```

```
    #endregion Public Enumerations

    #region AccessDBPSDriveInfo

    /// <summary>
    /// Any state associated with the drive should be held here.
    /// In this case, it's the connection to the database.
    /// </summary>
    internal class AccessDBPSDriveInfo : PSDriveInfo
    {
        private OdbcConnection connection;

        /// <summary>
        /// ODBC connection information.
        /// </summary>
        public OdbcConnection Connection
        {
            get { return connection; }
            set { connection = value; }
        }

        /// <summary>
        /// Constructor that takes one argument
        /// </summary>
        /// <param name="driveInfo">Drive provided by this provider</param>
        public AccessDBPSDriveInfo(PSDriveInfo driveInfo)
            : base(driveInfo)
        { }

    } // class AccessDBPSDriveInfo

    #endregion AccessDBPSDriveInfo

    #region DatabaseTableInfo

    /// <summary>
    /// Contains information specific to the database table.
    /// Similar to the DirectoryInfo class.
    /// </summary>
    public class DatabaseTableInfo
    {
        /// <summary>
        /// Row from the "tables" schema
        /// </summary>
        public DataRow Data
        {
            get
            {
                return data;
            }
            set
            {
                data = value;
            }
        }
```

```
        private DataRow data;

        /// <summary>
        /// The table name.
        /// </summary>
        public string Name
        {
            get
            {
                return name;
            }
            set
            {
                name = value;
            }
        }
        private String name;

        /// <summary>
        /// The number of rows in the table.
        /// </summary>
        public int RowCount
        {
            get
            {
                return rowCount;
            }
            set
            {
                rowCount = value;
            }
        }
        private int rowCount;

        /// <summary>
        /// The column definitions for the table.
        /// </summary>
        public DataColumnCollection Columns
        {
            get
            {
                return columns;
            }
            set
            {
                columns = value;
            }
        }
        private DataColumnCollection columns;

        /// <summary>
        /// Constructor.
        /// </summary>
        /// <param name="row">The row definition.</param>
        /// <param name="name">The table name.</param>
```

```
        /// <param name="rowCount">The number of rows in the table.</param>
        /// <param name="columns">Information on the column tables.</param>
        public DatabaseTableInfo(DataRow row, string name, int rowCount,
                        DataColumnCollection columns)
        {
            Name = name;
            Data = row;
            RowCount = rowCount;
            Columns = columns;
        } // DatabaseTableInfo
    } // class DatabaseTableInfo

    #endregion DatabaseTableInfo

    #region DatabaseRowInfo

    /// <summary>
    /// Contains information specific to an individual table row.
    /// Analogous to the FileInfo class.
    /// </summary>
    public class DatabaseRowInfo
    {
        /// <summary>
        /// Row data information.
        /// </summary>
        public DataRow Data
        {
            get
            {
                return data;
            }
            set
            {
                data = value;
            }
        }
        private DataRow data;

        /// <summary>
        /// The row index.
        /// </summary>
        public string RowNumber
        {
            get
            {
                return rowNumber;
            }
            set
            {
                rowNumber = value;
            }
        }
        private string rowNumber;

        /// <summary>
```

```
        /// Constructor.
        /// </summary>
        /// <param name="row">The row information.</param>
        /// <param name="name">The row index.</param>
        public DatabaseRowInfo(DataRow row, string name)
        {
            RowNumber = name;
            Data = row;
        } // DatabaseRowInfo
    } // class DatabaseRowInfo

    #endregion DatabaseRowInfo

    #region AccessDBContentReader

    /// <summary>
    /// Content reader used to retrieve data from this provider.
    /// </summary>
    public class AccessDBContentReader : IContentReader
    {
        // A provider instance is required so as to get "content"
        private AccessDBProvider provider;
        private string path;
        private long currentOffset;

        internal AccessDBContentReader(string path, AccessDBProvider
provider)
        {
            this.path = path;
            this.provider = provider;
        }

        /// <summary>
        /// Read the specified number of rows from the source.
        /// </summary>
        /// <param name="readCount">The number of items to
        /// return.</param>
        /// <returns>An array of elements read.</returns>
        public IList Read(long readCount)
        {
            // Read the number of rows specified by readCount and increment
            // offset
            string tableName;
            int rowNumber;
            PathType type = provider.GetNamesFromPath(path, out tableName,
out rowNumber);

            Collection<DatabaseRowInfo> rows =
                provider.GetRows(tableName);
            Collection<DataRow> results = new Collection<DataRow>();

            if (currentOffset < 0 || currentOffset >= rows.Count)
            {
                return null;
            }
```

```
            int rowsRead = 0;

            while (rowsRead < readCount && currentOffset < rows.Count)
            {
                results.Add(rows[(int)currentOffset].Data);
                rowsRead++;
                currentOffset++;
            }

            return results;
        } // Read

        /// <summary>
        /// Moves the content reader specified number of rows from the
        /// origin
        /// </summary>
        /// <param name="offset">Number of rows to offset</param>
        /// <param name="origin">Starting row from which to offset</param>
        public void Seek(long offset, System.IO.SeekOrigin origin)
        {
            // get the number of rows in the table which will help in
            // calculating current position
            string tableName;
            int rowNumber;

            PathType type = provider.GetNamesFromPath(path, out tableName,
out rowNumber);

            if (type == PathType.Invalid)
            {
                throw new ArgumentException("Path specified must represent a
table or a row :" + path);
            }

            if (type == PathType.Table)
            {
                Collection<DatabaseRowInfo> rows =
provider.GetRows(tableName);

                int numRows = rows.Count;

                if (offset > rows.Count)
                {
                    throw new
                           ArgumentException(
                               "Offset cannot be greater than the number of
rows available"
                                                );
                }

                if (origin == System.IO.SeekOrigin.Begin)
                {
                    // starting from Beginning with an index 0, the current
offset
```

```
                    // has to be advanced to offset - 1
                    currentOffset = offset - 1;
                }
                else if (origin == System.IO.SeekOrigin.End)
                {
                    // starting from the end which is numRows - 1, the
current
                    // offset is so much less than numRows - 1
                    currentOffset = numRows - 1 - offset;
                }
                else
                {
                    // calculate from the previous value of current offset
                    // advancing forward always
                    currentOffset += offset;
                }
            } // if (type...
            else
            {
                // for row, the offset will always be set to 0
                currentOffset = 0;
            }

        } // Seek

        /// <summary>
        /// Closes the content reader, so all members are reset
        /// </summary>
        public void Close()
        {
            Dispose();
        } // Close

        /// <summary>
        /// Dispose any resources being used
        /// </summary>
        public void Dispose()
        {
            Seek(0, System.IO.SeekOrigin.Begin);

            GC.SuppressFinalize(this);
        } // Dispose
    } // AccessDBContentReader

    #endregion AccessDBContentReader

    #region AccessDBContentWriter

    /// <summary>
    /// Content writer used to write data in this provider.
    /// </summary>
    public class AccessDBContentWriter : IContentWriter
    {
        // A provider instance is required so as to get "content"
        private AccessDBProvider provider;
```

```
        private string path;
        private long currentOffset;

        internal AccessDBContentWriter(string path, AccessDBProvider
provider)
        {
            this.path = path;
            this.provider = provider;
        }

        /// <summary>
        /// Write the specified row contents in the source
        /// </summary>
        /// <param name="content"> The contents to be written to the source.
        /// </param>
        /// <returns>An array of elements which were successfully written to
        /// the source</returns>
        ///
        public IList Write(IList content)
        {
            if (content == null)
            {
                return null;
            }

            // Get the total number of rows currently available it will
            // determine how much to overwrite and how much to append at
            // the end
            string tableName;
            int rowNumber;
            PathType type = provider.GetNamesFromPath(path, out tableName,
out rowNumber);

            if (type == PathType.Table)
            {
                OdbcDataAdapter da = provider.GetAdapterForTable(tableName);
                if (da == null)
                {
                    return null;
                }

                DataSet ds = provider.GetDataSetForTable(da, tableName);
                DataTable table = provider.GetDataTable(ds, tableName);

                string[] colValues = (content[0] as string).Split(',');

                // set the specified row
                DataRow row = table.NewRow();

                for (int i = 0; i < colValues.Length; i++)
                {
                    if (!String.IsNullOrEmpty(colValues[i]))
                    {
                        row[i] = colValues[i];
                    }
```

```
                }

                //table.Rows.InsertAt(row, rowNumber);
                // Update the table
                table.Rows.Add(row);
                da.Update(ds, tableName);

            }
            else
            {
                throw new InvalidOperationException("Operation not
supported. Content can be added only for tables");
            }

            return null;
        } // Write

        /// <summary>
        /// Moves the content reader specified number of rows from the
        /// origin
        /// </summary>
        /// <param name="offset">Number of rows to offset</param>
        /// <param name="origin">Starting row from which to offset</param>
        public void Seek(long offset, System.IO.SeekOrigin origin)
        {
            // get the number of rows in the table which will help in
            // calculating current position
            string tableName;
            int rowNumber;

            PathType type = provider.GetNamesFromPath(path, out tableName,
out rowNumber);

            if (type == PathType.Invalid)
            {
                throw new ArgumentException("Path specified should represent
either a table or a row : " + path);
            }

            Collection<DatabaseRowInfo> rows =
                   provider.GetRows(tableName);

            int numRows = rows.Count;

            if (offset > rows.Count)
            {
                throw new
                       ArgumentException(
                           "Offset cannot be greater than the number of rows
available"
                                                );
            }

            if (origin == System.IO.SeekOrigin.Begin)
            {
```

```
                // starting from Beginning with an index 0, the current
offset
                // has to be advanced to offset - 1
                currentOffset = offset - 1;
            }
            else if (origin == System.IO.SeekOrigin.End)
            {
                // starting from the end which is numRows - 1, the current
                // offset is so much less than numRows - 1
                currentOffset = numRows - 1 - offset;
            }
            else
            {
                // calculate from the previous value of current offset
                // advancing forward always
                currentOffset += offset;
            }

        } // Seek

        /// <summary>
        /// Closes the content reader, so all members are reset
        /// </summary>
        public void Close()
        {
            Dispose();
        } // Close

        /// <summary>
        /// Dispose any resources being used
        /// </summary>
        public void Dispose()
        {
            Seek(0, System.IO.SeekOrigin.Begin);

            GC.SuppressFinalize(this);
        } // Dispose
    } // AccessDBContentWriter

    #endregion AccessDBContentWriter

    #endregion Helper Classes
} // namespace Microsoft.Samples.PowerShell.Providers
```

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

GetProc01 Code Samples

Article • 09/17/2021

Here are the code samples for the GetProc01 sample cmdlet. This is the basic `Get-Process` cmdlet sample described in Creating Your First Cmdlet. A `Get-Process` cmdlet is designed to retrieve information about all the processes running on the local computer.

For complete sample code, see the following topics.

Language	Topic
C#	GetProc01 (C#) Sample Code
VB.NET	GetProc01 (VB.NET) Sample Code

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

GetProc01 (C#) Sample Code

Article • 09/17/2021

The following code shows the implementation of the GetProc01 sample cmdlet. Notice that the cmdlet is simplified by leaving the actual work of process retrieval to the System.Diagnostics.Process.Getprocesses* method.

> **Note**
>
> You can download the C# source file (getproc01.cs) for this Get-Proc cmdlet using the Microsoft Windows Software Development Kit for Windows Vista and .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded source files are available in the <**PowerShell Samples**> directory.

Code Sample

C#

```
using System;
using System.Diagnostics;
using System.Management.Automation;             //Windows PowerShell
namespace

using System.ComponentModel;

// This sample shows how to create a simple cmdlet. To test this
// cmdlet, the snapin must be registered.  First, run the command:
//     installutil GetProcessSample01.dll
// Then run:
//     Add-PSSnapin GetProcessSnapIn01
// After the snapin has been loaded, you can run:
//     get-proc

namespace Microsoft.Samples.PowerShell.Commands
{

   #region GetProcCommand

   /// <summary>
   /// This class implements the Get-Proc cmdlet.
   /// </summary>
   [Cmdlet(VerbsCommon.Get, "Proc")]
   public class GetProcCommand : Cmdlet
   {
      #region Cmdlet Overrides
```

```
        /// <summary>
        /// The ProcessRecord method calls the Process.GetProcesses
        /// method to retrieve the processes of the local computer.
        /// Then, the WriteObject method writes the associated processes
        /// to the pipeline.
        /// </summary>
        protected override void ProcessRecord()
        {
            // Retrieve the current processes.
            Process[] processes = Process.GetProcesses();

            // Write the processes to the pipeline to make them available
            // to the next cmdlet. The second argument (true) tells Windows
            // PowerShell to enumerate the array and to send one process
            // object at a time to the pipeline.
            WriteObject(processes, true);
        }

        #endregion Overrides

    } //GetProcCommand

    #endregion GetProcCommand

    #region PowerShell snap-in

    /// <summary>
    /// Create this sample as an PowerShell snap-in
    /// </summary>
    [RunInstaller(true)]
    public class GetProcPSSnapIn01 : PSSnapIn
    {
        /// <summary>
        /// Create an instance of the GetProcPSSnapIn01
        /// </summary>
        public GetProcPSSnapIn01()
            : base()
        {
        }

        /// <summary>
        /// Get a name for this PowerShell snap-in. This name will be used in
registering
        /// this PowerShell snap-in.
        /// </summary>
        public override string Name
        {
            get
            {
                return "GetProcPSSnapIn01";
            }
        }

        /// <summary>
```

```
        /// Vendor information for this PowerShell snap-in.
        /// </summary>
        public override string Vendor
        {
            get
            {
                return "Microsoft";
            }
        }

        /// <summary>
        /// Gets resource information for vendor. This is a string of format:
        /// resourceBaseName,resourceName.
        /// </summary>
        public override string VendorResource
        {
            get
            {
                return "GetProcPSSnapIn01,Microsoft";
            }
        }

        /// <summary>
        /// Description of this PowerShell snap-in.
        /// </summary>
        public override string Description
        {
            get
            {
                return "This is a PowerShell snap-in that includes the get-
proc cmdlet.";
            }
        }
    }

    #endregion PowerShell snap-in
}
```

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

GetProc01 (VB.NET) Sample Code

Article • 09/17/2021

The following code shows the implementation of the GetProc01 sample cmdlet. Notice that the cmdlet is simplified by leaving the actual work of process retrieval to the System.Diagnostics.Process.Getprocesses* method.

> **Note**
>
> You can download the C# source file (getproc01.cs) for this Get-Proc cmdlet using the Microsoft Windows Software Development Kit for Windows Vista and .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**.
>
> The downloaded source files are available in the <**PowerShell Samples**> directory.

Code Sample

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

GetProc02 Code Samples

Article • 09/17/2021

Here are the code samples for the GetProc02 sample cmdlet. This is the `Get-Process` cmdlet sample described in Adding Parameters that Process Command-Line Input. This `Get-Process` cmdlet retrieves processes based on their name, and then displays information about the processes at the command line.

> **Note**
>
> You can download the C# source file (getproc02.cs) for this Get-Proc cmdlet using the Microsoft Windows Software Development Kit for Windows Vista and .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**.
>
> The downloaded source files are available in the **<PowerShell Samples>** directory.

For complete sample code, see the following topics.

Language	Topic
C#	GetProc02 (C#) Sample Code
VB.NET	GetProc02 (VB.NET) Sample Code

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

GetProc02 (C#) Sample Code

Article • 09/17/2021

The following code shows the implementation of a `Get-Process` cmdlet that accepts command-line input. Notice that this implementation defines a `Name` parameter to allow command-line input, and it uses the WriteObject(System.Object,System.Boolean) method as the output mechanism for sending output objects to the pipeline.

Code Sample

C#

```
namespace Microsoft.Samples.PowerShell.Commands
{
    using System;
    using System.Diagnostics;
    using System.Management.Automation;     // Windows PowerShell namespace.
   #region GetProcCommand

   /// <summary>
   /// This class implements the get-proc cmdlet.
   /// </summary>
   [Cmdlet(VerbsCommon.Get, "Proc")]
   public class GetProcCommand : Cmdlet
   {
      #region Parameters

       /// <summary>
       /// The names of the processes to act on.
       /// </summary>
      private string[] processNames;

      /// <summary>
      /// Gets or sets the list of process names on which
      /// the Get-Proc cmdlet will work.
      /// </summary>
      [Parameter(Position = 0)]
      [ValidateNotNullOrEmpty]
      public string[] Name
      {
         get { return this.processNames; }
         set { this.processNames = value; }
      }

      #endregion Parameters

      #region Cmdlet Overrides

      /// <summary>
```

```
        /// The ProcessRecord method calls the Process.GetProcesses
        /// method to retrieve the processes specified by the Name
        /// parameter. Then, the WriteObject method writes the
        /// associated processes to the pipeline.
        /// </summary>
        protected override void ProcessRecord()
        {
            // If no process names are passed to the cmdlet, get all
            // processes.
            if (this.processNames == null)
            {
                WriteObject(Process.GetProcesses(), true);
            }
            else
            {
                // If process names are passed to cmdlet, get and write
                // the associated processes.
                foreach (string name in this.processNames)
                {
                    WriteObject(Process.GetProcessesByName(name), true);
                }
            } // if (processNames...
        } // ProcessRecord

        #endregion Cmdlet Overrides
    } // End GetProcCommand class.

    #endregion GetProcCommand
}
```

See Also

Windows PowerShell SDK

GetProc02 (VB.NET) Sample Code

Article • 09/17/2021

The following code shows the implementation of a `Get-Process` cmdlet that accepts command-line input. Notice that this implementation defines a `Name` parameter to allow command-line input, and it uses the WriteObject(System.Object,System.Boolean) method as the output mechanism for sending output objects to the pipeline.

Code Sample

See Also

Windows PowerShell SDK

GetProc03 Code Samples

Article • 09/17/2021

Here are the code samples for the GetProc03 sample cmdlet. This is the `Get-Process` cmdlet sample described in Adding Parameters that Process Pipeline Input. This `Get-Process` cmdlet uses a `Name` parameter that accepts input from a pipeline object, retrieves process information from the local computer based on the supplied names, and then displays information about the processes at the command line.

> **Note**
>
> You can download the C# source file (getprov03.cs) for this Get-Proc cmdlet using the Microsoft Windows Software Development Kit for Windows Vista and .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**.
>
> The downloaded source files are available in the **<PowerShell Samples>** directory.

For complete sample code, see the following topics.

Language	Topic
C#	GetProc03 (C#) Sample Code
VB.NET	GetProc03 (VB.NET) Sample Code

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

GetProc03 (C#) Sample Code

Article • 09/17/2021

The following code shows the implementation of a `Get-Process` cmdlet that can accept pipelined input. This implementation defines a `Name` parameter that accepts pipeline input, retrieves process information from the local computer based on the supplied names, and then uses the WriteObject(System.Object,System.Boolean) method as the output mechanism for sending objects to the pipeline.

> **Note**
>
> You can download the C# source file (getprov03.cs) for this Get-Proc cmdlet using the Microsoft Windows Software Development Kit for Windows Vista and .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded source files are available in the **<PowerShell Samples>** directory.

Code Sample

C#

```
namespace Microsoft.Samples.PowerShell.Commands
{
    using System;
    using System.Diagnostics;
    using System.Management.Automation;       // Windows PowerShell
namespace.
    #region GetProcCommand

   /// <summary>
   /// This class implements the get-proc cmdlet.
   /// </summary>
   [Cmdlet(VerbsCommon.Get, "Proc")]
   public class GetProcCommand : Cmdlet
   {
      #region Parameters

       /// <summary>
       /// The names of the processes to act on.
       /// </summary>
       private string[] processNames;

      /// <summary>
      /// Gets or setsthe list of process names on
      /// which the Get-Proc cmdlet will work.
```

```
        /// </summary>
        [Parameter(
           Position = 0,
           ValueFromPipeline = true,
           ValueFromPipelineByPropertyName = true)]
        [ValidateNotNullOrEmpty]
        public string[] Name
        {
           get { return this.processNames; }
           set { this.processNames = value; }
        }

        #endregion Parameters

        #region Cmdlet Overrides

        /// <summary>
        /// The ProcessRecord method calls the Process.GetProcesses
        /// method to retrieve the processes specified by the Name
        /// parameter. Then, the WriteObject method writes the
        /// associated processes to the pipeline.
        /// </summary>
        protected override void ProcessRecord()
        {
            // If no process names are passed to the cmdlet, get all
            // processes.
            if (this.processNames == null)
            {
                WriteObject(Process.GetProcesses(), true);
            }
            else
            {
                // If process names are passed to the cmdlet, get and write
                // the associated processes.
                foreach (string name in this.processNames)
                {
                    WriteObject(Process.GetProcessesByName(name), true);
                }
            } // if (processNames ...
        } // ProcessRecord
        #endregion Overrides
    } // End GetProcCommand class.

     #endregion GetProcCommand
}
```

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

GetProc03 (VB.NET) Sample Code

Article • 09/17/2021

The following code shows the implementation of a `Get-Process` cmdlet that can accept pipelined input. This implementation defines a `Name` parameter that accepts pipeline input, retrieves process information from the local computer based on the supplied names, and then uses the WriteObject(System.Object,System.Boolean) method as the output mechanism for sending objects to the pipeline.

Code Sample

GetProc04 Code Samples

Article • 09/17/2021

Here are the code samples for the GetProc04 sample cmdlet. This is the `Get-Process` cmdlet sample described in Adding Nonterminating Error Reporting to Your Cmdlet. This `Get-Process` cmdlet calls the System.Management.Automation.Cmdlet.WriteError method whenever an invalid operation exception is thrown while retrieving process information.

> **Note**
>
> You can download the C# source file (getprov04.cs) for this Get-Proc cmdlet using the Microsoft Windows Software Development Kit for Windows Vista and .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**.
>
> The downloaded source files are available in the <**PowerShell Samples**> directory.

For complete sample code, see the following topics.

Language	Topic
C#	GetProc04 (C#) Sample Code
VB.NET	GetProc04 (VB.NET) Sample Code

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

GetProc04 (C#) Sample Code

Article • 09/17/2021

The following code shows the implementation of a `Get-Process` cmdlet that reports nonterminating errors. This implementation calls the System.Management.Automation.Cmdlet.WriteError method to report nonterminating errors.

> **Note**
>
> You can download the C# source file (getprov04.cs) for this Get-Proc cmdlet using the Microsoft Windows Software Development Kit for Windows Vista and .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded source files are available in the **<PowerShell Samples>** directory.

Code Sample

C#

```
namespace Microsoft.Samples.PowerShell.Commands
{
    using System;
    using System.Diagnostics;
    using System.Management.Automation;      // Windows PowerShell
namespace.
   #region GetProcCommand

   /// <summary>
   /// This class implements the get-proc cmdlet.
   /// </summary>
   [Cmdlet(VerbsCommon.Get, "Proc")]
   public class GetProcCommand : Cmdlet
   {
      #region Parameters

       /// <summary>
       /// The names of the processes to act on.
       /// </summary>
       private string[] processNames;

      /// <summary>
      /// Gets or sets the list of process names on
      /// which the Get-Proc cmdlet will work.
      /// </summary>
```

```
        [Parameter(
           Position = 0,
           ValueFromPipeline = true,
           ValueFromPipelineByPropertyName = true)]
        [ValidateNotNullOrEmpty]
        public string[] Name
        {
           get { return this.processNames; }
           set { this.processNames = value; }
        }

        #endregion Parameters

        #region Cmdlet Overrides

        /// <summary>
        /// The ProcessRecord method calls the Process.GetProcesses
        /// method to retrieve the processes specified by the Name
        /// parameter. Then, the WriteObject method writes the
        /// associated processes to the pipeline.
        /// </summary>
        protected override void ProcessRecord()
        {
            // If no process names are passed to cmdlet, get all
            // processes.
            if (this.processNames == null)
            {
                WriteObject(Process.GetProcesses(), true);
            }
            else
            {
                // If process names are passed to the cmdlet, get and write
                // the associated processes.
                // If a nonterminating error occurs while retrieving
processes,
                // call the WriteError method to send an error record to the
                // error stream.
                foreach (string name in this.processNames)
                {
                    Process[] processes;

                    try
                    {
                        processes = Process.GetProcessesByName(name);
                    }
                    catch (InvalidOperationException ex)
                    {
                        WriteError(new ErrorRecord(
                           ex,
                           "UnableToAccessProcessByName",
                           ErrorCategory.InvalidOperation,
                           name));
                        continue;
                    }
```

```
                    WriteObject(processes, true);
                } // foreach (string name...
            } // else
        } // ProcessRecord

        #endregion Overrides
    } // End GetProcCommand class.

    #endregion GetProcCommand
}
```

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

GetProc04 (VB.NET) Sample Code

Article • 09/17/2021

The following code shows the implementation of a `Get-Process` cmdlet that reports nonterminating errors. This implementation calls the System.Management.Automation.Cmdlet.WriteError method to report nonterminating errors.

> **Note**
>
> You can download the C# source file (getprov04.cs) for this Get-Proc cmdlet using the Microsoft Windows Software Development Kit for Windows Vista and .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**.
>
> The downloaded source files are available in the <**PowerShell Samples**> directory.

Code Sample

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

GetProc05 Code Samples

Article • 09/17/2021

Here are the code samples for the GetProc05 sample cmdlet. This `Get-Process` cmdlet is similar to the cmdlet described in Adding Nonterminating Error Reporting to Your Cmdlet.

Language	Topic
C#	GetProc05 (C#) Sample Code
VB.NET	GetProc05 (VB.NET) Sample Code

See Also

Windows PowerShell SDK

GetProc05 (C#) Sample Code

Article • 09/17/2021

Here is the complete C# code for the GetProc05 sample cmdlet.

C#

```
namespace Microsoft.Samples.PowerShell.Commands
{
    using System;
    using System.Collections.Generic;
    using System.Diagnostics;
    using System.Management.Automation;    // Windows PowerShell namespace.
    using System.Security.Permissions;
    using Win32Exception = System.ComponentModel.Win32Exception;
    #region GetProcCommand

    /// <summary>
   /// This class implements the get-proc cmdlet.
   /// </summary>
   [Cmdlet(VerbsCommon.Get, "Proc",
      DefaultParameterSetName = "ProcessName")]
   public class GetProcCommand : PSCmdlet
   {
       #region Fields
       /// <summary>
       /// The names of the processes to act on.
       /// </summary>
       private string[] processNames;

       /// <summary>
       /// The identifiers of the processes to act on.
       /// </summary>
       private int[] processIds;

       /// <summary>
       /// The process objects to act on.
       /// </summary>
       private Process[] inputObjects;

       #endregion Fields

       #region Parameters

      /// <summary>
      /// Gets or sets the list of process names on
      /// which the Get-Proc cmdlet will work.
      /// </summary>
      [Parameter(
         Position = 0,
         ParameterSetName = "ProcessName",
         ValueFromPipeline = true,
```

```
        ValueFromPipelineByPropertyName = true)]
    [ValidateNotNullOrEmpty]
    public string[] Name
    {
        get { return this.processNames; }
        set { this.processNames = value; }
    }

    /// <summary>
    /// Gets or sets the list of process identifiers on
    /// which the Get-Proc cmdlet will work.
    /// </summary>
    [Parameter(
        ParameterSetName = "Id",
        Mandatory = true,
        ValueFromPipeline = true,
        ValueFromPipelineByPropertyName = true,
        HelpMessage = "The unique id of the process to get.")]
    public int[] Id
    {
        get { return this.processIds; }
        set { this.processIds = value; }
    }

    /// <summary>
    /// Gets or sets Process objects directly. If the input is a
    /// stream of [collection of] Process objects, the cmdlet bypasses the
    /// ProcessName and Id parameters and reads the Process objects
    /// directly.  This allows the cmdlet to deal with processes that have
    /// wildcard characters in their name.
    /// <value>Process objects</value>
    /// </summary>
    [Parameter(
        ParameterSetName = "InputObject",
        Mandatory = true,
        ValueFromPipeline = true)]
    public Process[] Input
    {
        get { return this.inputObjects; }
        set { this.inputObjects = value; }
    }

    #endregion Parameters

    #region Cmdlet Overrides

    /// <summary>
    /// The ProcessRecord method calls the Process.GetProcesses
    /// method to retrieve the processes. Then, the WriteObject
    /// method writes the associated processes to the pipeline.
    /// </summary>
    protected override void ProcessRecord()
    {
        List<Process> matchingProcesses;
```

```
            WriteDebug("Obtaining the list of matching process objects.");

            switch (ParameterSetName)
            {
                case "Id":
                    matchingProcesses = this.GetMatchingProcessesById();
                    break;
                case "ProcessName":
                    matchingProcesses = this.GetMatchingProcessesByName();
                    break;
                case "InputObject":
                    matchingProcesses = this.GetProcessesByInput();
                    break;
                default:
                    ThrowTerminatingError(
                        new ErrorRecord(
                            new ArgumentException("Bad ParameterSetName"),
                            "UnableToAccessProcessList",
                            ErrorCategory.InvalidOperation,
                            null));
                    return;
            } // switch (ParameterSetName)

            WriteDebug("Outputting the matching process objects.");

            matchingProcesses.Sort(ProcessComparison);

            foreach (Process process in matchingProcesses)
            {
                WriteObject(process);
            }
        } // ProcessRecord

        #endregion Overrides

        #region protected Methods and Data

        /// <summary>
        /// Retrieves the list of all processes matching the ProcessName
        /// parameter and generates a nonterminating error for each
        /// specified process name which is not found even though the name
        /// contains no wildcards.
        /// </summary>
        /// <returns>The matching processes.</returns>
        [EnvironmentPermissionAttribute(
            SecurityAction.LinkDemand,
            Unrestricted = true)]
        private List<Process> GetMatchingProcessesByName()
        {
            new EnvironmentPermission(
                PermissionState.Unrestricted).Assert();

            List<Process> allProcesses =
                new List<Process>(Process.GetProcesses());
```

```
            // The keys dictionary is used for rapid lookup of
            // processes that are already in the matchingProcesses list.
            Dictionary<int, byte> keys = new Dictionary<int, byte>();

            List<Process> matchingProcesses = new List<Process>();

            if (null == this.processNames)
            {
                matchingProcesses.AddRange(allProcesses);
            }
            else
            {
                foreach (string pattern in this.processNames)
                {
                    WriteVerbose("Finding matches for process name \""
                       + pattern + "\".");

                    // WildCard serach on the available processes
                    WildcardPattern wildcard =
                       new WildcardPattern(
                           pattern,
                           WildcardOptions.IgnoreCase);

                    bool found = false;

                    foreach (Process process in allProcesses)
                    {
                        if (!keys.ContainsKey(process.Id))
                        {
                            string processName = SafeGetProcessName(process);

                            // Remove the process from the allProcesses list
                            // so that it is not tested again.
                            if (processName.Length == 0)
                            {
                                allProcesses.Remove(process);
                            }

                            // Perform a wildcard search on this particular
                            // process name and check whether it matches the
                            // pattern specified.
                            if (!wildcard.IsMatch(processName))
                            {
                                continue;
                            }

                            WriteDebug("Found matching process id "
                               + process.Id + ".");

                            // A match is found.
                            found = true;

                            // Store the process identifier so that the same
process
                            // is not added twice.
```

```
                        keys.Add(process.Id, 0);

                        // Add the process to the processes list.
                        matchingProcesses.Add(process);
                    }
                } // foreach (Process...

                if (!found &&
                  !WildcardPattern.ContainsWildcardCharacters(pattern))
                {
                    WriteError(new ErrorRecord(
                       new ArgumentException("Cannot find process name "
                          + "\"" + pattern + "\"."),
                       "ProcessNameNotFound",
                       ErrorCategory.ObjectNotFound,
                       pattern));
                }
            } // foreach (string...
        } // if (null...

        return matchingProcesses;
    } // GetMatchingProcessesByName

    /// <summary>
    /// Returns the name of a process.  If an error occurs, a blank
    /// string is returned.
    /// </summary>
    /// <param name="process">The process whose name is
    /// returned.</param>
    /// <returns>The name of the process.</returns>
    [EnvironmentPermissionAttribute(
       SecurityAction.LinkDemand, Unrestricted = true)]
    protected static string SafeGetProcessName(Process process)
    {
       new EnvironmentPermission(PermissionState.Unrestricted).Assert();
       string name = String.Empty;

       if (process != null)
       {
          try
          {
              return process.ProcessName;
          }
          catch (Win32Exception)
          {
          }
          catch (InvalidOperationException)
          {
          }
       }

       return name;
    } // SafeGetProcessName

    #endregion Cmdlet Overrides
```

```
#region Private Methods

/// <summary>
/// Function to sort by process name first, and then by
/// the process identifier.
/// </summary>
/// <param name="x">First process object.</param>
/// <param name="y">Second process object.</param>
/// <returns>
/// Returns less than zero if x is less than y,
/// greater than 0 if x is greater than y, and 0 if x == y.
/// </returns>
private static int ProcessComparison(Process x, Process y)
{
   int diff = String.Compare(
      SafeGetProcessName(x),
      SafeGetProcessName(y),
      StringComparison.CurrentCultureIgnoreCase);

   if (0 != diff)
   {
       return diff;
   }
   else
   {
       return x.Id.CompareTo(y.Id);
   }
}

/// <summary>
/// Retrieves the list of all processes matching the Id
/// parameter and generates a nonterminating error for
/// each specified process identofier which is not found.
/// </summary>
/// <returns>
/// An array of processes that match the given identifier.
/// </returns>
[EnvironmentPermissionAttribute(
   SecurityAction.LinkDemand,
   Unrestricted = true)]
private List<Process> GetMatchingProcessesById()
{
   new EnvironmentPermission(
      PermissionState.Unrestricted).Assert();

   List<Process> matchingProcesses = new List<Process>();

   if (null != this.processIds)
   {
      // The keys dictionary is used for rapid lookup of the
      // processes already in the matchingProcesses list.
      Dictionary<int, byte> keys = new Dictionary<int, byte>();

      foreach (int processId in this.processIds)
```

```
            {
                WriteVerbose("Finding match for process id "
                    + processId + ".");

                if (!keys.ContainsKey(processId))
                {
                    Process process;
                    try
                    {
                        process = Process.GetProcessById(processId);
                    }
                    catch (ArgumentException ex)
                    {
                        WriteError(new ErrorRecord(
                            ex,
                            "ProcessIdNotFound",
                            ErrorCategory.ObjectNotFound,
                            processId));
                        continue;
                    }

                    WriteDebug("Found matching process.");

                    matchingProcesses.Add(process);
                    keys.Add(processId, 0);
                }
            }
        }

        return matchingProcesses;
    } // GetMatchingProcessesById

    /// <summary>
    /// Retrieves the list of all processes matching the InputObject
    /// parameter.
    /// </summary>
    /// <returns>The matching processes.</returns>
    [EnvironmentPermissionAttribute(
        SecurityAction.LinkDemand,
        Unrestricted = true)]
    private List<Process> GetProcessesByInput()
    {
        new EnvironmentPermission(
            PermissionState.Unrestricted).Assert();

        List<Process> matchingProcesses = new List<Process>();

        if (null != this.Input)
        {
            // The keys dictionary is used for rapid lookup of the
            // processes already in the matchingProcesses list.
            Dictionary<int, byte> keys = new Dictionary<int, byte>();

            foreach (Process process in this.Input)
            {
```

```
                WriteVerbose("Refreshing process object.");

                if (!keys.ContainsKey(process.Id))
                {
                   try
                   {
                       process.Refresh();
                   }
                   catch (Win32Exception)
                   {
                   }
                   catch (InvalidOperationException)
                   {
                   }

                   matchingProcesses.Add(process);
                }
             }
          }

          return matchingProcesses;
       } // GetProcessesByInput
       #endregion Private Methods
    } // End GetProcCommand class.

    #endregion GetProcCommand
}
```

See Also

Windows PowerShell SDK

GetProc05 (VB.NET) Sample Code

Article • 09/17/2021

Here is the complete VB.NET code for the GetProc05 sample cmdlet.

VB

```
Imports System
Imports System.Collections.Generic
Imports Win32Exception = System.ComponentModel.Win32Exception
Imports System.Diagnostics
Imports System.Security.Permissions

'Windows PowerShell namespace
Imports System.Management.Automation
Imports System.ComponentModel

Namespace Microsoft.Samples.PowerShell.Commands

    ' This sample is a complete implementation of the get-proc Cmdlet.
#Region "GetProcCommand"

    ''' <summary>
    ''' This class implements the get-proc cmdlet
    ''' </summary>
    <Cmdlet(VerbsCommon.Get, "Proc", _
    DefaultParameterSetName:="ProcessName")> _
    Public Class GetProcCommand
        Inherits PSCmdlet
#Region "Parameters"

        ''' <summary>
        ''' The list of process names on which this cmdlet will work
        ''' </summary>
        <Parameter(Position:=0, ParameterSetName:="ProcessName", _
        ValueFromPipeline:=True, _
        ValueFromPipelineByPropertyName:=True), _
        ValidateNotNullOrEmpty()> _
        Public Property Name() As String()
            Get
                Return processNames
            End Get

            Set(ByVal value As String())
                processNames = value
            End Set

        End Property

        ''' <summary>
        ''' gets/sets an array of process IDs
        ''' </summary>
```

```
        <Parameter(ParameterSetName:="Id", _
        Mandatory:=True, ValueFromPipeline:=True, _
        ValueFromPipelineByPropertyName:=True, _
        HelpMessage:="The unique id of the process to get.")> _
        Public Property Id() As Integer()
            Get
                Return processIds
            End Get
            Set(ByVal value As Integer())
                processIds = value
            End Set
        End Property

        ''' <summary>
        ''' If the input is a stream of [collections of] Process
        ''' objects, we bypass the ProcessName and Id parameters and
        ''' read the Process objects directly.  This allows us to deal
        ''' with processes which have wildcard characters in their name.
        ''' <value>Process objects</value>
        ''' </summary>
        <Parameter(ParameterSetName:="InputObject", _
        Mandatory:=True, ValueFromPipeline:=True)> _
        Public Property Input() As Process()
            Get
                Return inputObjects
            End Get
            Set(ByVal value As Process())
                inputObjects = value
            End Set
        End Property

#End Region

#Region "Cmdlet Overrides"

        ''' <summary>
        ''' For each of the requested processnames, retrieve and write
        ''' the associated processes.
        ''' </summary>
        Protected Overrides Sub ProcessRecord()
            Dim matchingProcesses As List(Of Process)

            WriteDebug("Obtaining list of matching process objects.")

            Select Case ParameterSetName
                Case "Id"
                    matchingProcesses = GetMatchingProcessesById()
                Case "ProcessName"
                    matchingProcesses = GetMatchingProcessesByName()
                Case "InputObject"
                    matchingProcesses = GetProcessesByInput()
                Case Else
                    ThrowTerminatingError(New ErrorRecord( _
                        New ArgumentException("Bad ParameterSetName"), _
                            "UnableToAccessProcessList", _
```

```
                            ErrorCategory.InvalidOperation, Nothing))
                    Return
                End Select

                WriteDebug("Outputting matching process objects.")

                matchingProcesses.Sort(AddressOf ProcessComparison)

                Dim process As Process
                For Each process In matchingProcesses
                    WriteObject(process)
                Next process

            End Sub 'ProcessRecord

#End Region

#Region "protected Methods and Data"
            ''' <summary>
            ''' Retrieves the list of all processes matching the ProcessName
            ''' parameter.
            ''' Generates a non-terminating error for each specified
            ''' process name which is not found even though it contains
            ''' no wildcards.
            ''' </summary>
            ''' <returns></returns>

            Private Function GetMatchingProcessesByName() As List(Of Process)

                Dim allProcesses As List(Of Process) = _
                    New List(Of Process)(Process.GetProcesses())

                ' The keys dictionary will be used for rapid lookup of
                ' processes already in the matchingProcesses list.
                Dim keys As Dictionary(Of Integer, Byte) = _
                    New Dictionary(Of Integer, Byte)()

                Dim matchingProcesses As List(Of Process) = New List(Of Process)
()

                If Nothing Is processNames Then
                    matchingProcesses.AddRange(allProcesses)
                Else
                    Dim pattern As String
                    For Each pattern In processNames
                        WriteVerbose(("Finding matches for process name """ & _
                            pattern & """."))

                        ' WildCard search on the available processes
                        Dim wildcard As New WildcardPattern(pattern, _
                            WildcardOptions.IgnoreCase)

                        Dim found As Boolean = False

                        Dim process As Process
```

```
                    For Each process In allProcesses
                        If Not keys.ContainsKey(process.Id) Then
                            Dim processName As String = _
                                SafeGetProcessName(process)

                            ' Remove the process from the allProcesses list
                            ' so that it's not tested again.
                            If processName.Length = 0 Then
                                allProcesses.Remove(process)
                            End If

                            ' Perform a wildcard search on this particular
                            ' process and check whether this matches the
                            ' pattern specified.
                            If Not wildcard.IsMatch(processName) Then
                                GoTo ContinueForEach2
                            End If

                            WriteDebug(String.Format( _
                                "Found matching process id ""{0}"".",
process.Id))

                            ' We have found a match.
                            found = True

                            ' Store the process ID so that we don't add the
                            ' same one twice.
                            keys.Add(process.Id, 0)

                            ' Add the process to the processes list.
                            matchingProcesses.Add(process)
                        End If
ContinueForEach2:
                    Next process ' foreach (Process...
                    If Not found AndAlso Not _
                       WildcardPattern.ContainsWildcardCharacters(pattern) _
                    Then
                        WriteError(New ErrorRecord( _
                            New ArgumentException("Cannot find process name
" & _
                            " " & pattern & "."), "ProcessNameNotFound", _
                            ErrorCategory.ObjectNotFound, pattern))
                    End If
                Next pattern
            End If
            Return matchingProcesses

        End Function 'GetMatchingProcessesByName

        ''' <summary>
        ''' Returns the name of a process.  If an error occurs, a blank
        ''' string will be returned.
        ''' </summary>
        ''' <param name="process">The process whose name will be
        ''' returned.</param>
```

```
        ''' <returns>The name of the process.</returns>
        Protected Shared Function SafeGetProcessName(ByVal process As
Process) _
            As String

            Dim name As String = ""

            If Not (process Is Nothing) Then
                Try
                    Return process.ProcessName
                Catch e1 As Win32Exception
                Catch e2 As InvalidOperationException
                End Try
            End If
            Return name


        End Function 'SafeGetProcessName

#End Region


#Region "Private Methods"

        ''' <summary>
        ''' Function to sort by ProcessName first, then by Id
        ''' </summary>
        ''' <param name="x">first Process object</param>
        ''' <param name="y">second Process object</param>
        ''' <returns>
        ''' returns less than zero if x less than y,
        ''' greater than 0 if x greater than y, 0 if x == y
        ''' </returns>
        Private Shared Function ProcessComparison(ByVal x As Process, _
                ByVal y As Process) As Integer
            Dim diff As Integer = String.Compare(SafeGetProcessName(x), _
            SafeGetProcessName(y),
StringComparison.CurrentCultureIgnoreCase)

            If 0 <> diff Then
                Return diff
            End If
            Return x.Id - y.Id

        End Function 'ProcessComparison

        ''' <summary>
        ''' Retrieves the list of all processes matching the Id
        ''' parameter.
        ''' Generates a non-terminating error for each specified
        ''' process ID which is not found.
        ''' </summary>
        ''' <returns>An array of processes that match the given id.
        ''' </returns>
        Protected Function GetMatchingProcessesById() As List(Of Process)
```

```
            Dim matchingProcesses As List(Of Process) = New List(Of Process)

            If Not (processIds Is Nothing) Then

                ' The keys dictionary will be used for rapid lookup of
                ' processes already in the matchingProcesses list.
                Dim keys As Dictionary(Of Integer, Byte) = _
                    New Dictionary(Of Integer, Byte)()

                Dim processId As Integer
                For Each processId In processIds
                    WriteVerbose("Finding match for process id " & _
                        processId & ".")

                    If Not keys.ContainsKey(processId) Then
                        Dim process As Process
                        Try
                            process = _
                               System.Diagnostics.Process.GetProcessById( _
                                   processId)
                        Catch ex As ArgumentException
                            WriteError(New ErrorRecord(ex, _
                                "ProcessIdNotFound", _
                                ErrorCategory.ObjectNotFound, processId))
                            GoTo ContinueForEach1
                        End Try

                        WriteDebug("Found matching process.")

                        matchingProcesses.Add(process)
                        keys.Add(processId, 0)
                    End If
ContinueForEach1:
                Next processId
            End If

            Return matchingProcesses

        End Function 'GetMatchingProcessesById

        ''' <summary>
        ''' Retrieves the list of all processes matching the Input
        ''' parameter.
        ''' </summary>
        Private Function GetProcessesByInput() As List(Of Process)

            Dim matchingProcesses As List(Of Process) = New List(Of Process)
()

            If Not (Nothing Is Input) Then
                ' The keys dictionary will be used for rapid lookup of
                ' processes already in the matchingProcesses list.
                Dim keys As Dictionary(Of Integer, Byte) = _
                    New Dictionary(Of Integer, Byte)()
```

```
                Dim process As Process
                For Each process In Input
                    WriteVerbose("Refreshing process object.")

                    If Not keys.ContainsKey(process.Id) Then
                        Try
                            process.Refresh()
                        Catch e1 As Win32Exception
                        Catch e2 As InvalidOperationException
                        End Try
                        matchingProcesses.Add(process)
                    End If
                Next process
            End If
            Return matchingProcesses

        End Function 'GetProcessesByInput

#End Region

#Region "Private Data"

        Private processNames() As String
        Private processIds() As Integer
        Private inputObjects() As Process

#End Region

    End Class 'GetProcCommand

#End Region

#Region "PowerShell snap-in" '
    ''' <summary>
    ''' Create this sample as an PowerShell snap-in
    ''' </summary>
    <RunInstaller(True)> _
    Public Class GetProcPSSnapIn05
        Inherits PSSnapIn

        ''' <summary>
        ''' Create an instance of the GetProcPSSnapIn05
        ''' </summary>
        Public Sub New()

        End Sub 'New

        ''' <summary>
        ''' Get a name for this PowerShell snap-in. This name will
        ''' be used in registering
        ''' this PowerShell snap-in.
        ''' </summary>

        Public Overrides ReadOnly Property Name() As String
```

```
            Get
                Return "GetProcPSSnapIn05"
            End Get
        End Property

        ''' <summary>
        ''' Vendor information for this PowerShell snap-in.
        ''' </summary>

        Public Overrides ReadOnly Property Vendor() As String
            Get
                Return "Microsoft"
            End Get
        End Property

        ''' <summary>
        ''' Gets resource information for vendor. This is a string of
format:
        ''' resourceBaseName,resourceName.
        ''' </summary>

        Public Overrides ReadOnly Property VendorResource() As String
            Get
                Return "GetProcPSSnapIn05,Microsoft"
            End Get
        End Property

        ''' <summary>
        ''' Description of this PowerShell snap-in.
        ''' </summary>

        Public Overrides ReadOnly Property Description() As String
            Get
                Return "This is a PowerShell snap-in that includes " & _
                    "the get-proc sample."
            End Get
        End Property
    End Class 'GetProcPSSnapIn05

#End Region

End Namespace
```

See Also

Windows PowerShell SDK

StopProc01 Code Samples

Article • 09/17/2021

Here is the code sample for the StopProc01 sample cmdlet. This is the `Stop-Process` cmdlet sample described in Creating a Cmdlet that Modifies the System. The `Stop-Process` cmdlet is designed to stop processes that are retrieved using the Get-Proc cmdlet (described in Creating Your First Cmdlet).

> **Note**
>
> You can download the C# (stopproc01.cs) source file for the Stop-Proc cmdlet using the Microsoft Windows Software Development Kit for Windows Vista and .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**.
>
> The downloaded source files are available in the <**PowerShell Samples**> directory.

Language	Topic
C#	StopProc01 (C#) Sample Code

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

StopProc01 (C#) Sample Code

Article • 09/17/2021

Here is the complete C# code for the StopProc01 sample cmdlet.

> **Note**
>
> You can download the C# (stopproc01.cs) source file for the Stop-Proc cmdlet using the Microsoft Windows Software Development Kit for Windows Vista and .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded source files are available in the <**PowerShell Samples**> directory.

C#

```
using System;
using System.Diagnostics;
using System.Collections;
using Win32Exception = System.ComponentModel.Win32Exception;
using System.Management.Automation;    // Windows PowerShell namespace
using System.Globalization;

// This sample shows how to implement a PassThru parameter that indicates
that
// the user wants the cmdlet to return an object, and how to request
// user feedback by calls to the ShouldProcess and ShouldContinue methods.
//
// To test this cmdlet, create a module folder that has the same name as
// this assembly (StopProcesssample01), save the assembly in the module
folder, and then run the
// following command:
// import-module stopprocesssample01

namespace Microsoft.Samples.PowerShell.Commands
{
   #region StopProcCommand

    /// <summary>
   /// This class implements the stop-proc cmdlet.
   /// </summary>
   [Cmdlet(VerbsLifecycle.Stop, "Proc",
       SupportsShouldProcess = true)]
   public class StopProcCommand : Cmdlet
   {
       #region Parameters

      /// <summary>
      /// This parameter provides the list of process names on
```

```
        /// which the Stop-Proc cmdlet will work.
        /// </summary>
        [Parameter(
           Position = 0,
           Mandatory = true,
           ValueFromPipeline = true,
           ValueFromPipelineByPropertyName = true
        )]
        public string[] Name
        {
            get { return processNames; }
            set { processNames = value; }
        }
        private string[] processNames;

        /// <summary>
        /// This parameter overrides the ShouldContinue call to force
        /// the cmdlet to stop its operation. This parameter should always
        /// be used with caution.
        /// </summary>
        [Parameter]
        public SwitchParameter Force
        {
            get { return force; }
            set { force = value; }
        }
        private bool force;

        /// <summary>
        /// This parameter indicates that the cmdlet should return
        /// an object to the pipeline after the processing has been
        /// completed.
        /// </summary>
        [Parameter]
        public SwitchParameter PassThru
        {
            get { return passThru; }
            set { passThru = value; }
        }
        private bool passThru;

        #endregion Parameters

        #region Cmdlet Overrides

        /// <summary>
        /// The ProcessRecord method does the following for each of the
        /// requested process names:
        /// 1) Check that the process is not a critical process.
        /// 2) Attempt to stop that process.
        /// If no process is requested then nothing occurs.
        /// </summary>
        protected override void ProcessRecord()
        {
            foreach (string name in processNames)
```

```
            {
                // For every process name passed to the cmdlet, get the
associated
                // processes.
                // Write a nonterminating error for failure to retrieve
                // a process.
                Process[] processes;

                try
                {
                    processes = Process.GetProcessesByName(name);
                }
                catch (InvalidOperationException ioe)
                {
                    WriteError(new
ErrorRecord(ioe,"UnableToAccessProcessByName",
                        ErrorCategory.InvalidOperation, name));

                    continue;
                }

                // Try to stop the processes that have been retrieved.
                foreach (Process process in processes)
                {
                    string processName;

                    try
                    {
                        processName = process.ProcessName;
                    }
                    catch (Win32Exception e)
                    {
                       WriteError(new ErrorRecord(e, "ProcessNameNotFound",
                                           ErrorCategory.ReadError,
process));
                       continue;
                    }

                    // Confirm the operation with the user first.
                    // This is always false if the WhatIf parameter is set.
                    if
(!ShouldProcess(string.Format(CultureInfo.CurrentCulture,"{0} ({1})",
processName,
                                    process.Id)))
                    {
                        continue;
                    }

                    // Make sure that the user really wants to stop a
critical
                    // process that could possibly stop the computer.
                    bool criticalProcess =

criticalProcessNames.Contains(processName.ToLower(CultureInfo.CurrentCulture
));
```

```
                    if (criticalProcess &&!force)
                    {
                        string message = String.Format
                            (CultureInfo.CurrentCulture,
                                 "The process \"{0}\" is a critical process
and should not be stopped. Are you sure you wish to stop the process?",
                                      processName);

                        // It is possible that the ProcessRecord method is
called
                        // multiple times when objects are received as inputs
from
                        // the pipeline. So to retain YesToAll and NoToAll
input that
                        // the user may enter across multiple calls to this
function,
                        // they are stored as private members of the cmdlet.
                        if (!ShouldContinue(message, "Warning!",
                                            ref yesToAll, ref noToAll))
                        {
                            continue;
                        }
                    } // if (criticalProcess...

                    // Stop the named process.
                    try
                    {
                        process.Kill();
                    }
                    catch (Exception e)
                    {
                        if ((e is Win32Exception) || (e is SystemException)
||
                           (e is InvalidOperationException))
                        {
                            // This process could not be stopped so write
                            // a nonterminating error.
                            WriteError(new ErrorRecord(e,
"CouldNotStopProcess",
                                                       ErrorCategory.CloseError,
process));
                            continue;
                        } // if ((e is...
                        else throw;
                    } // catch

                    // If the PassThru parameter is
                    // specified, return the terminated process.
                    if (passThru)
                    {
                        WriteObject(process);
                    }
                } // foreach (Process...
            } // foreach (string...
```

```
        } // ProcessRecord

        #endregion Cmdlet Overrides

        #region Private Data

        private bool yesToAll, noToAll;

        /// <summary>
        /// Partial list of critical processes that should not be
        /// stopped.  Lower case is used for case insensitive matching.
        /// </summary>
        private ArrayList criticalProcessNames = new ArrayList(
           new string[] { "system", "winlogon", "spoolsv" }
        );

        #endregion Private Data

    } // StopProcCommand

    #endregion StopProcCommand
}
```

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

StopProcessSample04 Code Samples

Article • 09/17/2021

Here are the code samples for the StopProc00 sample cmdlet. This is the `Stop-Process` cmdlet sample described in Adding Parameter Sets to a Cmdlet. The `Stop-Process` cmdlet is designed to stop processes that are retrieved using the Get-Proc cmdlet (described in Creating Your First Cmdlet).

> **Note**
>
> You can download the C# (stopprocesssample04.cs) and VB.NET (stopprocesssample04.vb) for this Stop-Proc cmdlet using the Microsoft Windows Software Development Kit for Windows Vista and .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**.
>
> The downloaded source files are available in the <**PowerShell Samples**> directory.

For complete sample code, see the following topics.

Language	Topic
C#	StopProc04 (C#) Sample Code
VB.NET	StopProc04 (VB.NET) Sample Code

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

StopProcessSample04 (C#) Sample Code

Article • 09/17/2021

Here is the complete C# sample code for the StopProc04 sample cmdlet. This is the code for the `Stop-Process` cmdlet described in Adding Parameter Sets to a Cmdlet. The `Stop-Process` cmdlet is designed to stop processes that are retrieved using the Get-Proc cmdlet (described in Creating Your First Cmdlet).

> **Note**
>
> You can download the C# (stopprocesssample04.cs) source file for this Stop-Proc cmdlet using the Microsoft Windows Software Development Kit for Windows Vista and .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded source files are available in the <**PowerShell Samples**> directory.

C#

```
using System;
using System.Diagnostics;
using System.Collections;
using Win32Exception = System.ComponentModel.Win32Exception;
using System.Management.Automation;             //Windows PowerShell
namespace
using System.Globalization;

// This sample shows how to declare parameter sets, the input object, and
// how to specify the default parameter set to use.
//
// To test this cmdlet, create a module folder that has the same name as
// this assembly (StopProcesssample04), save the assembly in the module
folder, and then run the
// following command:
// import-module stopprocesssample04

namespace Microsoft.Samples.PowerShell.Commands
{
   #region StopProcCommand

   /// <summary>
   /// This class implements the stop-proc cmdlet.
   /// </summary>
   [Cmdlet(VerbsLifecycle.Stop, "Proc",
       DefaultParameterSetName = "ProcessId",
       SupportsShouldProcess = true)]
   public class StopProcCommand : PSCmdlet
   {
```

```
        #region Parameters

       /// <summary>
       /// This parameter provides the list of process names on
       /// which the Stop-Proc cmdlet will work.
       /// </summary>
        [Parameter(
           Position = 0,
           ParameterSetName = "ProcessName",
           Mandatory = true,
           ValueFromPipeline = true,
           ValueFromPipelineByPropertyName = true,
           HelpMessage = "The name of one or more processes to stop.
Wildcards are permitted."
        )]
        [Alias("ProcessName")]
        public string[] Name
        {
            get { return processNames; }
            set { processNames = value; }
        }
        private string[] processNames;

        /// <summary>
        /// This parameter overrides the ShouldContinue call to force
        /// the cmdlet to stop its operation. This parameter should always
        /// be used with caution.
        /// </summary>
        [Parameter]
        public SwitchParameter Force
        {
            get { return force; }
            set { force = value; }
        }
        private bool force;

        /// <summary>
        /// This parameter indicates that the cmdlet should return
        /// an object to the pipeline after the processing has been
        /// completed.
        /// </summary>
        [Parameter(
           HelpMessage = "If set the process(es) will be passed to the
pipeline after stopped."
        )]
        public SwitchParameter PassThru
        {
            get { return passThru; }
            set { passThru = value; }
        }
        private bool passThru;

       /// This parameter provides the list of process identifiers on
       /// which the Stop-Proc cmdlet will work.
        [Parameter(
```

```
            ParameterSetName = "ProcessId",
            Mandatory = true,
            ValueFromPipelineByPropertyName = true,
            ValueFromPipeline = true
        )]
        [Alias("ProcessId")]
        public int[] Id
        {
            get { return processIds; }
            set { processIds = value; }
        }
        private int[] processIds;

        /// <summary>
        /// This parameter accepts an array of Process objects from the
        /// the pipeline. This object contains the processes to stop.
        /// </summary>
        /// <value>Process objects</value>
        [Parameter(
            ParameterSetName = "InputObject",
            Mandatory = true,
            ValueFromPipeline = true)]
        public Process[] InputObject
        {
            get { return inputObject; }
            set { inputObject = value; }
        }
        private Process[] inputObject;

        #endregion Parameters

        #region CmdletOverrides

        /// <summary>
        /// The ProcessRecord method does the following for each of the
        /// requested process names:
        /// 1) Check that the process is not a critical process.
        /// 2) Attempt to stop that process.
        /// If no process is requested then nothing occurs.
        /// </summary>
        protected override void ProcessRecord()
        {
            switch (ParameterSetName)
            {
                case "ProcessName":
                    ProcessByName();
                break;

                case "ProcessId":
                    ProcessById();
                    break;

                case "InputObject":
                    foreach (Process process in inputObject)
                    {
```

```
                        SafeStopProcess(process);
                    }
                    break;

                default:
                    throw new ArgumentException("Bad ParameterSet Name");
            } // switch (ParameterSetName...
        } // ProcessRecord

        #endregion Cmdlet Overrides

        #region Helper Methods

        /// <summary>
        /// Returns all processes with matching names.
        /// </summary>
        /// <param name="processName">
        /// The name of the processes to return.
        /// </param>
        /// <param name="allProcesses">An array of all
        /// computer processes.</param>
        /// <returns>An array of matching processes.</returns>
        internal ArrayList SafeGetProcessesByName(string processName,
                                  ref ArrayList allProcesses)
        {
            // Create and array to store the matching processes.
            ArrayList matchingProcesses = new ArrayList();

            // Create the wildcard for pattern matching.
            WildcardOptions options = WildcardOptions.IgnoreCase |
                                      WildcardOptions.Compiled;
            WildcardPattern wildcard = new WildcardPattern(processName,
options);

            // Walk all of the machine processes.
            foreach(Process process in allProcesses)
            {
                string processNameToMatch = null;
                try
                {
                    processNameToMatch = process.ProcessName;
                }
                catch (Win32Exception e)
                {
                    // Remove the process from the list so that it is not
                    // checked again.
                    allProcesses.Remove(process);

                    string message =
                          String.Format(CultureInfo.CurrentCulture, "The
process \"{0}\" could not be found",
                                                processName);
                    WriteVerbose(message);
                    WriteError(new ErrorRecord(e, "ProcessNotFound",
                                    ErrorCategory.ObjectNotFound,
```

```
processName));

                    continue;
                }

                if (!wildcard.IsMatch(processNameToMatch))
                {
                    continue;
                }

                matchingProcesses.Add(process);
            } // foreach(Process...

            return matchingProcesses;
        } // SafeGetProcessesByName

        /// <summary>
        /// Safely stops a named process.  Used as standalone function
        /// to declutter the ProcessRecord method.
        /// </summary>
        /// <param name="process">The process to stop.</param>
        private void SafeStopProcess(Process process)
        {
            string processName = null;

            try
            {
                processName = process.ProcessName;
            }
            catch (Win32Exception e)
            {
                WriteError(new ErrorRecord(e, "ProcessNotFound",
                                ErrorCategory.OpenError, processName));

                return;
            }

            // Confirm the operation first.
            // This is always false if the WhatIf parameter is specified.
            if (!ShouldProcess(string.Format(CultureInfo.CurrentCulture,
                     "{0} ({1})", processName, process.Id)))
            {
                return;
            }

            // Make sure that the user really wants to stop a critical
            // process that can possibly stop the computer.
            bool criticalProcess =
criticalProcessNames.Contains(processName.ToLower(CultureInfo.CurrentCulture
));

            string message = null;
            if (criticalProcess && !force)
            {
                message = String.Format(CultureInfo.CurrentCulture,
```

```
                                            "The process \"{0}\" is a
critical process and should not be stopped. Are you sure you wish to stop
the process?",
                                                processName);
                // It is possible that the ProcessRecord method is called
                // multiple times when objects are recieved as inputs from
                // the pipeline. So to retain YesToAll and NoToAll input that
                // the user may enter across mutilple calls to this function,
                // they are stored as private members of the cmdlet.
                if (!ShouldContinue(message, "Warning!",
                            ref yesToAll, ref noToAll))
                {
                    return;
                }
            } // if (criticalProcess...

            // Display a warning message if stopping a critical
            // process.
            if (criticalProcess)
            {
                message =
                  String.Format(CultureInfo.CurrentCulture,
                                "Stopping the critical process \"{0}\".",
                                    processName);
                WriteWarning(message);
            } // if (criticalProcess...

            try
            {
                // Stop the process.
                process.Kill();
            }
            catch (Exception e)
            {
                if ((e is Win32Exception) || (e is SystemException) ||
                    (e is InvalidOperationException))
                {
                    // This process could not be stopped so write
                    // a non-terminating error.
                    WriteError(new ErrorRecord(e, "CouldNotStopProcess",
                                    ErrorCategory.CloseError,
                                    process)
                               );

                    return;
                } // if ((e is...
                else throw;
            } // catch

            // Write a user-level verbose message to the pipeline. These are
            // intended to give the user detailed information on the
            // operations performed by the cmdlet. These messages will
            // appear with the -Verbose option.
            message = String.Format(CultureInfo.CurrentCulture,
                                    "Stopped process \"{0}\", pid {1}.",
```

```
                                        processName, process.Id);

            WriteVerbose(message);

            // If the PassThru prameter is specified, return the terminated
            // process to the pipeline.
            if (passThru)
            {
                // Write a debug message to the host that can be used
                // when troubleshooting a problem. All debug messages
                // will appear with the -Debug option
                message =
                    String.Format(CultureInfo.CurrentCulture,
                                  "Writing process \"{0}\" to pipeline",
                                      processName);
                WriteDebug(message);
                WriteObject(process);
            } // if (passThru..
        } // SafeStopProcess


        /// <summary>
        /// Stop processes based on their names (using the
        /// ParameterSetName as ProcessName)
        /// </summary>
        private void ProcessByName()
        {
            ArrayList allProcesses = null;

            // Get a list of all processes.
            try
            {
                allProcesses = new ArrayList(Process.GetProcesses());
            }
            catch (InvalidOperationException ioe)
            {
                base.ThrowTerminatingError(new ErrorRecord(
                     ioe, "UnableToAccessProcessList",
                     ErrorCategory.InvalidOperation, null));
            }

            // If a process name is passed to the cmdlet, get
            // the associated processes.
            // Write a nonterminating error for failure to
            // retrieve a process.
            foreach (string name in processNames)
            {
                // The allProcesses array list is passed as a reference
because
                // any process whose name cannot be obtained will be removed
                // from the list so that its not compared the next time.
                ArrayList processes =
                    SafeGetProcessesByName(name, ref allProcesses);

                // If no processes were found write a non-
```

```
                // terminating error.
                if (processes.Count == 0)
                {
                    WriteError(new ErrorRecord(
                        new Exception("Process not found."),
                        "ProcessNotFound",
                        ErrorCategory.ObjectNotFound,
                        name));
                } // if (processes...
                // Otherwise terminate all processes in the list.
                else
                {
                    foreach (Process process in processes)
                    {
                        SafeStopProcess(process);
                    } // foreach (Process...
                } // else
            } // foreach (string...
        } // ProcessByName

        /// <summary>
        /// Stop processes based on their identifiers (using the
        /// ParameterSetName as ProcessIds)
        /// </summary>
        internal void ProcessById()
        {
            foreach (int processId in processIds)
            {
                Process process = null;
                try
                {
                    process = Process.GetProcessById(processId);

                    // Write a debug message to the host that can be used
                    // when troubleshooting a problem. All debug messages
                    // will appear with the -Debug option
                    string message =
                        String.Format(CultureInfo.CurrentCulture,
                                      "Acquired process for pid : {0}",
                                          process.Id);
                    WriteDebug(message);
                }
                catch (ArgumentException ae)
                {
                    string
                        message = String.Format(CultureInfo.CurrentCulture,
                                                "The process id {0} could not be
found",
                                                    processId);
                    WriteVerbose(message);
                    WriteError(new ErrorRecord(ae, "ProcessIdNotFound",
                                    ErrorCategory.ObjectNotFound,
processId));
                    continue;
                }
```

```
                SafeStopProcess(process);
            } // foreach (int...
        } // ProcessById

        #endregion Helper Methods

        #region Private Data

        private bool yesToAll, noToAll;

        /// <summary>
        /// Partial list of critical processes that should not be
        /// stopped.  Lower case is used for case insensitive matching.
        /// </summary>
        private ArrayList criticalProcessNames = new ArrayList(
           new string[] { "system", "winlogon", "spoolsv", "calc" }
        );

        #endregion Private Data

    } // StopProcCommand

    #endregion StopProcCommand
}
```

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

StopProcessSample04 (VB.NET) Sample Code

Article • 09/17/2021

Here is the complete VB.NET sample code for the StopProc04 sample cmdlet. This is the code for the `Stop-Process` cmdlet described in Adding Parameter Sets to a Cmdlet. The `Stop-Process` cmdlet is designed to stop processes that are retrieved using the Get-Proc cmdlet (described in Creating Your First Cmdlet).

> **Note**
>
> You can download the VB.NET (stopprocesssample04.vb) source file for this Stop-Proc cmdlet using the Microsoft Windows Software Development Kit for Windows Vista and .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**.
>
> The downloaded source files are available in the **<PowerShell Samples>** directory.

VB

```
Imports System
Imports System.Diagnostics
Imports System.Collections
Imports Win32Exception = System.ComponentModel.Win32Exception
Imports System.Management.Automation 'Windows PowerShell namespace
Imports System.ComponentModel
Imports System.Globalization

Namespace Microsoft.Samples.PowerShell.Commands

    ' This sample introduces parameter sets, the input object and
    ' DefaultParameterSet.
#Region "StopProcCommand"

    ''' <summary>
    ''' Class that implements the stop-proc cmdlet.
    ''' </summary>
    <Cmdlet(VerbsLifecycle.Stop, "Proc",
DefaultParameterSetName:="ProcessId", _
    SupportsShouldProcess:=True)> _
    Public Class StopProcCommand
        Inherits PSCmdlet
#Region "Parameters"
```

```
        ''' <summary>
        ''' The list of process names on which this cmdlet will work.
        ''' </summary>

        <Parameter(Position:=0, ParameterSetName:="ProcessName", _
        Mandatory:=True, _
        ValueFromPipeline:=True, ValueFromPipelineByPropertyName:=True, _
        HelpMessage:="The name of one or more processes to stop. " & _
            "Wildcards are permitted."), [Alias]("ProcessName")> _
        Public Property Name() As String()
            Get
                Return processNames
            End Get
            Set(ByVal value As String())
                processNames = value
            End Set
        End Property
        Private processNames() As String

        ''' <summary>
        ''' Overrides the ShouldContinue check to force stop operation.
        ''' This option should always be used with caution.
        ''' </summary>

        <Parameter()> _
        Public Property Force() As SwitchParameter
            Get
                Return myForce
            End Get
            Set(ByVal value As SwitchParameter)
                myForce = value
            End Set
        End Property
        Private myForce As Boolean

        ''' <summary>
        ''' Common parameter to determine if the process should pass the
        ''' object down the pipeline after the process has been stopped.
        ''' </summary>

        <Parameter( _
        HelpMessage:= _
           "If set the process(es) will be passed to the pipeline " & _
           "after stopping them.")> _
        Public Property PassThru() As SwitchParameter
            Get
                Return myPassThru
            End Get
            Set(ByVal value As SwitchParameter)
                myPassThru = value
            End Set
        End Property
        Private myPassThru As Boolean

        ''' <summary>
```

```
        ''' The list of process IDs on which this cmdlet will work.
        ''' </summary>

        <Parameter(ParameterSetName:="ProcessId", _
        Mandatory:=True, _
        ValueFromPipelineByPropertyName:=True, _
        ValueFromPipeline:=True), [Alias]("ProcessId")> _
        Public Property Id() As Integer()
            Get
                Return processIds
            End Get
            Set(ByVal value As Integer())
                processIds = value
            End Set
        End Property
        Private processIds() As Integer

        ''' <summary>
        ''' An array of Process objects from the stream to stop.
        ''' </summary>
        ''' <value>Process objects</value>
        <Parameter(ParameterSetName:="InputObject", _
        Mandatory:=True, ValueFromPipeline:=True)> _
        Public Property InputObject() As Process()
            Get
                Return myInputObject
            End Get
            Set(ByVal value As Process())
                myInputObject = value
            End Set
        End Property
        Private myInputObject() As Process

#End Region

#Region "CmdletOverrides"
        ''' <summary>
        ''' For each of the requested processnames:
        ''' 1) check it's not a special process
        ''' 2) attempt to stop that process.
        ''' If no process requested, then nothing occurs.
        ''' </summary>
        Protected Overrides Sub ProcessRecord()
            Select Case ParameterSetName
                Case "ProcessName"
                    ProcessByName()

                Case "ProcessId"
                    ProcessById()

                Case "InputObject"
                    Dim process As Process
                    For Each process In myInputObject
                        SafeStopProcess(process)
                    Next process
```

```
                Case Else
                    Throw New ArgumentException("Bad ParameterSet Name")
            End Select

        End Sub 'ProcessRecord ' ProcessRecord
#End Region

#Region "Helper Methods"
        ''' <summary>
        ''' Returns all processes with matching names.
        ''' </summary>
        ''' <param name="processName">
        ''' The name of the process(es) to return
        ''' </param>
        ''' <param name="allProcesses">An array of all
        ''' machine processes.</param>
        ''' <returns>An array of matching processes.</returns>
        Friend Function SafeGetProcessesByName(ByVal processName As String,
_
            ByRef allProcesses As ArrayList) As ArrayList

            ' Create and array to store the matching processes.
            Dim matchingProcesses As New ArrayList()

            ' Create the wildcard for pattern matching.
            Dim options As WildcardOptions = WildcardOptions.IgnoreCase Or _
                WildcardOptions.Compiled
            Dim wildcard As New WildcardPattern(processName, options)

            ' Walk all of the machine processes.
            Dim process As Process
            For Each process In allProcesses
                Dim processNameToMatch As String = Nothing
                Try
                    processNameToMatch = process.ProcessName
                Catch e As Win32Exception
                    ' Remove the process from the list so that it is not
                    ' checked again.
                    allProcesses.Remove(process)

                    Dim message As String = _
                        String.Format(CultureInfo.CurrentCulture, _
                            "The process ""{0}"" could not be found",
processName)
                    WriteVerbose(message)
                    WriteError(New ErrorRecord(e, _
                        "ProcessNotFound", ErrorCategory.ObjectNotFound, _
                        processName))

                    GoTo ContinueForEach1
                End Try

                If Not wildcard.IsMatch(processNameToMatch) Then
                    GoTo ContinueForEach1
```

```
                End If

                matchingProcesses.Add(process)
ContinueForEach1:
            Next process
            Return matchingProcesses

        End Function 'SafeGetProcessesByName

        ''' <summary>
        ''' Safely stops a named process.  Used as standalone function
        ''' to declutter ProcessRecord method.
        ''' </summary>
        ''' <param name="process">The process to stop.</param>
        Private Sub SafeStopProcess(ByVal process As Process)
            Dim processName As String = Nothing

            Try
                processName = process.ProcessName
            Catch e As Win32Exception
                WriteError(New ErrorRecord(e, "ProcessNotFound", _
                    ErrorCategory.OpenError, processName))

                Return
            End Try

            ' Confirm the operation first.
            ' This is always false if WhatIf is set.
            If Not ShouldProcess(String.Format(CultureInfo.CurrentCulture, _
                    "{0} ({1})", processName, process.Id)) Then
                Return
            End If

            ' Make sure the user really wants to stop a critical
            ' process and possibly stop the machine.
            Dim criticalProcess As Boolean = _
                criticalProcessNames.Contains( _
                processName.ToLower(CultureInfo.CurrentCulture))

            Dim message As String = Nothing
            If criticalProcess AndAlso Not myForce Then
                message = String.Format(CultureInfo.CurrentCulture, _
                    "The process ""{0}"" is a critical process and " & _
                    "should not be stopped. " & _
                    "Are you sure you wish to stop the process?",
processName)

                ' It is possible that ProcessRecord is called multiple
                ' when objects are received as inputs from a pipeline.
                ' So, to retain YesToAll and NoToAll input that the
                ' user may enter across multiple calls to this
                ' function, they are stored as private members of the
                ' Cmdlet.
                If Not ShouldContinue(message, "Warning!", yesToAll,
noToAll) Then
```

```
                    Return
                End If
            End If

            ' Display a warning information if stopping a critical
            ' process
            If criticalProcess Then
                message = String.Format(CultureInfo.CurrentCulture, _
                    "Stopping the critical process ""{0}"".", processName)
                WriteWarning(message)
            End If

            Try
                ' Stop the process.
                process.Kill()
            Catch e As Exception
                If TypeOf e Is Win32Exception OrElse TypeOf e Is
SystemException _
                  OrElse TypeOf e Is InvalidOperationException Then
                    ' This process could not be stopped so write
                    ' a non-terminating error.
                    WriteError(New ErrorRecord(e, _
                        "CouldNotStopProcess", ErrorCategory.CloseError,
process))
                    Return
                Else
                    Throw
                End If
            End Try

            ' Write a user-level message to the pipeline. These are
            ' intended to give the user detailed information on the
            ' operations performed by the Cmdlet. These messages will
            ' appear with the -Verbose option.
            message = String.Format(CultureInfo.CurrentCulture, _
                "Stopped process ""{0}"", pid {1}.", processName,
process.Id)

            WriteVerbose(message)

            ' If the -PassThru command line argument is
            ' specified, pass the terminated process on.
            If myPassThru Then
                ' Write a debug message to the host which will be helpful
                ' in troubleshooting a problem. All debug messages
                ' will appear with the -Debug option
                message = String.Format(CultureInfo.CurrentCulture, _
                    "Writing process ""{0}"" to pipeline", processName)
                WriteDebug(message)
                WriteObject(process)
            End If

        End Sub 'SafeStopProcess
```

```
        ''' <summary>
        ''' Stop processes based on their names (using the
        ''' ParameterSetName as ProcessName)
        ''' </summary>
        Private Sub ProcessByName()
            Dim allProcesses As ArrayList = Nothing

            ' Get a list of all processes.
            Try
                allProcesses = New ArrayList(Process.GetProcesses())
            Catch ioe As InvalidOperationException
                MyBase.ThrowTerminatingError(New ErrorRecord(ioe, _
                    "UnableToAccessProcessList", _
                    ErrorCategory.InvalidOperation, Nothing))
            End Try

            ' If a name parameter is passed to cmdlet, get
            ' the associated process(es).
            ' Write a non-terminating error for failure to
            ' retrieve a process
            Dim name As String
            For Each name In processNames
                ' The allProcesses array list is passed as a reference
because
                ' any process whose name cannot be obtained will be removed
                ' from the list so that its not compared the next time.
                Dim processes As ArrayList = SafeGetProcessesByName(name, _
                    allProcesses)

                ' If no processes were found write a non-terminating error.
                If processes.Count = 0 Then
                    WriteError(New ErrorRecord( _
                         New Exception("Process not found."), _
                         "ProcessNotFound", ErrorCategory.ObjectNotFound,
name))
                Else
                    ' Otherwise terminate all processes in the list.
                    Dim process As Process
                    For Each process In processes
                        SafeStopProcess(process)
                    Next process
                End If

            Next name

        End Sub 'ProcessByName

        ''' <summary>
        ''' Stop processes based on their ids (using the
        ''' ParameterSetName as ProcessIds)
        ''' </summary>
        Friend Sub ProcessById()
            Dim processId As Integer
            For Each processId In processIds
                Dim process As Process = Nothing
```

```
                Try
                    process =
System.Diagnostics.Process.GetProcessById(processId)

                    ' Write a debug message to the host which will be
helpful
                    ' in troubleshooting a problem. All debug messages
                    ' will appear with the -Debug option
                    Dim message As String = String.Format( _
                        CultureInfo.CurrentCulture, _
                        "Acquired process for pid : {0}", process.Id)
                    WriteDebug(message)
                Catch ae As ArgumentException
                    Dim message As String = String.Format( _
                        CultureInfo.CurrentCulture, _
                        "The process id {0} could not be found", processId)
                    WriteVerbose(message)
                    WriteError(New ErrorRecord(ae, _
                        "ProcessIdNotFound", _
                         ErrorCategory.ObjectNotFound, processId))
                    GoTo ContinueForEach1
                End Try

                SafeStopProcess(process)
ContinueForEach1:
            Next processId

        End Sub 'ProcessById ' ProcessById
#End Region

#Region "Private Data"

        Private yesToAll, noToAll As Boolean

        ''' <summary>
        ''' Partial list of critical processes that should not be
        ''' stopped.  Lower case is used for case insensitive matching.
        ''' </summary>
        Private criticalProcessNames As New ArrayList( _
            New String() {"system", "winlogon", "spoolsv", "calc"})

#End Region

    End Class 'StopProcCommand

#End Region

#Region "PowerShell snap-in" '
    ''' <summary>
    ''' Create this sample as an PowerShell snap-in
    ''' </summary>
    <RunInstaller(True)> _
    Public Class StopProcPSSnapIn04
        Inherits PSSnapIn
```

```
        ''' <summary>
        ''' Create an instance of the StopProcPSSnapIn04
        ''' </summary>
        Public Sub New()

        End Sub 'New

        ''' <summary>
        ''' Get a name for this PowerShell snap-in. This name will
        ''' be used in registering this PowerShell snap-in.
        ''' </summary>
        Public Overrides ReadOnly Property Name() As String
            Get
                Return "StopProcPSSnapIn04"
            End Get
        End Property

        ''' <summary>
        ''' Vendor information for this PowerShell snap-in.
        ''' </summary>

        Public Overrides ReadOnly Property Vendor() As String
            Get
                Return "Microsoft"
            End Get
        End Property

        ''' <summary>
        ''' Gets resource information for vendor. This is a string of
format:
        ''' resourceBaseName,resourceName.
        ''' </summary>
        Public Overrides ReadOnly Property VendorResource() As String
            Get
                Return "StopProcPSSnapIn04,Microsoft"
            End Get
        End Property

        ''' <summary>
        ''' Description of this PowerShell snap-in.
        ''' </summary>
        Public Overrides ReadOnly Property Description() As String
            Get
                Return "This is a PowerShell snap-in that includes " & _
                    "the stop-proc cmdlet."
            End Get
        End Property
    End Class 'StopProcPSSnapIn04

#End Region

End Namespace
```

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

Runspace01 Code Samples

Article • 09/17/2021

Here are the code samples for the runspace described in Creating a Console Application That Runs a Specified Command. The command that is invoked in the runspace is the `Get-Process` cmdlet.

For complete sample code, see the following topics.

Language	Topic
C#	Runspace01 (C#) Code Sample
VB.NET	Runspace01 (VB.NET) Code Sample

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

Runspace01 (C#) Code Sample

Article • 09/17/2021

Here are the code samples for the runspace described in Creating a Console Application That Runs a Specified Command. To do this, the application invokes a runspace, and then invokes a command. (Note that this application does not specify runspace configuration information, nor does it explicitly create a pipeline). The command that is invoked is the `Get-Process` cmdlet.

> **Note**
>
> You can download the C# source file (runspace01.cs) for this runspace using the Microsoft Windows Software Development Kit for Windows Vista and Microsoft .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded source files are available in the **<PowerShell Samples>** directory.

Code Sample

C#

```
namespace Microsoft.Samples.PowerShell.Runspaces
{
  using System;
  using System.Management.Automation;
  using PowerShell = System.Management.Automation.PowerShell;

  /// <summary>
  /// This class contains the Main entry point for this host application.
  /// </summary>
  internal class Runspace01
  {
    /// <summary>
    /// This sample uses the PowerShell class to execute
    /// the get-process cmdlet synchronously. The name and
    /// handlecount are then extracted from the PSObjects
    /// returned and displayed.
    /// </summary>
    /// <param name="args">Parameter not used.</param>
    /// <remarks>
    /// This sample demonstrates the following:
    /// 1. Creating a PowerShell object to run a command.
    /// 2. Adding a command to the pipeline of the PowerShell object.
    /// 3. Running the command synchronously.
    /// 4. Using PSObject objects to extract properties from the objects
```

```
    ///    returned by the command.
    /// </remarks>
    private static void Main(string[] args)
    {
      // Create a PowerShell object. Creating this object  takes care of
      // building all of the other data structures needed to run the
command.
      using (PowerShell powershell = PowerShell.Create().AddCommand("get-
process"))
      {
        Console.WriteLine("Process             HandleCount");
        Console.WriteLine("--------------------------------");

        // Invoke the command synchronously and display the
        // ProcessName and HandleCount properties of the
        // objects that are returned.
        foreach (PSObject result in powershell.Invoke())
        {
          Console.WriteLine(
                      "{0,-20} {1}",
                      result.Members["ProcessName"].Value,
                      result.Members["HandleCount"].Value);
        }
      }

      System.Console.WriteLine("Hit any key to exit...");
      System.Console.ReadKey();
    }
  }
}
```

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

Runspace01 (VB.NET) Code Sample

Article • 09/17/2021

Here are the code samples for the runspace described in Creating a Console Application That Runs a Specified Command. To do this, the application invokes a runspace, and then invokes a command. (Note that this application does not specify runspace configuration information, nor does it explicitly create a pipeline.) The command that is invoked is the `Get-Process` cmdlet.

Code Sample

VB

```
Imports System
Imports System.Collections.Generic
Imports System.Text
Imports System.Management.Automation
Imports System.Management.Automation.Host
Imports System.Management.Automation.Runspaces

Namespace Microsoft.Samples.PowerShell.Runspaces

    Module Runspace01
        ' <summary>
        ' This sample uses the RunspaceInvoke class to execute
        ' the get-process cmdlet synchronously. The name and
        ' handlecount are then extracted from  the PSObjects
        ' returned and displayed.
        ' </summary>
        ' <param name="args">Unused</param>
        ' <remarks>
        ' This sample demonstrates the following:
        ' 1. Creating an instance of the RunspaceInvoke class.
        ' 2. Using this instance to invoke a PowerShell command.
        ' 3. Using PSObject to extract properties from the objects
        '    returned by this command.
        ' </remarks>
        Sub Main()
            ' Create an instance of the RunspaceInvoke class.
            ' This takes care of all building all of the other
            ' data structures needed...
            Dim invoker As RunspaceInvoke = New RunspaceInvoke()

            Console.WriteLine("Process             HandleCount")
            Console.WriteLine("-------------------------------")

            ' Now invoke the runspace and display the objects that are
            ' returned...
```

```
            For Each result As PSObject In invoker.Invoke("get-process")
                Console.WriteLine("{0,-20} {1}", _
                    result.Members("ProcessName").Value, _
                    result.Members("HandleCount").Value)
            Next
            System.Console.WriteLine("Hit any key to exit...")
            System.Console.ReadKey()
        End Sub
    End Module
End Namespace
```

See Also

Windows PowerShell SDK

Runspace02 Code Samples

Article • 09/17/2021

Here is the source code for the Runspace02 sample. This sample uses the System.Management.Automation.Runspaceinvoke class to execute the `Get-Process` cmdlet synchronously. Windows Forms and data binding are then used to display the results in a DataGridView control.

For complete sample code, see the following topics.

Language	Topic
C#	Runspace02 (C#) Code Sample
VB.NET	Runspace02 (VB.NET) Code Sample

See Also

Windows PowerShell SDK

Runspace02 (C#) Code Sample

Article • 09/17/2021

Here is the C# source code for the Runspace02 sample. This sample uses the System.Management.Automation.Runspaceinvoke class to execute the `Get-Process` cmdlet synchronously. Windows Forms and data binding are then used to display the results in a DataGridView control

Code Sample

C#

```
namespace Microsoft.Samples.PowerShell.Runspaces
{
  using System;
  using System.Collections;
  using System.Collections.ObjectModel;
  using System.Management.Automation;
  using System.Management.Automation.Runspaces;
  using System.Windows.Forms;
  using PowerShell = System.Management.Automation.PowerShell;

  /// <summary>
  /// This class contains the Main entry point for this host application.
  /// </summary>
  internal class Runspace02
  {
    /// <summary>
    /// This method creates the form where the output is displayed.
    /// </summary>
    private static void CreateForm()
    {
      Form form = new Form();
      DataGridView grid = new DataGridView();
      form.Controls.Add(grid);
      grid.Dock = DockStyle.Fill;

      // Create a PowerShell object. Creating this object takes care of
      // building all of the other data structures needed to run the
command.
      using (PowerShell powershell = PowerShell.Create())
      {
        powershell.AddCommand("get-process").AddCommand("sort-
object").AddArgument("ID");
        if (Runspace.DefaultRunspace == null)
        {
          Runspace.DefaultRunspace = powershell.Runspace;
        }
```

```
            Collection<PSObject> results = powershell.Invoke();

            // The generic collection needs to be re-wrapped in an ArrayList
            // for data-binding to work.
            ArrayList objects = new ArrayList();
            objects.AddRange(results);

            // The DataGridView will use the PSObjectTypeDescriptor type
            // to retrieve the properties.
            grid.DataSource = objects;
          }

          form.ShowDialog();
        }

        /// <summary>
        /// This sample uses a PowerShell object to run the
        /// Get-Process cmdlet synchronously. Windows Forms and
        /// data binding are then used to display the results in a
        /// DataGridView control.
        /// </summary>
        /// <param name="args">Parameter not used.</param>
        /// <remarks>
        /// This sample demonstrates the following:
        /// 1. Creating a PowerShell object.
        /// 2. Adding commands and arguments to the pipeline of
        ///    the powershell object.
        /// 3. Running the commands synchronously.
        /// 4. Using a DataGridView control to display the output
        ///    of the PowerShell object in a Windows Forms application.
        /// </remarks>
        private static void Main(string[] args)
        {
          Runspace02.CreateForm();
        }
      }
    }
```

See Also

Windows PowerShell SDK

Runspace02 (VB.NET) Code Sample

Article • 09/17/2021

Here is the VB.NET source code for the Runspace02 sample. This sample uses the System.Management.Automation.Runspaceinvoke class to execute the `Get-Process` cmdlet synchronously. Windows Forms and data binding are then used to display the results in a DataGridView control.

Code Sample

VB

```
Imports System
Imports System.Collections
Imports System.Collections.ObjectModel
Imports System.Windows.Forms
Imports System.Management.Automation.Runspaces
Imports System.Management.Automation

Namespace Microsoft.Samples.PowerShell.Runspaces

    Class Runspace02

        Shared Sub CreateForm()
            Dim form As New Form()
            Dim grid As New DataGridView()
            form.Controls.Add(grid)
            grid.Dock = DockStyle.Fill

            ' Create an instance of the RunspaceInvoke class.
            ' This takes care of all building all of the other
            ' data structures needed...
            Dim invoker As New RunspaceInvoke()

            Dim results As Collection(Of PSObject) = _
                invoker.Invoke("get-process | sort-object ID")

            ' The generic collection needs to be re-wrapped in an ArrayList
            ' for data-binding to work...
            Dim objects As New ArrayList()
            objects.AddRange(results)

            ' The DataGridView will use the PSObjectTypeDescriptor type
            ' to retrieve the properties.
            grid.DataSource = objects

            form.ShowDialog()

        End Sub 'CreateForm
```

```
        ''' <summary>
        ''' This sample uses the RunspaceInvoke class to execute
        ''' the get-process cmdlet synchronously. Windows Forms and data
        ''' binding are then used to display the results in a
        ''' DataGridView control.
        ''' </summary>
        ''' <param name="args">Unused</param>
        ''' <remarks>
        ''' This sample demonstrates the following:
        ''' 1. Creating an instance of the RunspaceInvoke class.
        ''' 2. Using this instance to invoke a PowerShell command.
        ''' 3. Using the output of RunspaceInvoke in a DataGridView
        '''    in a Windows Forms application
        ''' </remarks
        Shared Sub Main(ByVal args() As String)
            Runspace02.CreateForm()
        End Sub 'Main

    End Class 'Runspace02

End Namespace
```

See Also

Windows PowerShell SDK

RunSpace03 Code Samples

Article • 09/17/2021

Here are the code samples for the runspace described in "Creating a Console Application That Runs a Specified Script".

> **Note**
>
> You can download the C# source file (runspace03.cs) and the VB.NET source file (runspace03.vb) for this sample using the Microsoft Windows Software Development Kit for Windows Vista and Microsoft .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded source files are available in the **<PowerShell Samples>** directory.

For complete sample code, see the following topics.

Language	Topic
C#	RunSpace03 (C#) Code Sample
VB.NET	RunSpace03 (VB.NET) Code Sample

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

RunSpace03 (C#) Code Sample

Article • 09/17/2021

Here is the C# source code for the console application described in "Creating a Console Application That Runs a Specified Script". This sample uses the System.Management.Automation.Runspaceinvoke class to execute a script that retrieves process information by using the list of process names passed into the script. It shows how to pass input objects to a script and how to retrieve error objects as well as the output objects.

> **Note**
>
> You can download the C# source file (runspace03.cs) for this sample using the Microsoft Windows Software Development Kit for Windows Vista and Microsoft .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded source files are available in the **<PowerShell Samples>** directory.

Code Sample

C#

```
namespace Microsoft.Samples.PowerShell.Runspaces
{
    using System;
    using System.Collections;
    using System.Management.Automation;
    using System.Management.Automation.Runspaces;
    using PowerShell = System.Management.Automation.PowerShell;

    /// <summary>
    /// This class contains the Main entry point for this host application.
    /// </summary>
    internal class Runspace03
    {
        /// <summary>
        /// This sample uses the PowerShell class to execute
        /// a script that retrieves process information for the
        /// list of process names passed into the script.
        /// It shows how to pass input objects to a script and
        /// how to retrieve error objects as well as the output objects.
        /// </summary>
        /// <param name="args">Parameter not used.</param>
        /// <remarks>
        /// This sample demonstrates the following:
```

```
        /// 1. Creating an instance of the PowerSHell class.
        /// 2. Using this instance to execute a string as a PowerShell
script.
        /// 3. Passing input objects to the script from the calling program.
        /// 4. Using PSObject to extract and display properties from the
objects
        ///    returned by this command.
        /// 5. Retrieving and displaying error records that were generated
        ///    during the execution of that script.
        /// </remarks>
        private static void Main(string[] args)
        {
            // Define a list of processes to look for
            string[] processNames = new string[]
            {
              "lsass", "nosuchprocess", "services", "nosuchprocess2"
            };

            // The script to run to get these processes. Input passed
            // to the script will be available in the $input variable.
            string script = "$input | get-process -name {$_}";

            // Create an instance of the PowerShell class.
            using (PowerShell powershell = PowerShell.Create())
            {
                powershell.AddScript(script);

                Console.WriteLine("Process             HandleCount");
                Console.WriteLine("-------------------------------");

                // Now invoke the PowerShell and display the objects that
are
                // returned...
                foreach (PSObject result in powershell.Invoke(processNames))
                {
                    Console.WriteLine(
                        "{0,-20} {1}",
                        result.Members["ProcessName"].Value,
                        result.Members["HandleCount"].Value);
                }

                // Now process any error records that were generated while
running the script.
                Console.WriteLine("\nThe following non-terminating errors
occurred:\n");
                PSDataCollection<ErrorRecord> errors =
powershell.Streams.Error;
                if (errors != null && errors.Count > 0)
                {
                    foreach (ErrorRecord err in errors)
                    {
                        System.Console.WriteLine("    error: {0}",
err.ToString());
                    }
                }
```

```
            }

            System.Console.WriteLine("\nHit any key to exit...");
            System.Console.ReadKey();
        }
    }
}
```

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

RunSpace03 (VB.NET) Code Sample

Article • 09/17/2021

Here is the VB.NET source code for the console application described in "Creating a Console Application That Runs a Specified Script". This sample uses the System.Management.Automation.Runspaceinvoke class to execute a script that retrieves process information for the list of process names passed into the script. It shows how to pass input objects to a script and how to retrieve error objects as well as the output objects.

> **Note**
>
> You can download the VB.NET source file (runspace03.vb) for this sample by using the Windows Software Development Kit for Windows Vista and Microsoft .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded source files are available in the **<PowerShell Samples>** directory.

Code Sample

VB

```
Imports System
Imports System.Collections
Imports System.Collections.Generic
Imports System.Collections.ObjectModel
Imports System.Text
Imports Microsoft.VisualBasic
Imports System.Management.Automation
Imports System.Management.Automation.Host
Imports System.Management.Automation.Runspaces

Namespace Microsoft.Samples.PowerShell.Runspaces

    Class Runspace03

        ''' <summary>
        ''' This sample uses the RunspaceInvoke class to execute
        ''' a script that retrieves process information for the
        ''' list of process names passed into the script.
        ''' It shows how to pass input objects to a script and
        ''' how to retrieve error objects as well as the output objects.
        ''' </summary>
        ''' <param name="args">Unused</param>
        ''' <remarks>
```

```
        ''' This sample demonstrates the following:
        ''' 1. Creating an instance of the RunspaceInvoke class.
        ''' 2. Using this instance to execute a string as a PowerShell
script.
        ''' 3. Passing input objects to the script from the calling program.
        ''' 4. Using PSObject to extract and display properties from the
objects
        '''    returned by this command.
        ''' 5. Retrieving and displaying error records that were generated
        '''    during the execution of that script.
        ''' </remarks>
        Shared Sub Main(ByVal args() As String)
            ' Define a list of processes to look for
            Dim processNames() As String = {"lsass", "nosuchprocess", _
                "services", "nosuchprocess2"}

            ' The script to run to get these processes. Input passed
            ' to the script will be available in the $input variable.
            Dim script As String = "$input | get-process -name {$_}"

            ' Create an instance of the RunspaceInvoke class.
            Dim invoker As New RunspaceInvoke()

            Console.WriteLine("Process             HandleCount")
            Console.WriteLine("--------------------------------")

            ' Now invoke the runspace and display the objects that are
            ' returned...
            Dim errors As System.Collections.IList = Nothing
            Dim result As PSObject
            For Each result In invoker.Invoke(script, processNames, errors)
                Console.WriteLine("{0,-20} {1}", _
                result.Members("ProcessName").Value, _
                result.Members("HandleCount").Value)
            Next result

            ' Now process any error records that were generated while
            ' running the script.
            Console.WriteLine(vbCrLf & _
                "The following non-terminating errors occurred:" & vbCrLf)
            If Not (errors Is Nothing) AndAlso errors.Count > 0 Then
                Dim err As PSObject
                For Each err In errors
                    System.Console.WriteLine("    error: {0}",
err.ToString())
                Next err
            End If
            System.Console.WriteLine(vbCRLF & "Hit any key to exit...")
            System.Console.ReadKey()

        End Sub 'Main

    End Class 'Runspace03

End Namespace
```

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

RunSpace04 Code Samples

Article • 09/17/2021

Here is a code sample for a runspace that uses the System.Management.Automation.Runspaceinvoke class to execute a script that generates a terminating error. The host application is responsible for catching the error and interpreting the error record.

> **Note**
>
> You can download the VB.NET source file (Runspace04.vb) for this runspace using the Windows Software Development Kit for Windows Vista and Microsoft .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded source files are available in the **<PowerShell Samples>** directory.

For complete sample code, see the following topics.

Language	Topic
VB.NET	Runspace04 (VB.NET) Code Sample

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

RunSpace04 (VB.NET) Code Sample

Article • 09/17/2021

Here is the VB.NET source code for the Runspace04 sample. This sample uses the System.Management.Automation.Runspaceinvoke class to execute a script that generates a terminating error. The host application is responsible for catching the error and interpreting the error record.

> **Note**
>
> You can download the VB.NET source file (runspace02.vb) for this sample by using the Windows Software Development Kit for Windows Vista and Microsoft .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**.
>
> The downloaded source files are available in the **<PowerShell Samples>** directory.

Code Sample

VB

```
Imports System
Imports System.Collections
Imports System.Collections.Generic
Imports System.Collections.ObjectModel
Imports System.Text
Imports Microsoft.VisualBasic
Imports System.Management.Automation
Imports System.Management.Automation.Host
Imports System.Management.Automation.Runspaces

Namespace Microsoft.Samples.PowerShell.Runspaces

    Class Runspace04

        ''' <summary>
        ''' This sample uses the RunspaceInvoke class to execute
        ''' a script. This script will generate a terminating
        ''' exception that the caller should catch and process.
        ''' </summary>
        ''' <param name="args">Unused</param>
        ''' <remarks>
        ''' This sample demonstrates the following:
        ''' 1. Creating an instance of the RunspaceInvoke class.
        ''' 2. Using this instance to execute a string as a PowerShell
script.
```

```
        ''' 3. Passing input objects to the script from the calling program.
        ''' 4. Using PSObject to extract and display properties from the
objects
        '''    returned by this command.
        ''' 5. Retrieving and displaying error records that may be generated
        '''    during the execution of that script.
        ''' 6. Catching and displaying terminating exceptions generated
        '''    by the script being run.
        ''' </remarks>
        Shared Sub Main(ByVal args() As String)
            ' Define a list of patterns to use in matching
            ' Note that the fourth pattern is not a valid regular
            ' expression so it will cause a terminating exception to
            ' be thrown when used in select-string.
            Dim patterns() As String = {"aa", "bc", "ab*c", "*", "abc"}

            ' The script to run to use the patterns. Input passed
            ' to the script will be available in the $input variable.
            Dim script As String = "$input | where {" & _
                " select-string $_ -inputobject 'abc' }"

            ' Create an instance of the RunspaceInvoke class.
            Dim invoker As New RunspaceInvoke()

            ' Invoke the runspace. Because of the bad regular expression,
            ' no objects will be returned. Instead, an exception will be
            ' thrown.
            Try
                Dim errors As System.Collections.IList = Nothing
                Dim result As PSObject
                For Each result In invoker.Invoke(script, patterns, errors)
                    Console.WriteLine("'{0}'", result.ToString())
                Next result

                ' Now process any error records that were generated
                ' while running the script.
                Console.WriteLine(vbCrLf & _
                    "The following non-terminating errors occurred:" &
vbCrLf)
                If Not (errors Is Nothing) AndAlso errors.Count > 0 Then
                    Dim err As PSObject
                    For Each err In errors
                        System.Console.WriteLine("    error: {0}",
err.ToString())
                    Next err
                End If
            Catch runtimeException As RuntimeException
                ' Trap any exception generated by the script. These
exceptions
                ' will all be derived from RuntimeException.
                System.Console.WriteLine("Runtime exception: {0}: {1}" & _
                   vbCrLf + "{2}", _

runtimeException.ErrorRecord.InvocationInfo.InvocationName, _
                   runtimeException.Message, _
```

```
runtimeException.ErrorRecord.InvocationInfo.PositionMessage)
            End Try

            System.Console.WriteLine(vbCrLf + "Hit any key to exit...")
            System.Console.ReadKey()

        End Sub 'Main
    End Class 'Runspace04

End Namespace
```

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

RunSpace05 Code Sample

Article • 09/17/2021

Here is the source code for the Runspace05 sample that is described in Configuring a Runspace Using RunspaceConfiguration. This sample shows how to create the runspace configuration information, create a runspace, create a pipeline with a single command, and then execute the pipeline. The command that is executed is the `Get-Process` cmdlet.

> **Note**
>
> You can download the C# source file (runspace05.cs) by using the Microsoft Windows Software Development Kit for Windows Vista and Microsoft .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded source files are available in the **<PowerShell Samples>** directory.

Code Sample

C#

```
namespace Microsoft.Samples.PowerShell.Runspaces
{
  using System;
  using System.Collections.ObjectModel;
  using System.Management.Automation;
  using System.Management.Automation.Runspaces;
  using PowerShell = System.Management.Automation.PowerShell;

  /// <summary>
  /// This class contains the Main entry point for this host application.
  /// </summary>
  internal class Runspace05
  {
    /// <summary>
    /// This sample uses an initial session state to create a runspace. The
sample
    /// invokes a command from a PowerShell snap-in present in the console
file.
    /// </summary>
    /// <param name="args">Parameter not used.</param>
    /// <remarks>
    /// This sample assumes that user has the GetProcessSample01.dll that is
produced
    /// by the GetProcessSample01 sample copied to the current directory.
```

```
    /// This sample demonstrates the following:
    /// 1. Creating a default initial session state.
    /// 2. Creating a runspace using the default initial session state.
    /// 3. Creating a PowerShell object that uses the runspace.
    /// 4. Adding the get-proc cmdlet to the PowerShell object from a
    ///    snap-in.
    /// 5. Using PSObject objects to extract and display properties from
    ///    the objects returned by the cmdlet.
    /// </remarks>
    private static void Main(string[] args)
    {
      // Create the default initial session state. The default initial
      // session state contains all the elements provided by Windows
PowerShell.
      InitialSessionState iss = InitialSessionState.CreateDefault();
      PSSnapInException warning;
      iss.ImportPSSnapIn("GetProcPSSnapIn01", out warning);

      // Create a runspace. Notice that no PSHost object is supplied to the
      // CreateRunspace method so the default host is used. See the Host
      // samples for more information on creating your own custom host.
      using (Runspace myRunSpace = RunspaceFactory.CreateRunspace(iss))
      {
        myRunSpace.Open();

        // Create a PowerShell object.
        using (PowerShell powershell = PowerShell.Create())
        {
          // Add the Cmdlet and specify the runspace.
          powershell.AddCommand("GetProcPSSnapIn01\\get-proc");
          powershell.Runspace = myRunSpace;

          // Run the cmdlet synchronously.
          Collection<PSObject> results = powershell.Invoke();

          Console.WriteLine("Process             HandleCount");
          Console.WriteLine("-------------------------------");

          // Display the results.
          foreach (PSObject result in results)
          {
            Console.WriteLine(
                            "{0,-20} {1}",
                            result.Members["ProcessName"].Value,
                            result.Members["HandleCount"].Value);
          }
        }

        // Close the runspace to release any resources.
        myRunSpace.Close();
      }
      System.Console.WriteLine("Hit any key to exit...");
      System.Console.ReadKey();
    }
```

```
    }
}
```

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

RunSpace06 Code Sample

Article • 09/17/2021

Here is the source code for the Runspace06 sample described in Configuring a Runspace Using a Windows PowerShell Snap-in. This sample application creates a runspace based on a Windows PowerShell snap-in, which is then used to run a pipeline with a single command. To do this, the application creates the runspace configuration information, creates a runspace, creates a pipeline with a single command, and then executes the pipeline.

> **Note**
>
> You can download the C# source file (runspace06.cs) by using the Windows Software Development Kit for Windows Vista and Microsoft .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded source files are available in the **<PowerShell Samples>** directory.

Code Sample

C#

```
namespace Microsoft.Samples.PowerShell.Runspaces
{
  using System;
  using System.Collections.ObjectModel;
  using System.Management.Automation;
  using System.Management.Automation.Runspaces;
  using PowerShell = System.Management.Automation.PowerShell;

  /// <summary>
  /// This class contains the Main entry point for this host application.
  /// </summary>
  internal class Runspace06
  {
    /// <summary>
    /// This sample uses an initial session state to create a runspace.
    /// The sample invokes a command from binary module that is loaded by
the
    /// initial session state.
    /// </summary>
    /// <param name="args">Parameter not used.</param>
    /// <remarks>
    /// This sample assumes that user has the GetProcessSample02.dll that is
    /// produced by the GetProcessSample02 sample copied to the current
```

```
directory.
    /// This sample demonstrates the following:
    /// 1. Creating a default initial session state.
    /// 2. Creating a runspace using the initial session state.
    /// 3. Creating a PowerShell object that uses the runspace.
    /// 4. Adding the get-proc cmdlet to the PowerShell object from a
    ///    module.
    /// 5. Using PSObject objects to extract and display properties from
    ///    the objects returned by the cmdlet.
    /// </remarks>
    private static void Main(string[] args)
    {
      // Create an initial session state.
      InitialSessionState iss = InitialSessionState.CreateDefault();
      iss.ImportPSModule(new string[] { @".\GetProcessSample02.dll" });

      // Create a runspace. Notice that no PSHost object is supplied to the
      // CreateRunspace method so the default host is used. See the Host
      // samples for more information on creating your own custom host.
      using (Runspace myRunSpace = RunspaceFactory.CreateRunspace(iss))
      {
        myRunSpace.Open();

        // Create a PowerShell object.
        using (PowerShell powershell = PowerShell.Create())
        {
          // Add the cmdlet and specify the runspace.
          powershell.AddCommand(@"GetProcessSample02\get-proc");
          powershell.Runspace = myRunSpace;

          Collection<PSObject> results = powershell.Invoke();

          Console.WriteLine("Process             HandleCount");
          Console.WriteLine("-------------------------------");

          // Display the results.
          foreach (PSObject result in results)
          {
            Console.WriteLine(
                            "{0,-20} {1}",
                            result.Members["ProcessName"].Value,
                            result.Members["HandleCount"].Value);
          }
        }

        // Close the runspace to release any resources.
        myRunSpace.Close();
      }

      System.Console.WriteLine("Hit any key to exit...");
      System.Console.ReadKey();
    }
  }
}
```

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

RunSpace07 Code Sample

Article • 09/17/2021

Here is the source code for the Runspace07 sample described in Creating a Console Application That Adds Commands to a Pipeline. This sample application creates a runspace, creates a pipeline, adds two commands to the pipeline, and then executes the pipeline. The commands added to the pipeline are the `Get-Process` and `Measure-Object` cmdlets.

> **Note**
>
> You can download the C# source file (runspace07.cs) using the Microsoft Windows Software Development Kit for Windows Vista and Microsoft .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded source files are available in the **<PowerShell Samples>** directory.

Code Sample

C#

```
namespace Microsoft.Samples.PowerShell.Runspaces
{
  using System;
  using System.Collections.ObjectModel;
  using System.Management.Automation;
  using System.Management.Automation.Runspaces;
  using PowerShell = System.Management.Automation.PowerShell;

  /// <summary>
  /// This class contains the Main entry point for this host application.
  /// </summary>
  internal class Runspace07
  {
    /// <summary>
    /// This sample shows how to create a runspace and how to run
    /// commands using a PowerShell object. It builds a pipeline
    /// that runs the get-process cmdlet, which is piped to the measure-
object
    /// cmdlet to count the number of processes running on the system.
    /// </summary>
    /// <param name="args">Parameter is not used.</param>
    /// <remarks>
    /// This sample demonstrates the following:
    /// 1. Creating a runspace using the RunspaceFactory class.
```

```
    /// 2. Creating a PowerShell object
    /// 3. Adding individual cmdlets to the PowerShell object.
    /// 4. Running the cmdlets synchronously.
    /// 5. Working with PSObject objects to extract properties
    ///    from the objects returned by the cmdlets.
    /// </remarks>
    private static void Main(string[] args)
    {
      Collection<PSObject> result;     // Will hold the result
                                       // of running the cmdlets.

      // Create a runspace. We can not use the RunspaceInvoke class
      // because we need to get at the underlying runspace to
      // explicitly add the commands. Notice that no PSHost object is
      // supplied to the CreateRunspace method so the default host is
      // used. See the Host samples for more information on creating
      // your own custom host.
      using (Runspace myRunSpace = RunspaceFactory.CreateRunspace())
      {
        myRunSpace.Open();

        // Create a PowerShell object and specify the runspace.
        PowerShell powershell = PowerShell.Create();
        powershell.Runspace = myRunSpace;

        // Use the using statement so we dispose of the PowerShell object
        // when we're done.
        using (powershell)
        {
          // Add the get-process cmdlet to the PowerShell object. Notice
          // we are specify the name of the cmdlet, not a script.
          powershell.AddCommand("get-process");

          // Add the measure-object cmdlet to count the number
          // of objects being returned. Commands are always added to the end
          // of the pipeline.
          powershell.AddCommand("measure-object");

          // Run the cmdlets synchronously and save the objects returned.
          result = powershell.Invoke();
        }

        // Even after disposing of the pipeLine, we still need to set
        // the powershell variable to null so that the garbage collector
        // can clean it up.
        powershell = null;

        // Display the results of running the commands (checking that
        // everything is ok first.
        if (result == null || result.Count != 1)
        {
          throw new InvalidOperationException(
                    "pipeline.Invoke() returned the wrong number of
objects");
        }
```

```
        PSMemberInfo count = result[0].Properties["Count"];
        if (count == null)
        {
          throw new InvalidOperationException(
                    "The object returned doesn't have a 'count' property");
        }

        Console.WriteLine(
                  "Runspace07: The get-process cmdlet returned {0}
objects",
                  count.Value);

        // Close the runspace to release any resources.
        myRunSpace.Close();
      }

      System.Console.WriteLine("Hit any key to exit...");
      System.Console.ReadKey();
    }
  }
}
```

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

RunSpace08 Code Sample

Article • 09/17/2021

Here is the source code for the Runspace08 sample described in Creating a Console Application That Adds Parameters to a Command. This sample application creates a runspace, creates a pipeline, adds two commands to the pipeline, adds two parameters to the second command, and then executes the pipeline. The commands that are added to the pipeline are the `Get-Process` and `Sort-Object` cmdlets.

Code Sample

C#

```
namespace Microsoft.Samples.PowerShell.Runspaces
{
  using System;
  using System.Collections.Generic;
  using System.Collections.ObjectModel;
  using System.Management.Automation;
  using System.Management.Automation.Runspaces;
  using PowerShell = System.Management.Automation.PowerShell;

  /// <summary>
  /// This class contains the Main entry point for this host application.
  /// </summary>
  internal class Runspace08
  {
    /// <summary>
    /// This sample shows how to use a PowerShell object to run commands.
The
    /// PowerShell object builds a pipeline that include the get-process
cmdlet,
    /// which is then piped to the sort-object cmdlet. Parameters are added
to the
    /// sort-object cmdlet to sort the HandleCount property in descending
order.
    /// </summary>
    /// <param name="args">Parameter is not used.</param>
    /// <remarks>
    /// This sample demonstrates:
    /// 1. Creating a PowerShell object
    /// 2. Adding individual commands to the PowerShell object.
    /// 3. Adding parameters to the commands.
    /// 4. Running the pipeline of the PowerShell object synchronously.
    /// 5. Working with PSObject objects to extract properties
    ///    from the objects returned by the commands.
    /// </remarks>
    private static void Main(string[] args)
```

```
    {
      Collection<PSObject> results; // Holds the result of the pipeline
execution.

      // Create the PowerShell object. Notice that no runspace is specified
so a
      // new default runspace is used.
      PowerShell powershell = PowerShell.Create();

      // Use the using statement so that we can dispose of the PowerShell
object
      // when we are done.
      using (powershell)
      {
        // Add the get-process cmdlet to the pipeline of the PowerShell
object.
        powershell.AddCommand("get-process");

        // Add the sort-object cmdlet and its parameters to the pipeline of
        // the PowerShell object so that we can sort the HandleCount
property
        //  in descending order.
        powershell.AddCommand("sort-
object").AddParameter("descending").AddParameter("property", "handlecount");

        // Run the pipeline of the Powerhell object synchronously.
        results = powershell.Invoke();
      }

      // Even after disposing of the PowerShell object, we still
      // need to set the powershell variable to null so that the
      // garbage collector can clean it up.
      powershell = null;

      Console.WriteLine("Process             HandleCount");
      Console.WriteLine("-------------------------------");

      // Display the results returned by the commands.
      foreach (PSObject result in results)
      {
        Console.WriteLine(
                          "{0,-20} {1}",
                          result.Members["ProcessName"].Value,
                          result.Members["HandleCount"].Value);
      }

      System.Console.WriteLine("Hit any key to exit...");
      System.Console.ReadKey();
    }
  }
}
```

See Also

Windows PowerShell SDK

RunSpace09 Code Sample

Article • 09/17/2021

This sample application creates and opens a runspace, creates and asynchronously invokes a pipeline, and then uses pipeline events to process the script asynchronously. The script that is run by this application creates the integers 1 through 10 in 0.5-second intervals (500 ms).

Code Sample

C#

```
namespace Microsoft.Samples.PowerShell.Runspaces
{
  using System;
  using System.Collections.Generic;
  using System.Collections.ObjectModel;
  using System.Diagnostics;
  using System.Management.Automation;
  using System.Management.Automation.Runspaces;
  using PowerShell = System.Management.Automation.PowerShell;

  /// <summary>
  /// This class contains the Main entry point for this host application.
  /// </summary>
  internal class Runspace09
  {
    /// <summary>
    /// This sample shows how to use a PowerShell object to run a
    /// script that generates the numbers from 1 to 10 with delays
    /// between each number. The pipeline of the PowerShell object
    /// is run asynchronously and events are used to handle the output.
    /// </summary>
    /// <param name="args">This parameter is not used.</param>
    /// <remarks>
    /// This sample demonstrates the following:
    /// 1. Creating a PowerShell object.
    /// 2. Adding a script to the pipeline of the PowerShell object.
    /// 3. Using the BeginInvoke method to run the pipeline asynchronosly.
    /// 4. Using the events of the PowerShell object to process the
    ///    output of the script.
    /// 5. Using the PowerShell.Stop() method to interrupt an executing
pipeline.
    /// </remarks>
    private static void Main(string[] args)
    {
      Console.WriteLine("Print the numbers from 1 to 10. Hit any key to halt
processing\n");
```

```
      using (PowerShell powershell = PowerShell.Create())
      {
        // Add a script to the PowerShell object. The script generates the
        // numbers from 1 to 10 in half second intervals.
        powershell.AddScript("1..10 | foreach {$_ ; start-sleep -milli
500}");

        // Add the event handlers.  If we did not care about hooking the
DataAdded
        // event, we would let BeginInvoke create the output stream for us.
        PSDataCollection<PSObject> output = new PSDataCollection<PSObject>
();
        output.DataAdded += new EventHandler<DataAddedEventArgs>
(Output_DataAdded);
        powershell.InvocationStateChanged += new
EventHandler<PSInvocationStateChangedEventArgs>
(Powershell_InvocationStateChanged);

        // Invoke the pipeline asynchronously.
        IAsyncResult asyncResult = powershell.BeginInvoke<PSObject,
PSObject>(null, output);

        // Wait for things to happen. If the user hits a key before the
        // script has completed, then call the PowerShell Stop() method
        // to halt processing.
        Console.ReadKey();
        if (powershell.InvocationStateInfo.State !=
PSInvocationState.Completed)
        {
          // Stop the execution of the pipeline.
          Console.WriteLine("\nStopping the pipeline!\n");
          powershell.Stop();

          // Wait for the Windows PowerShell state change messages to be
displayed.
          System.Threading.Thread.Sleep(500);
          Console.WriteLine("\nPress a key to exit");
          Console.ReadKey();
        }
      }
    }

    /// <summary>
    /// The output data added event handler. This event is called when
    /// data is added to the output pipe. It reads the data that is
    /// available and displays it on the console.
    /// </summary>
    /// <param name="sender">The output pipe this event is associated with.
</param>
    /// <param name="e">Parameter is not used.</param>
    private static void Output_DataAdded(object sender, DataAddedEventArgs
e)
    {
      PSDataCollection<PSObject> myp = (PSDataCollection<PSObject>)sender;
```

```
      Collection<PSObject> results = myp.ReadAll();
      foreach (PSObject result in results)
      {
        Console.WriteLine(result.ToString());
      }
    }

    /// <summary>
    /// This event handler is called when the pipeline state is changed.
    /// If the state change is to Completed, the handler issues a message
    /// asking the user to exit the program.
    /// </summary>
    /// <param name="sender">This parameter is not used.</param>
    /// <param name="e">The PowerShell state information.</param>
    private static void Powershell_InvocationStateChanged(object sender,
PSInvocationStateChangedEventArgs e)
    {
      Console.WriteLine("PowerShell object state changed: state: {0}\n",
e.InvocationStateInfo.State);
      if (e.InvocationStateInfo.State == PSInvocationState.Completed)
      {
        Console.WriteLine("Processing completed, press a key to exit!");
      }
    }
  }
}
```

See Also

Windows PowerShell SDK

RunSpace10 Code Sample

Article • 09/17/2021

Here is the source code for the Runspace10 sample. This sample application adds a cmdlet to System.Management.Automation.Runspaces.Runspaceconfiguration and then uses the modified configuration information to create the runspace.

> **Note**
>
> You can download the C# source file (runspace10.cs) by using the Windows Software Development Kit for Windows Vista and Microsoft .NET Framework 3.0 Runtime Components. For download instructions, see **How to Install Windows PowerShell and Download the Windows PowerShell SDK**. The downloaded source files are available in the <**PowerShell Samples**> directory.

Code Sample

C#

```
namespace Microsoft.Samples.PowerShell.Runspaces
{
  using System;
  using System.Collections.Generic;
  using System.Collections.ObjectModel;
  using System.Diagnostics;
  using System.Management.Automation;
  using System.Management.Automation.Runspaces;
  using PowerShell = System.Management.Automation.PowerShell;

  #region GetProcCommand

  /// <summary>
  /// Class that implements the GetProcCommand.
  /// </summary>
  [Cmdlet(VerbsCommon.Get, "Proc")]
  public class GetProcCommand : Cmdlet
  {
    #region Cmdlet Overrides

    /// <summary>
    /// For each of the requested process names, retrieve and write
    /// the associated processes.
    /// </summary>
    protected override void ProcessRecord()
    {
      // Get the current processes.
```

```
      Process[] processes = Process.GetProcesses();

      // Write the processes to the pipeline making them available
      // to the next cmdlet. The second argument (true) tells the
      // system to enumerate the array, and send one process object
      // at a time to the pipeline.
      WriteObject(processes, true);
    }

    #endregion Overrides
  } // End GetProcCommand class.

  #endregion GetProcCommand

  /// <summary>
  /// This class contains the Main entry point for this host application.
  /// </summary>
  internal class Runspace10
  {
    /// <summary>
    /// This sample shows how to add a cmdlet to an InitialSessionState
object and then
    /// uses the modified InitialSessionState object when creating a
Runspace object.
    /// </summary>
    /// <param name="args">Parameter is not used.</param>
    /// This sample demonstrates:
    /// 1. Creating an InitialSessionState object.
    /// 2. Adding a cmdlet to the InitialSessionState object.
    /// 3. Creating a runspace that uses the InitialSessionState object.
    /// 4. Craeting a PowerShell object tht uses the Runspace object.
    /// 5. Running the pipeline of the PowerShell object synchronously.
    /// 6. Working with PSObject objects to extract properties
    ///    from the objects returned by the pipeline.
    private static void Main(string[] args)
    {
      // Create a default InitialSessionState object. The default
      // InitialSessionState object contains all the elements provided
      // by Windows PowerShell.
      InitialSessionState iss = InitialSessionState.CreateDefault();

      // Add the get-proc cmdlet to the InitialSessionState object.
      SessionStateCmdletEntry ssce = new SessionStateCmdletEntry("get-proc",
typeof(GetProcCommand), null);
      iss.Commands.Add(ssce);

      // Create a Runspace object that uses the InitialSessionState object.
      // Notice that no PSHost object is specified, so the default host is
used.
      // See the Hosting samples for information on creating your own custom
host.
      using (Runspace myRunSpace = RunspaceFactory.CreateRunspace(iss))
      {
        myRunSpace.Open();
```

```
        using (PowerShell powershell = PowerShell.Create())
        {
          powershell.Runspace = myRunSpace;

          // Add the get-proc cmdlet to the pipeline of the PowerShell
object.
          powershell.AddCommand("get-proc");

          Collection<PSObject> results = powershell.Invoke();

          Console.WriteLine("Process             HandleCount");
          Console.WriteLine("--------------------------------");

          // Display the output of the pipeline.
          foreach (PSObject result in results)
          {
             Console.WriteLine(
                              "{0,-20} {1}",
                              result.Members["ProcessName"].Value,
                              result.Members["HandleCount"].Value);
          }
        }

        // Close the runspace to release resources.
        myRunSpace.Close();
      }

      System.Console.WriteLine("Hit any key to exit...");
      System.Console.ReadKey();
    }
  }
}
```

See Also

Windows PowerShell Programmer's Guide

Windows PowerShell SDK

Contributing to PowerShell documentation

Article • 09/22/2022

Thank you for your support of PowerShell!

The Contributor's Guide is a collection of articles that describe the tools and processes we use to create documentation at Microsoft. Some of these guides cover information common to any documentation set published to `learn.microsoft.com`. Other guides are specific to how we write documentation for PowerShell.

The common articles are available in our centralized Contributor's Guide. The PowerShell-specific guides are available here.

Ways to contribute

There are two ways to contribute. Both contributions are valuable to us.

- Filing issues helps us identify problems and gaps in our documentation. Sometimes the issues are difficult to resolve, requiring more investigation and research. The issue process allows us to have a conversation about the problem and develop a satisfactory resolution.
- Submitting a pull request to add or change content is a more involved process. The following information outlines the tools, processes, and standards for submitting content to the documentation.

Prepare to make a contribution

Contributing to the documentation requires a GitHub account. Use the following checklist to install and configure the tools you need to make contributions.

1. Sign up for GitHub
2. Install Git and Markdown tools
3. Install the Docs Authoring Pack
4. Install Posh-Git - not required but recommended
5. Set up a local Git repository
6. Review Git and GitHub fundamentals

Get started writing docs

There are two ways to contribute changes to the documentation:

1. Quick edits to existing docs - Minor corrections, fixing typos, or small additions
2. Full GitHub workflow for docs - large changes, multiple versions, adding or changing images, or contributing new articles

Also, read the Writing essentials section of the centralized Contributor's Guide. Another excellent resource is the Microsoft Writing Style Guide.

Minor corrections or clarifications to documentation and code examples in public repositories are covered by the learn.microsoft.com Terms of Use.

Use the full GitHub workflow when you're making significant changes. If you're not an employee of Microsoft, our PR validation system adds a comment to the pull request asking you to sign the online Contribution Licensing Agreement (CLA). You must complete this step before we can review or accept your pull request. Signing the CLA is only required the first time you submit a PR in the repository. You will be asked to sign the CLA for each time you contribute to a new repository.

Code of conduct

All repositories that publish to Microsoft Learn have adopted the Microsoft Open Source Code of Conduct or the .NET Foundation Code of Conduct. For more information, see the Code of Conduct FAQ.

Next steps

The following articles cover information specific to PowerShell documentation. Where there's overlap with the guidance in the centralized Contributor's Guide, we call out how those rules differ for the PowerShell content.

Review the following documents:

- Get started writing docs
- Markdown best practices
- PowerShell-Docs style guide
- How to file an issue
- Submitting a pull request

Additional resources

- Editorial checklist
- How we manage issues
- How we manage pull requests

Get started contributing to PowerShell documentation

Article • 10/27/2022

This article is an overview of how to get started as a contributor to the PowerShell documentation.

PowerShell-Docs structure

The PowerShell-Docs repository is divided into two groups of content: reference and conceptual.

Reference content

The reference content is the PowerShell cmdlet reference for the cmdlets that ship in PowerShell. The cmdlet reference is collected in versioned folders (like 5.1, 7.0, and 7.2), which contain reference for the modules that ship with PowerShell. This content is also used to create the help information displayed by the `Get-Help` cmdlet.

Conceptual content

The conceptual documentation isn't organized by version. All articles are displayed for every version of PowerShell.

> **Note**
>
> Anytime a conceptual article is added, removed, or renamed, the TOC must be updated and deleted or renamed files must be redirected.

Creating new articles

A GitHub issue must be created for any new document you want to contribute. Check for existing issues to make sure you're not duplicating efforts. Assigned issues are considered to be `in progress`. If you wish to collaborate on an issue, contact the person assigned to the issue.

Similar to the PowerShell RFC process, create an issue before you write the content. The issue ensures you don't waste time and effort on work that gets rejected by the

PowerShell-Docs team. The issue allows us to consult with you on the scope of the content and where it fits in the PowerShell documentation. All articles must be included in the Table of Contents (TOC). The proposed TOC location should be included in the issue discussion.

> **Note**
>
> The TOC for reference content is autogenerated by the publishing system. You don't have to update the TOC.

Updating existing articles

Where applicable, cmdlet reference articles are duplicated across all versions of PowerShell maintained in this repository. When reporting an issue about a cmdlet reference or an `About_` article, list the versions of the article that have the problem.

Apply the appropriate change to each version of the file.

Localized content

The PowerShell documentation is written in English and translated into 17 other languages. The English content is stored in the GitHub repository named `MicrosoftDocs/PowerShell-Docs`. Issues found in the translated content should be submitted to the English repository.

All translations start from the English content first. We use both human and machine translation.

Translation method	Languages
Human translation	de-DE, es-ES, fr-FR, it-IT, ja-JP, ko-KR, pt-BR, ru-RU, zh-CN, zh-TW
Machine translation	cs-CZ, hu-HU, nl-NL, pl-PL, pt-PT, sv-SE, tr-TR

The content translated by machine translation may not always result in correct word choices and grammar. If you find an error in translation for any language, rather than in the technical details of the article, open an issue explaining why you think the translation is wrong.

Some translation issues can be fixed by changing the English source files. However, some issues may require updates to our internal translation system. For those cases, we

must submit the issue to our internal localization team for review and response.

Next steps

There are two common ways of submitting changes in GitHub. Both methods are described in the central Contributor's Guide:

1. You can make quick edits to existing documents in the GitHub web interface.
2. Use the full GitHub workflow for adding new articles, updating multiple files, or other large changes.

Before starting any changes, you should create a fork of the PowerShell-Docs repository. The changes should be made in a working branch in you copy of the PowerShell-Docs. If you're using the **quick edit** method in GitHub, these steps are handled for you. If you're using the **full GitHub workflow**, you must be set up to work locally.

Both methods end with the creation of a Pull Request (PR). See Submitting a pull request for more information and best practices.

Contribute using GitHub Codespaces

Article • 05/17/2023

GitHub has a feature called Codespaces that you can use to contribute to the PowerShell documentation without having to install or configure any software locally. When you use a codespace, you get the same authoring tools the team uses for writing and editing.

You can use a codespace in your browser, making your contributions in VS Code hosted over the internet. If you have VS Code installed locally, you can connect to the codespace there too.

Available tools

When you use a codespace to contribute to the PowerShell documentation, your editor has these tools already available for you:

- Markdownlint for checking your Markdown syntax.
- cSpell for checking your spelling.
- Vale for checking your prose.
- The Learn Authoring Pack for inserting platform-specific syntax, previewing your contribution, and more.
- The Reflow Markdown extension for wrapping your Markdown as needed, making reading and editing easier.
- The Table Formatter extension for making your tables more readable without having to manually align columns.
- The change-case extension for converting the casing of your headings and prose.
- The GitLens extension for reviewing historical file changes.
- The PowerShell extension for interacting authoring PowerShell examples.
- The Gremlins tracker for Visual Studio Code for finding problematic characters in your Markdown.

Cost

GitHub Codespaces can be used for free up to 120 core-hours per month. With the configuration we recommend in this article, that means up to 60 hours of free usage per month. The monthly usage is calculated across all your repositories, not just documentation.

For more information about pricing, see About billing for GitHub Codespaces.

> **Tip**
>
> If you're comfortable using containers and Docker, you can get the same experience as using GitHub Codespaces in VS Code by using the devcontainer defined for the PowerShell documentation repositories. There's no cost associated with using devcontainers. For more information, see the **Dev Containers tutorial**.

Creating your GitHub Codespace

To create your GitHub Codespace for contributing to PowerShell documentation, follow these steps:

1. Open https://github.com/codespaces in your browser.
2. Select the "New codespace" button in the top right of the page.
3. In the "Create a new codespace" page, select the "Select a repository" button and type the name of the repository you want to contribute to, like `MicrosoftDocs/PowerShell-Docs`.
4. Leave all other settings as their default.
5. Select the "Create codespace" button.

After following these steps, GitHub creates a new codespace for that repository and sets it up for you. When the codespace is ready, the page refreshes and shows the web editor UI for the codespace. The UI is based on VS Code and works the same way.

Opening your GitHub Codespace

To open your GitHub Codespace in the browser, follow these steps:

1. Open https://github.com/codespaces in your browser.
2. The page lists your codespaces. Find the created codespace for the repository you want to contribute to and select it.

After you select your codespace, GitHub opens it in the same window. From here, you're ready to contribute.

To open your GitHub Codespace in VS Code, follow the steps in Using GitHub Codespaces in Visual Studio Code.

Authoring in your GitHub Codespace

Once you have your GitHub Codespace open in your browser or VS Code, contributing to the documentation follows the same process.

The rest of this article describes a selection of tasks you can do in your GitHub Codespace while writing or editing your contribution.

Extract a reference link

When you want to turn an inline link, like `[some text](destination.md)`, into a reference link like `[some text][01]`, select the link destination in the editor. Then you can either:

1. Right click on the link destination and select "Refactor..." in the context menu.
2. Press `Ctrl`+`Shift`+`R`.

Either action raises the refactoring context menu. Select "Extract to link definition" in the context menu. This replaces the `(destination.md)` in the link with `[def]`. You can rename the definition by typing a name in.

For the PowerShell documentation, we use two-digit numerical reference link definitions, like `[01]` or `[31]`. Only use reference link definitions in about topics and conceptual documentation. Don't use reference link definitions in cmdlet reference documentation.

Fix prose style violations

When you review an article in your codespace, Vale automatically checks the article when you first open it and every time you save it. If Vale finds any style violations, it highlights them in the document with colored squiggles.

Hover over a violation to see more information about it.

Select the rule's name in the hover information to open a web page that explains the rule. Select the rule's filename (ending in `.yml`) to open the rule and review its implementation.

If the rule supports a quick fix, you can select "Quick Fix..." in the hover information for the violation and apply one of the suggested fixes by selecting it from the context menu. You can also press `Ctrl`+`.` when your cursor is on a highlighted problem to apply a quick fix if the rule supports it.

If the rule doesn't support quick fixes, read the rule's message and fix it if you can. If you're not sure how to fix it, the editors can make a suggestion when reviewing your PR.

Fix syntax problems

When you review an article in your codespace, Markdownlint automatically checks the article when you open it and as you type. If Markdownlint finds any syntax problems, it highlights them in the document with colored squiggles.

Hover over a violation to see more information about it.

Select the rule's ID in the hover information to open a web page that explains the rule.

If the rule supports a quick fix, you can select "Quick Fix..." in the hover information for the violation and apply one of the suggested fixes by selecting it from the context menu. You can also press `Ctrl`+`.` when your cursor is on a highlighted problem to apply a quick fix if the rule supports it.

If the rule doesn't support quick fixes, read the rule's message and fix it if you can. If you're not sure how to fix it, the editors can make a suggestion when reviewing your PR.

You can also apply fixes to all syntax violations in an article. To do so, open the command palette and type `Fix all supported markdownlint violations in the document`. As you type, the command palette filters the available commands. Select the "Fix all supported markdownlint violations in the document" command. When you do, Markdownlint updates the document to resolve any violations it has a quick fix for.

Format a table

To format a Markdown table, place your cursor in or on the table in your Markdown. Open the Command Palette and search for the `Table: Format Current` command. When you select that command, it updates the Markdown for your table to align and pad the table for improved readability.

It converts a table defined like this:

markdown

```
| foo | bar | baz |
|:--:|:--|-:|
| a | b | c |
```

Into this:

markdown

```
|  foo  | bar  | baz  |
| :---: | :--- | ---: |
|   a   | b    |    c |
```

Insert an alert

The documentation uses alerts to make information more notable to a reader.

To insert an alert, you can, open the Command Palette and search for the `Learn: Alert` command. When you select that command, it opens a context menu. Select the alert type you want to add. When you do, the command inserts the alert's Markdown at your cursor in the document.

Make a heading use sentence casing

To convert a heading's casing, highlight the heading's text except for the leading `#` symbols, which set the heading level. When you have the text highlighted, open the Command Palette and search for the `Change case sentence` command. When you select that command, it converts the casing of the highlighted text.

You can also use the casing commands for any text in the document.

Open the Command Palette

You can use VS Code's Command Palette to run many helpful commands.

To open the Command Palette in the UI, select "View" in the top menu bar. Then select "Command Palette..." in the context menu.

To open the Command Palette with your keyboard, press the key combination for your operating system:

- Windows and Linux: `Ctrl`+`Shift`+`P`
- macOS: `Cmd`+`Shift`+`P`

Preview your contribution

To preview your contribution, open the Command Palette and search for the `Markdown: Open Preview` command. When you select that command, VS Code opens a preview of the active document. The preview's style matches the Learn platform.

> ⓘ **Note**
>
> Site-relative and cross-reference links won't work in the preview.

Reflow your content

To limit the line lengths for a paragraph in a document, place your cursor on the paragraph. Then open the Command Palette and search for the `Reflow Markdown` command. When you select the command, it updates the current paragraph's line lengths to the configured length. For our repositories, that length is 99 characters.

When using this command for block quotes, make sure the paragraph in the block quote you're reflowing is surrounded by blank lines. Otherwise, the command reflows every paragraph together.

> ⊗ **Caution**
>
> Don't use this command when editing about topics. The lines in those documents must not be longer than 80 characters. There's currently no way for a repository to configure different line lengths by folder or filename, so reflow doesn't work for about topic documents.

Review all problems in a document

To review all syntax and style rule violations in a document, open the Problems View.

To open the Problems View in the UI, select "View" in the top menu bar. Then select "Problems" in the context menu.

To open the Problems View with your keyboard, press the key combination for your operating system:

- Windows and Linux: `Ctrl`+`Shift`+`M`
- macOS: `Cmd`+`Shift`+`M`

The Problems View displays all errors, warnings, and suggestions for the open document. Select a problem to scroll to it in the document.

You can filter the problems by type or text matching.

Updating the ms.date metadata

To update the `ms.date` metadata for an article, open the Command Palette and search for the `Learn: Update "ms.date" Metadata Value` command. When you select the command, it updates the metadata to the current date.

Additional resources

The tasks and commands described in this article don't cover everything you can do with VS Code or the installed extensions.

For more information on using VS Code, see these articles:

- Visual Studio Code Tips and Tricks
- Basic Editing
- Using Git source control in VS Code
- Markdown and Visual Studio Code

For more information about the installed extensions, see their documentation:

- change-case
- GitLens
- Gremlins tracker for Visual Studio Code
- Learn Authoring Pack
- markdownlint
- Reflow Markdown
- Table Formatter

Markdown best practices

Article • 09/27/2022

This article provides specific guidance for using Markdown in our documentation. This is not a tutorial for Markdown, but list specific rules and best practice for Markdown in the PowerShell docs. If you need a tutorial for Markdown, see this Markdown cheatsheet.

Markdown specifics

The Microsoft Open Publishing System (OPS) that builds our documentation uses markdig to process the Markdown documents. Markdig parses the documents based on the rules of the latest CommonMark specification.

The CommonMark spec is much stricter about the construction of some Markdown elements. Pay close attention to the details provided in this document.

We use the markdownlint extension in VS Code to enforce our style and formatting rules. This extension is installed as part of the **Learn Authoring Pack**.

Blank lines, spaces, and tabs

Blank lines also signal the end of a block in Markdown.

- There should be a single blank between Markdown blocks of different types -- for example, between a paragraph and a list or header.
- Don't use more than one blank line. Multiple blank lines render as a single blank line in HTML and serve no purpose.
- Within a code block, consecutive blank lines break the code block.

Spacing is significant in Markdown.

- Remove extra spaces at the end of lines. Trailing spaces can change how Markdown renders.
- Always uses spaces instead of hard tabs.

Titles and headings

Only use ATX headings (# style, as opposed to `=` or `-` style headers).

- Use sentence case - only proper nouns and the first letter of a title or header should be capitalized

- There must be a single space between the `#` and the first letter of the heading
- Headings should be surrounded by a single blank line
- Only one H1 per document
- Header levels should increment by one -- don't skip levels
- Avoid using bold or other markup in headers

Limit line length to 100 characters

This applies to conceptual articles and cmdlet reference. Limiting the line length improves the readability of git diffs and history. It also makes it easier for other writers to make contributions.

Use the Reflow Markdown extension in VS Code to reflow paragraphs to fit the prescribed line length.

About_topics are limited to 80 characters. For more specific information, see Formatting About_ files.

Lists

If your list has multiple sentences or paragraphs, consider using a sublevel header rather than a list.

List should be surrounded by a single blank line.

Unordered lists

- Don't end list items with a period unless they contain multiple sentences.
- Use the hyphen character (`-`) for list item bullets. This avoids confusion with bold or italic markup that uses the asterisk (`*`).
- To include a paragraph or other elements under a bullet item, insert a line break and align indentation with the first character after the bullet.

For example:

markdown

```
This is a list that contain child elements under a bullet item.

- First bullet item

  Sentence explaining the first bullet.

  - Child bullet item
```

```
    Sentence explaining the child bullet.

- Second bullet item
- Third bullet item
```

This is a list that contains child elements under a bullet item.

- First bullet item

  Sentence explaining the first bullet.

  - Child bullet item

    Sentence explaining the child bullet.

- Second bullet item
- Third bullet item

Ordered lists

- All items in a numbered listed should use the number `1.` rather than incrementing each item.
  - Markdown rendering increments the value automatically.
  - This makes reordering items easier and standardizes the indentation of subordinate content.
- To include a paragraph or other elements under a numbered item, align indentation with the first character after the item number.

For example:

markdown

```
1. For the first element, insert a single space after the 1. Long sentences
should be wrapped to the
   next line and must line up with the first character after the numbered
list marker.

   To include a second element, insert a line break after the first and
align indentations. The
   indentation of the second element must line up with the first character
after the numbered list
   marker.

1. The next numbered item starts here.
```

The resulting Markdown is rendered as follows:

1. For the first element, insert a single space after the 1. Long sentences should be wrapped to the next line and must line up with the first character after the numbered list marker.

   To include a second element, insert a line break after the first and align indentations. The indentation of the second element must line up with the first character after the numbered list marker.

2. The next numbered item starts here.

Images

The syntax to include an image is:

```markdown
![[alt text]](<folderPath>)

Example:
![Introduction](./media/overview/Introduction.png)
```

Where `alt text` is a brief description of the image and `<folderPath>` is a relative path to the image.

- Alternate text is required to support screen readers for the visually impaired.
- Images should be stored in a `media/<article-name>` folder within the folder containing the article.
  - Create a folder that matches the filename of your article under the `media` folder. Copy the images for that article to that new folder.
- Don't share images between articles.
  - If an image is used by multiple articles, each folder must have a copy of that image.
  - This prevents a change to an image in one article affecting another article.

The following image file types are supported: `*.png`, `*.gif`, `*.jpeg`, `*.jpg`, `*.svg`

Markdown extensions supported by Open Publishing

The Learn Authoring Pack contains tools that support features unique to our publishing system. Alerts are a Markdown extension to create blockquotes that render with colors

and icons highlighting the significance of the content. The following alert types are supported:

```markdown
> [!NOTE]
> Information the user should notice even if skimming.

> [!TIP]
> Optional information to help a user be more successful.

> [!IMPORTANT]
> Essential information required for user success.

> [!CAUTION]
> Negative potential consequences of an action.

> [!WARNING]
> Dangerous certain consequences of an action.
```

These alerts look like this on Microsoft Learn:

Note block

> **Note**
>
> Information the user should notice even if skimming.

Tip block

> **Tip**
>
> Optional information to help a user be more successful.

Important block

> **Important**
>
> Essential information required for user success.

Caution block

> **Caution**

Negative potential consequences of an action.

Warning block

> **⚠ Warning**
>
> Dangerous certain consequences of an action.

Hyperlinks

- Hyperlinks must use Markdown syntax `[friendlyname](url-or-path)`.
- Link references are supported.
- The publishing system supports three types of links:
  - URL links
  - File links
  - Cross-reference links
- All URLs to external websites should use HTTPS unless that isn't valid for the target site.
- Links must have a friendly name, usually the title of the linked article
- Don't use backticks, bold, or other markup inside the brackets of a hyperlink.
- Bare URLs may be used when you're documenting a specific URI and must be enclosed in backticks. For example:

  markdown

  ```
  By default, if you don't specify this parameter, the DMTF standard
  resource URI
  `http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/` is used and the
  class name is appended to it.
  ```

URL-type Links

- URL links to other articles on `learn.microsoft.com` must use site-relative paths. The simplest way to create a relative link is to copy the URL from your browser then remove `https://learn.microsoft.com/en-us` from the value you paste into markdown.

- Don't include locales in URLs on Microsoft properties (remove `/en-us` from URL).
- Remove any unnecessary query parameters from the URL. Examples that should be removed:
  - `?view=powershell-5.1` - used to link to a specific version of PowerShell
  - `?redirectedfrom=MSDN` - added to the URL when you get redirected from an old article to its new location
- If you need to link to a specific version of a document, you must add the `&preserve-view=true` parameter to the query string. For example: `?view=powershell-5.1&preserve-view=true`
- URL links don't contain file extensions (for example, no `.md`)

File-type links

- A file link is used to link from one reference article to another, or from one conceptual article to another. If you need to link from a conceptual article to a reference article you must use a URL link.
- Use relative filepaths (for example: `../folder/file.md`)
- All file paths use forward-slash (`/`) characters
- Include the file extension (for example, `.md`)

Cross-reference links

Cross-reference links are a special feature supported by the publishing system. You can use cross-reference links in conceptual articles to link to .NET API or cmdlet reference.

- For links to .NET API reference, see Use links in documentation in the central Contributor Guide.

- Links to cmdlet reference have the following format: `xref:<module-name>.<cmdlet-name>`. For example, to link to the `Get-Content` cmdlet in the **Microsoft.PowerShell.Management** module.

  ```
  [Get-Content](xref:Microsoft.PowerShell.Management.Get-Content)
  ```

Deep linking

Deep linking is allowed on both URL and file links.

- The anchor text must be lowercase
- Add the anchor to the end of the target path. For example:
  - `[about_Splatting](about_Splatting.md#splatting-with-arrays)`

    - `[custom key bindings](https://code.visualstudio.com/docs/getstarted/keybindings#_custom-keybindings-for-refactorings)`

For more information, see Use links in documentation.

Next steps

PowerShell style guide

PowerShell-Docs style guide

Article • 11/15/2022

This article provides style guidance specific to the PowerShell-Docs content. It builds on the information outlined in the Overview.

Formatting command syntax elements

- Always use the full name for cmdlets and parameters. Avoid using aliases unless you're specifically demonstrating the alias.
- Property, parameter, object, type names, class names, class methods should be **bold**.
  - Property and parameter values should be wrapped in backticks (`).
  - When referring to types using the bracketed style, use backticks. For example: `[System.Io.FileInfo]`
- Language keywords, cmdlet names, functions, variables, native EXEs, file paths, and inline syntax examples should be wrapped in backtick (`) characters.

  For example:

  markdown

  ```
  The following code uses `Get-ChildItem` to list the contents of
  `C:\Windows` and assigns
  the output to the `$files` variable.

  ```powershell
  $files = Get-ChildItem C:\Windows
  ```
  ```

  - PowerShell keywords and operators should be all lowercase
  - Use proper (Pascal) casing for cmdlet names and parameters
  - When referring to a parameter by name, the name should be **bold**. When illustrating the use of a parameter with the hyphen prefix, the parameter should be wrapped in backticks. For example:

    markdown

    ```
    The parameter's name is **Name**, but it's typed as `-Name` when
    used on the command
    ```

```
line as a parameter.
```

- When showing example usage of an external command, the example should be wrapped in backticks. Always include the file extension in the native command. For example:

  ```
  markdown
  ```

  ```
  To start the spooler service on a remote computer named DC01, you
  type:
  `sc.exe \\DC01 start spooler`.
  ```

  Including the file extension ensures that the correct command is executed according to PowerShell's command precedence.

Markdown for code samples

Markdown supports two different code styles:

- **Code spans (inline)** - marked by a single backtick (`` ` ``) character. Used within a paragraph rather than as a standalone block.
- **Code blocks** - a multi-line block surrounded by triple-backtick (` ``` `) strings. Code blocks may also have a language label following the backticks. The language label enables syntax highlighting for the contents of the code block.

All code blocks should be contained in a code fence. Never use indentation for code blocks. Markdown allows this pattern but it can be problematic and should be avoided.

A code block is one or more lines of code surrounded by a triple-backtick (` ``` `) code fence. The code fence markers must be on their own line before and after the code sample. The opening marker may have an optional language label. The language label enables syntax highlighting on the rendered webpage.

For a full list of supported language tags, see Fenced code blocks in the centralized contributor guide.

Publishing also adds a **Copy** button that can copy the contents of the code block to the clipboard. This allows you to paste the code into a script to test the code sample. However, not all examples are intended to be run as written. Some code blocks are basic illustrations of PowerShell concepts.

There are three types code blocks used in our documentation:

1. Syntax blocks
2. Illustrative examples
3. Executable examples

Syntax code blocks

Syntax code blocks are used to describe the syntactic structure of a command. Don't use a language tag on the code fence. This example illustrates all the possible parameters of the `Get-Command` cmdlet.

markdown

````
```
Get-Command [-Verb <String[]>] [-Noun <String[]>] [-Module <String[]>]
  [-FullyQualifiedModule <ModuleSpecification[]>] [-TotalCount <Int32>] [-
Syntax]
  [-ShowCommandInfo] [[-ArgumentList] <Object[]>] [-All] [-ListImported]
  [-ParameterName <String[]>] [-ParameterType <PSTypeName[]>]
[<CommonParameters>]
```
````

This example describes the `for` statement in generalized terms:

markdown

````
```
for (<init>; <condition>; <repeat>)
{<statement list>}
```
````

Illustrative examples

Illustrative examples are used to explain a PowerShell concept. They aren't meant to be copied and pasted for execution. These are most commonly used for simple examples that are easy to understand. The code block can include the PowerShell prompt and example output.

Here's a simple example illustrating the PowerShell comparison operators. In this case, we don't intend the reader to copy and run this example.

markdown

````
```powershell
PS> 2 -eq 2
True
````
````

```
PS> 2 -eq 3
False

PS> 1,2,3 -eq 2
2

PS> "abc" -eq "abc"
True

PS> "abc" -eq "abc", "def"
False

PS> "abc", "def" -eq "abc"
abc
```

Executable examples

Complex examples, or examples that are intended to be copied and executed, should use the following block-style markup:

markdown

````
```powershell
<Your PowerShell code goes here>
```
````

The output displayed by PowerShell commands should be enclosed in an **Output** code block to prevent syntax highlighting. For example:

markdown

````
```powershell
Get-Command -Module Microsoft.PowerShell.Security
```

```Output
CommandType  Name                          Version    Source
-----------  ----                          -------    ------
Cmdlet       ConvertFrom-SecureString      3.0.0.0
Microsoft.PowerShell.Security
Cmdlet       ConvertTo-SecureString        3.0.0.0
Microsoft.PowerShell.Security
Cmdlet       Get-Acl                       3.0.0.0
Microsoft.PowerShell.Security
Cmdlet       Get-AuthenticodeSignature     3.0.0.0
Microsoft.PowerShell.Security
Cmdlet       Get-CmsMessage                3.0.0.0
Microsoft.PowerShell.Security
````
````

```
Cmdlet       Get-Credential              3.0.0.0
Microsoft.PowerShell.Security
Cmdlet       Get-ExecutionPolicy         3.0.0.0
Microsoft.PowerShell.Security
Cmdlet       Get-PfxCertificate          3.0.0.0
Microsoft.PowerShell.Security
Cmdlet       New-FileCatalog             3.0.0.0
Microsoft.PowerShell.Security
Cmdlet       Protect-CmsMessage          3.0.0.0
Microsoft.PowerShell.Security
Cmdlet       Set-Acl                     3.0.0.0
Microsoft.PowerShell.Security
Cmdlet       Set-AuthenticodeSignature   3.0.0.0
Microsoft.PowerShell.Security
Cmdlet       Set-ExecutionPolicy         3.0.0.0
Microsoft.PowerShell.Security
Cmdlet       Test-FileCatalog            3.0.0.0
Microsoft.PowerShell.Security
Cmdlet       Unprotect-CmsMessage        3.0.0.0
Microsoft.PowerShell.Security
```

The **Output** code label isn't an official "language" supported by the syntax highlighting system. However, this label is useful because our publishing system adds the "Output" label to the code box frame on the web page. The "Output" code box has no syntax highlighting.

Coding style rules

Avoid line continuation in code samples

Avoid using line continuation characters (`` ` ``) in PowerShell code examples. These are hard to see and can cause problems if there are extra spaces at the end of the line.

- Use PowerShell splatting to reduce line length for cmdlets that have several parameters.
- Take advantage of PowerShell's natural line break opportunities, like after pipe (`|`) characters, opening braces (`{`), parentheses (`(`), and brackets (`[`).

Avoid using PowerShell prompts in examples

Use of the prompt string is discouraged and should be limited to scenarios that are meant to illustrate command-line usage. For most of these examples, the prompt string should be `PS>`. This prompt is independent of OS-specific indicators.

Prompts are required in examples to illustrate commands that alter the prompt or when the path displayed is significant to the scenario. The following example illustrates how the prompt changes when using the Registry provider.

PowerShell

```
PS C:\> cd HKCU:\System\
PS HKCU:\System\> dir

    Hive: HKEY_CURRENT_USER\System

Name                   Property
----                   --------
CurrentControlSet
GameConfigStore        GameDVR_Enabled                         : 1
                       GameDVR_FSEBehaviorMode                 : 2
                       Win32_AutoGameModeDefaultProfile        : {2, 0, 1,
0...}
                       Win32_GameModeRelatedProcesses          : {1, 0, 1,
0...}
                       GameDVR_HonorUserFSEBehaviorMode        : 0
                       GameDVR_DXGIHonorFSEWindowsCompatible : 0
```

Don't use aliases in examples

Use the full name of all cmdlets and parameters unless you're specifically documenting the alias. Cmdlet and parameter names must use the proper Pascal-cased names.

Using parameters in examples

Avoid using positional parameters. In general, you should always include the parameter name in an example, even if the parameter is positional. This reduces the chance of confusion in your examples.

Formatting cmdlet reference articles

Cmdlet reference articles have a specific structure. This structure is defined by PlatyPS. PlatyPS generates the cmdlet help for PowerShell modules in Markdown. After editing the Markdown files, PlatyPS is used create the MAML help files used by the `Get-Help` cmdlet.

PlatyPS has a schema that expects a specific structure for cmdlet reference. The platyPS.schema.md document attempts to describe this structure. Schema violations cause build errors that must be fixed before we can accept your contribution.

- Don't remove any of the ATX header structures. PlatyPS expects a specific set of headers.
- The **Input type** and **Output type** headers must have a type. If the cmdlet doesn't take input or return a value, then use the value `None`.
- Inline code spans can be used in any paragraph.
- Fenced code blocks are only allowed in the **EXAMPLES** section.

In the PlatyPS schema, **EXAMPLES** is an H2 header. Each example is an H3 header. Within an example, the schema doesn't allow code blocks to be separated by paragraphs. The schema allows the following structure:

```
### Example X - Title sentence

0 or more paragraphs
1 or more code blocks
0 or more paragraphs.
```

Number each example and add a brief title.

For example:

markdown

````
### Example 1: Get cmdlets, functions, and aliases

This command gets the PowerShell cmdlets, functions, and aliases that are
installed on the
computer.

```powershell
Get-Command
```

### Example 2: Get commands in the current session

```powershell
Get-Command -ListImported
```
````

Formatting About_ files

`About_*` files are written in Markdown but are shipped as plain text files. We use Pandoc to convert the Markdown to plain text. `About_*` files are formatted for the best compatibility across all versions of PowerShell and with the publishing tools.

Basic formatting guidelines:

- Limit paragraph lines to 80 characters
- Limit code blocks to 76 characters
- Limit blockquotes and alerts to 78 characters
- When using these special meta-characters `\`, `$`, and `<`:
  - Within a header, these characters must be escaped using a leading `\` character or enclosed in code spans using backticks (`` ` ``)
  - Within a paragraph, these characters should be put into code spans. For example:

    ```markdown
    ### The purpose of the \$foo variable

    The `$foo` variable is used to store ...
    ```

- Markdown tables
  - For `About_*` topics, tables must fit within 76 characters
    - If the content doesn't fit within 76 character limit, use bullet lists instead
  - Use opening and closing `|` characters on each line

Next steps

Editorial checklist

Editor's checklist

Article • 11/16/2022

This is a summary of rules to apply when writing new or updating existing articles. See other articles in the Contributor's Guide for detailed explanations and examples of these rules.

Metadata

- `ms.date`: must be in the format **MM/DD/YYYY**
  - Change the date when there is a significant or factual update
    - Reorganizing the article
    - Fixing factual errors
    - Adding new information
  - Don't change the date if the update is insignificant
    - Fixing typos and formatting
- `title`: unique string of 43-59 characters long (including spaces)
  - Don't include site identifier (it's autogenerated)
  - Use sentence case - capitalize only the first word and any proper nouns
- `description`: 115-145 characters including spaces - this abstract displays in the search result

Formatting

- Backtick syntax elements that appear, inline, within a paragraph
  - Cmdlet names `Verb-Noun`
  - Variable `$counter`
  - Syntactic examples `Verb-Noun -Parameter`
  - File paths `C:\Program Files\PowerShell`, `/usr/bin/pwsh`
  - URLs that aren't meant to be clickable in the document
  - Property or parameter values
- Use bold for property names, parameter names, class names, module names, entity names, object or type names
  - Bold is used for semantic markup, not emphasis
  - Bold - use asterisks `**`
- Italic - use underscore `_`
  - Only used for emphasis, not for semantic markup
- Line breaks at 100 columns (or at 80 for **about_Topics**)

- No hard tabs - use spaces only
- No trailing spaces on lines
- PowerShell keywords and operators should be all lowercase
- Use proper (Pascal) casing for cmdlet names and parameters

Headers

- H1 is first - only one H1 per article
- Use ATX Headers only
- Use sentence case for all headers
- Don't skip levels - no H3 without an H2
- Max depth of H3 or H4
- Blank line before and after
- PlatyPS enforces specific headers in its schema - don't add or remove headers

Code blocks

- Blank line before and after
- Use tagged code fences - **powershell**, **Output**, or other appropriate language ID
- Untagged fence - syntax blocks or other shells
- Put output in separate code block except for basic examples where you don't intend the for the reader to use the **Copy** button
- See list of supported languages

Lists

- Indented properly
- Blank line before first item and after last item
- Bullet - use hyphen (`-`) not asterisk (`*`) to reduce confusion with emphasis
- For numbered lists, all numbers are "1."

Terminology

- PowerShell vs. Windows PowerShell
- See Product Terminology

Cmdlet reference examples

- Must have at least one example in cmdlet reference

- Examples should be just enough code to demonstrate the usage
- PowerShell syntax
  - Use full names of cmdlets and parameters - no aliases
  - Use splatting for parameters when the command line gets too long
  - Avoid using line continuation backticks - only use when necessary
- Remove or simplify the PowerShell prompt (`PS>`) except where required for the example
- Cmdlet reference example must follow the following PlatyPS schema

  markdown

  ````
  ### Example 1 - Descriptive title

  Zero or more short descriptive paragraphs explaining the context of the
  example followed by one or
  more code blocks. Recommend at least one and no more than two.

  ```powershell
  ... one or more PowerShell code statements ...
  ```

  ```Output
  Example output of the code above.
  ```

  Zero or more optional follow up paragraphs that explain the details of
  the code and output.
  ````

- don't put paragraphs between the code blocks. All descriptive content must come before or after the code blocks.

Linking to other documents

- When linking outside the docset or between cmdlet reference and conceptual
  - Use site-relative URLs when linking to Microsoft Learn (remove `https://learn.microsoft.com/en-us`)
  - don't include locales in URLs on Microsoft properties (eg. remove `/en-us` from URL)
  - All URLs to external websites should use HTTPS unless that's not valid for the target site
- When linking within the docset
  - Use the relative filepath (e.g. `../folder/file.md`)

- All paths use forward-slash (`/`) characters
- Image links should have unique alt text

Product terminology and branding guidelines

Article • 11/15/2022

When writing about any product it's important to correctly and consistently use product names and terminology. This guide defines product names and terminology related to PowerShell. Note the capitalization of specific words or use cases.

PowerShell (collective name)

Use **PowerShell** to describe the scripting language and an interactive shell.

PowerShell (product name)

The cross-platform version of PowerShell that's built on .NET (core), rather than the .NET Framework. PowerShell can be installed on Windows, Linux, and macOS.

PowerShell Core (product deprecated)

The name used for PowerShell v6, built on .NET Core. This name shouldn't be used.

Windows PowerShell (product name)

The version of PowerShell that ships in Windows, which requires the full .NET Framework.

Guidelines

- First mention - use "Windows PowerShell"
- Subsequent mentions - Use "PowerShell" unless the use case requires "Windows PowerShell" to be more specific:

  > In PowerShell, the `Invoke-WebRequest` cmdlet returns **BasicHtmlWebResponseObject**

  > In Windows PowerShell, the `Invoke-WebRequest` cmdlet returns **HtmlWebResponseObject**

PowerShell modules

PowerShell modules are add-ons that containing PowerShell cmdlets that manage specific products or services.

For example:

- Azure PowerShell
- Az.Accounts module
- Windows management module
- Hyper-V module
- Microsoft Graph PowerShell SDK
- Exchange PowerShell

Guidelines

- Always use the collective name or the more specific module name when referring to a PowerShell module
- Never refer to a module as "PowerShell"

Azure PowerShell (collective name)

The branded group of products containing PowerShell modules used to manage Azure.

There are several versions of Azure PowerShell products available. Each product contains multiple named modules.

Guidelines

- Use "Azure PowerShell" as the collective name for the product
- Always use the collective name, never just "PowerShell"
- Use the more specific product name when referring to a specific version

Az PowerShell (product name)

The currently supported collection of modules for use with Azure.

AzureRM PowerShell (product name)

The earlier collection of modules that use the Azure Resource Manager model for managing Azure resources. This product is deprecated and will not be supported after February 29, 2024.

Azure Service Management PowerShell (product name)

The earliest collection of modules is for managing legacy Azure resources that use Service Management APIs.

Azure PowerShell-related products

These products are used to manage Azure resources but aren't included in one of the Azure PowerShell product collections.

- Azure Active Directory PowerShell
- Azure Information Protection PowerShell
- Azure Deployment Manager PowerShell
- Azure Elastic Database Jobs PowerShell
- Azure Service Fabric PowerShell
- Azure Stack PowerShell

Guidelines

- Always use the full proper name of the product or the specific PowerShell module name

Other PowerShell-related products

Visual Studio Code (VS Code)

This is Microsoft's free, open source editor.

Guidelines

- First mention - use the full name
- Subsequent mentions - you can use "VS Code"
- Never use "VSCode"

PowerShell Extension for Visual Studio Code

The extension turns VS Code into the preferred IDE for PowerShell.

Guidelines

- First mention - use the full name
- Subsequent mentions - you can use "PowerShell extension"

How to file a PowerShell-Docs issue

Article • 09/19/2022

There are two ways to create an issue:

1. Use the feedback controls at the bottom of the page.
2. File an issue in GitHub directly

Using the feedback controls

For a full description of the feedback controls, see the Docs Team blog announcing this feature.

At the bottom of most pages on `learn.microsoft.com`, you'll see two feedback buttons. One is a link for product feedback and one is for documentation feedback. The documentation feedback requires a GitHub account. Clicking the button takes you in GitHub and presents an issue template. Enter your feedback and submit the form.

> **Note**
>
> The feedback tool not a support channel. This is a way to ask questions to clarify documentation or to report errors and omissions. If you need technical support, see **Community resources**.

Filing issues on GitHub

To file a GitHub issue directly, you can click the New issue button in the PowerShell-Docs repository. Click the **Get started** button for the issue you want to create. The GitHub issue template helps you provide the information needed to address the problem you're reporting.

Before you file a new issue, read through existing issues to see if your problem has already been reported. This helps avoid duplication and your issue may have been answered already. If you find an existing issue, you can add your comments, related questions, or answers.

Next steps

See Get started writing.

Additional resources

How we manage issues

How to submit pull requests

Article • 09/19/2022

To make changes to content, submit a pull request (PR) from your fork. A pull request must be reviewed before it can be merged. For best results, review the editorial checklist before submitting your pull request.

Using git branches

The default branch for PowerShell-Docs is the `main` branch. Changes made in working branches are merged into the `main` branch before then being published. The `main` branch is merged into the `live` branch every weekday at 3:00 PM (Pacific Time). The `live` branch contains the content that is published to `learn.microsoft.com`.

Before starting any changes, create a working branch in your local copy of the PowerShell-Docs repository. When working locally, be sure to synchronize your local repository before creating your working branch. The working branch should be created from an update-to-date copy of the `main` branch.

All pull requests should target the `main` branch. Don't submit change to the `live` branch. Changes made in the `main` branch get merged into `live`, overwriting any changes made to `live`.

Make the pull request process work better for everyone

The simpler and more focused you can make your PR, the faster it can be reviewed and merged.

Avoid pull requests that update large numbers of files or contain unrelated changes

Avoid creating PRs that contain unrelated changes. Separate minor updates to existing articles from new articles or major rewrites. Work on these changes in separate working branches.

Bulk changes create PRs with large numbers of changed files. Limit your PRs to a maximum of 50 changed files. Large PRs are difficult to review and are more prone to contain errors.

Renaming or deleting files

When renaming or deleting files, there must be an issue associated with the PR. That issue must discuss the need to rename or delete the files.

Avoid mixing content additions or change with file renames and deletes. Any file that's renamed or deleted must be added to the global redirection file. When possible, update any files that link to the renamed or deleted content, including any TOC files.

Avoid editing repository configuration files

Avoid modifying repository configuration files. Limit your changes where possible to the Markdown content files and any supporting image files needed for the content.

Incorrect modifications to repository configuration files can break the build, introduce vulnerabilities or accessibility issues, or violate organizational standards. Repository configuration files are any files that match one or more of these patterns:

- `*.yml`
- `.github/**`
- `.localization-config`
- `.openpublishing*`
- `LICENSE*`
- `reference/docfx.json`
- `reference/mapping/**`
- `tests/**`
- `ThirdPartyNotices`
- `tools/**`

For safety and security, if you believe you have discovered a bug or potential improvement for a repository configuration file, file an issue. The maintainers will review and implement any fixes or improvements as needed.

Use the PR template

When you create a PR, a template is automatically inserted into the PR body for you. It looks like this:

Markdown

```
# PR Summary
```

```
<!--
    Delete this comment block and summarize your changes and list
    related issues here. For example:

    This changes fixes problem X in the documentation for Y.

    - Fixes #1234
    - Resolves #1235
-->

## PR Checklist

<!--
    These items are mandatory. For your PR to be reviewed and merged,
    ensure you have followed these steps. As you complete the steps,
    check each box by replacing the space between the brackets with an
    x or by clicking on the box in the UI after your PR is submitted.
-->

- [ ] **Descriptive Title:** This PR's title is a synopsis of the changes it
proposes.
- [ ] **Summary:** This PR's summary describes the scope and intent of the
change.
- [ ] **Contributor's Guide:** I have read the [contributors guide]
[contrib].
- [ ] **Style:** This PR adheres to the [style guide][style].

<!--
    If your PR is a work in progress, please mark it as a draft or
    prefix it with "(WIP)" or "WIP:"

    This helps us understand whether or not your PR is ready to review.
-->

[contrib]: /powershell/scripting/community/contributing/overview
[style]: /powershell/scripting/community/contributing/powershell-style-guide
```

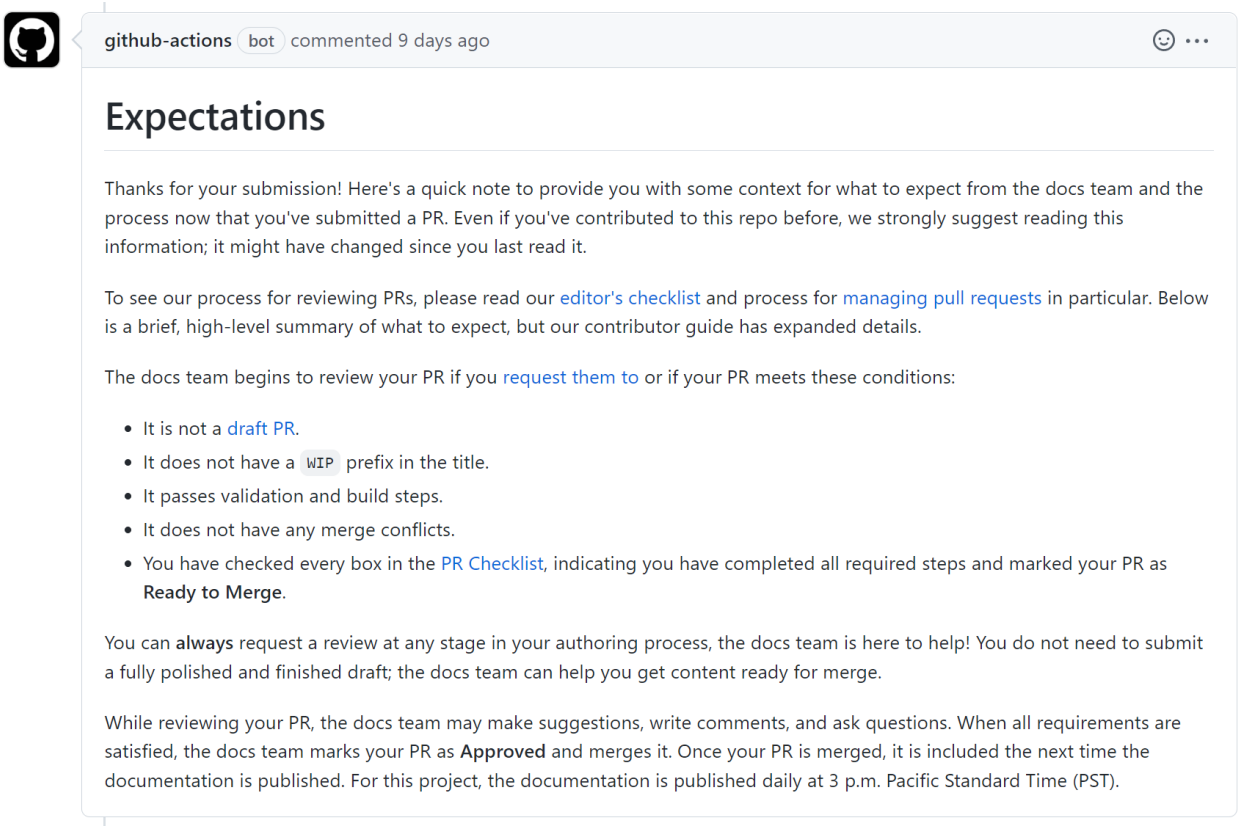
In the "PR Summary" section, write a short summary of your changes and list any related issues by their issue number, like `#1234`. If your PR fixes or resolves the issue, use GitHub's autoclose feature so the issue is automatically closed when your PR is merged.

Review the items in the "PR Checklist" section and check them off as you complete each one. You must follow the directions and check each item for the team to approve your PR.

If your PR is a work-in-progress, set it to draft mode or prefix your PR title with `WIP`.

Expectations Comment

After you submit your PR, a bot will comment on your PR to provide you with resources and to set expectations for the rest of the process. Always review this comment, even if you've contributed before, because it contains accurate and up-to-date information.



github-actions bot commented 9 days ago

Expectations

Thanks for your submission! Here's a quick note to provide you with some context for what to expect from the docs team and the process now that you've submitted a PR. Even if you've contributed to this repo before, we strongly suggest reading this information; it might have changed since you last read it.

To see our process for reviewing PRs, please read our editor's checklist and process for managing pull requests in particular. Below is a brief, high-level summary of what to expect, but our contributor guide has expanded details.

The docs team begins to review your PR if you request them to or if your PR meets these conditions:

- It is not a draft PR.
- It does not have a `WIP` prefix in the title.
- It passes validation and build steps.
- It does not have any merge conflicts.
- You have checked every box in the PR Checklist, indicating you have completed all required steps and marked your PR as **Ready to Merge**.

You can **always** request a review at any stage in your authoring process, the docs team is here to help! You do not need to submit a fully polished and finished draft; the docs team can help you get content ready for merge.

While reviewing your PR, the docs team may make suggestions, write comments, and ask questions. When all requirements are satisfied, the docs team marks your PR as **Approved** and merges it. Once your PR is merged, it is included the next time the documentation is published. For this project, the documentation is published daily at 3 p.m. Pacific Standard Time (PST).

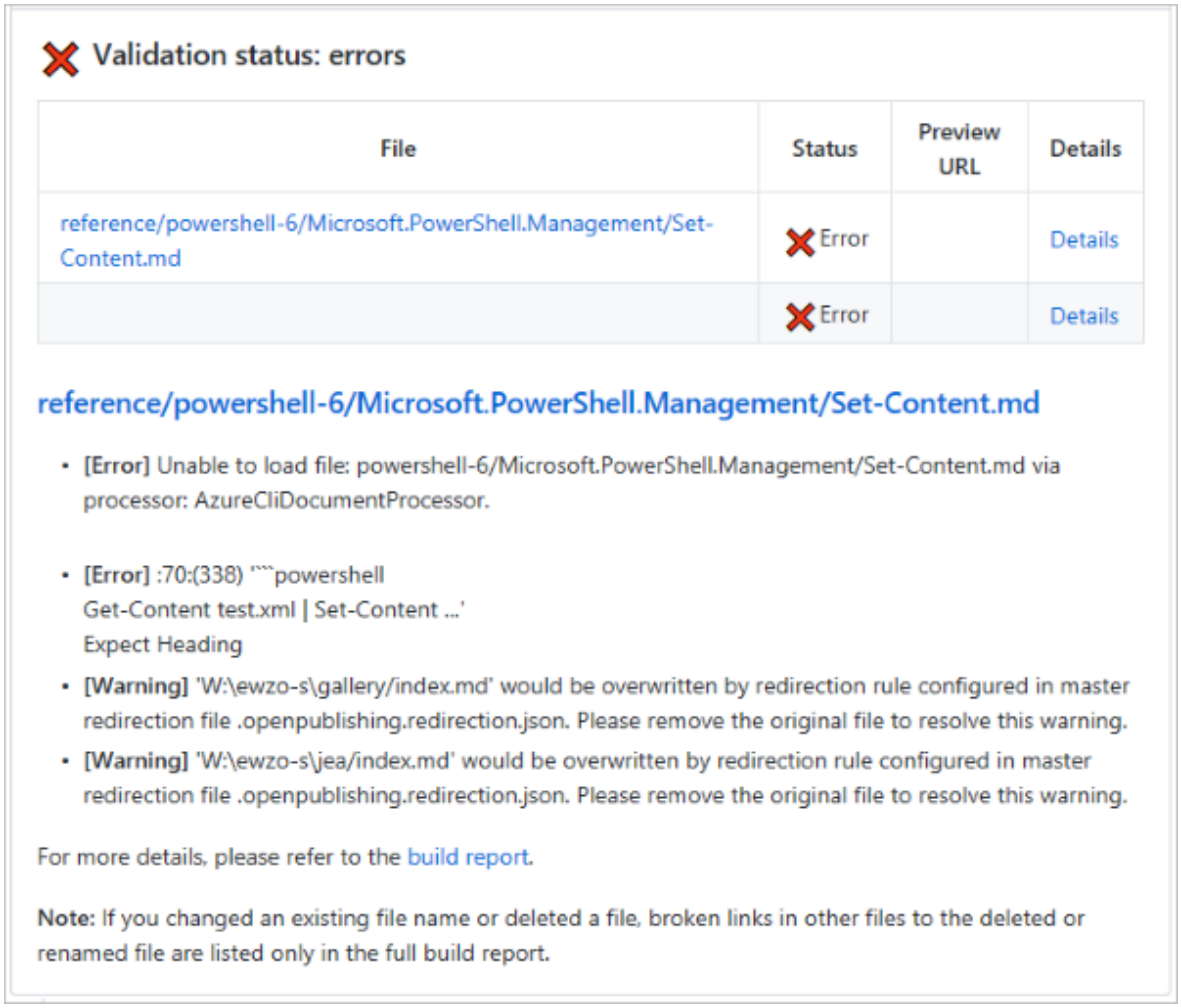
Docs PR validation service

The Docs PR validation service is a GitHub app that runs validation rules on your changes. You must fix any errors or warnings reported by the validation service.

You'll see the following behavior:

1. You submit a PR.

2. In the GitHub comment that indicates the status of your PR, you'll see the status of "checks" enabled on the repository. In this example, there are two checks enabled, "Commit Validation" and "OpenPublishing.Build":

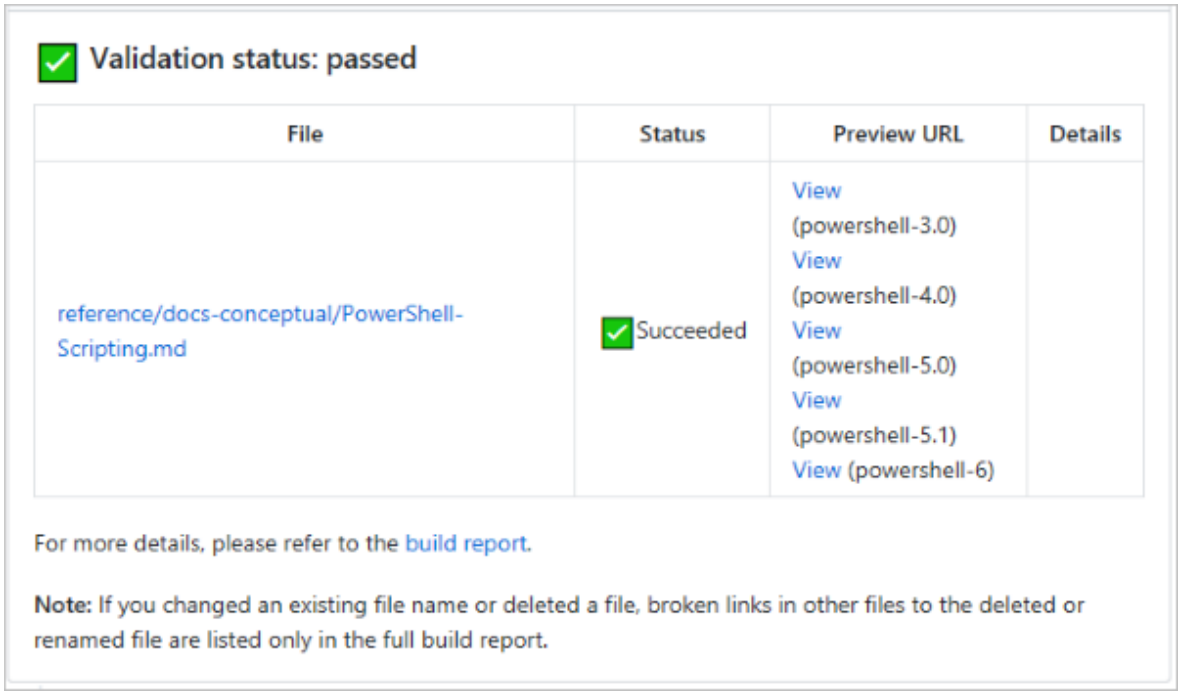


The build can pass even if commit validation fails.

3. Click **Details** for more information.

4. On the Details page, you'll see all the validation checks that failed, with information about how to fix the issues.

5. When validation succeeds, the following comment is added to the PR:



> **Note**
>
> If you are an external (not a Microsoft employee) contributor you don't have access to the detailed build reports or preview links.

When the PR is reviewed, you may be asked to make changes or fix validation warning messages. The PowerShell-Docs team can help you understand validation errors and editorial requirements.

GitHub Actions

Several different GitHub Actions run against your changes to validate and provide context for you and the reviewers.

Checklist verification

If your PR is not in draft mode and is not prefixed with `WIP`, a GitHub Action inspects your PR to verify that you have checked every item in the PR template's checklist. If this check fails, the team won't review or merge your PR. The checklist items are mandatory.

Authorization verification

If your PR targets the `live` branch or modifies any repository configuration files, a GitHub Action checks your permissions to verify that you are authorized to submit those changes.

Only repository administrators are authorized to target the `live` branch or modify repository configuration files.

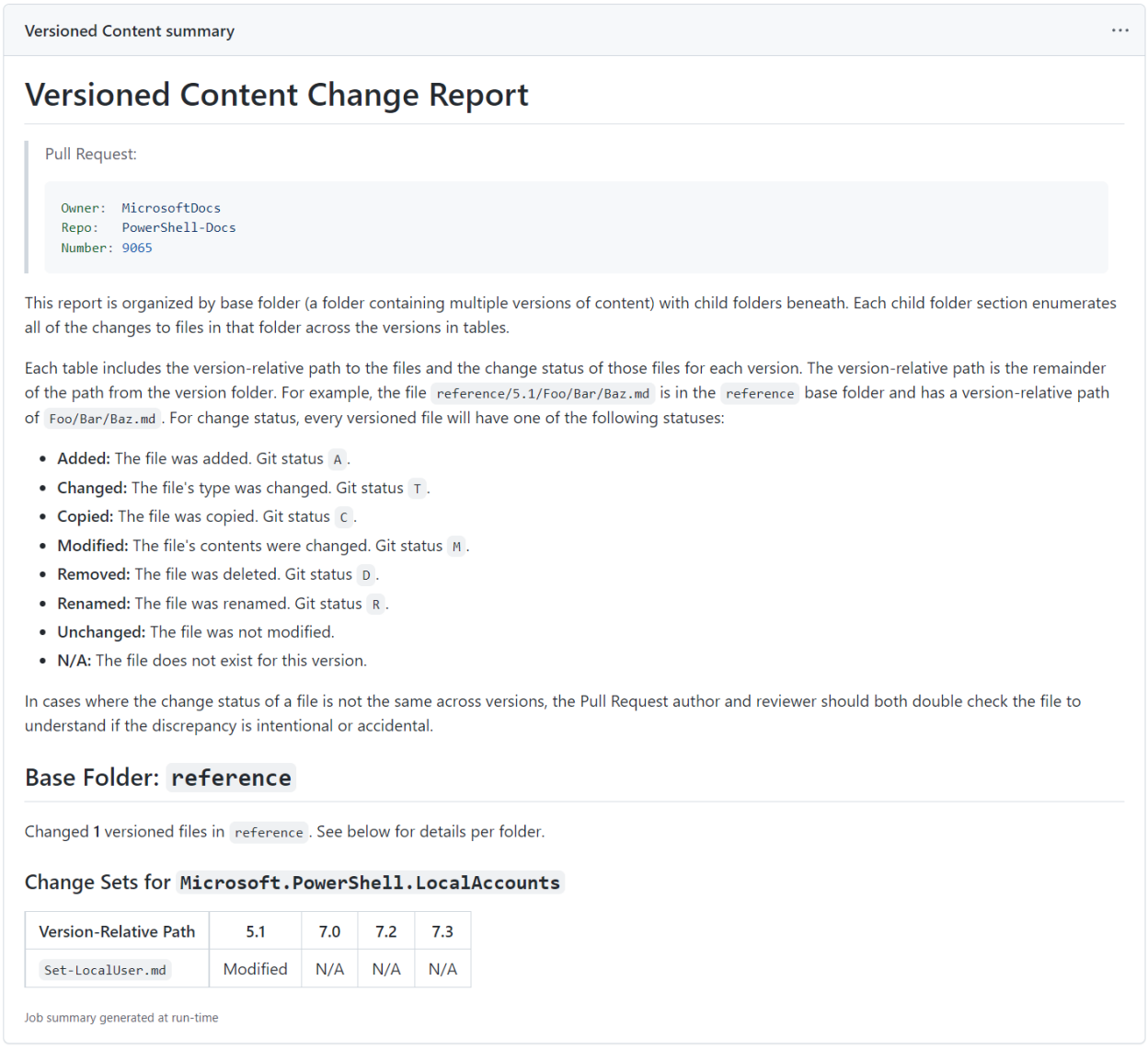
Versioned content change reporting

If your PR adds, removes, or modifies any versioned content a GitHub Action analyzes your changes and writes a report summarizing the types of changes made to versioned content.

This report is useful for seeing if there are other versions of the file(s) you modified and whether or not those versions have also been updated in the changeset.

To find the versioned content report for your PR:

1. Selecting the "Checks" tab on your PR page.
2. Select the "Reporting" job from the list of jobs.
3. Select the "..." button in the top right.
4. Select "View job summary."



Next steps

PowerShell-Docs style guide

Additional resources

How we manage pull requests

Contributing quality improvements

Article • 06/28/2023

For Hacktoberfest 2022, we piloted a process for contributing quality improvements to the PowerShell content. This guide continues and generalizes that process, providing a low-friction way for community members to contribute and collaborate on GitHub through enhancing the quality of documentation.

We're focusing on these quality areas:

- Formatting code samples
- Formatting command syntax
- Link References
- Markdown linting
- Spelling

Project Tracking

We're tracking contributions with the PowerShell Docs Quality Contributions GitHub Project.

The project page has several views for the issues and PRs related to this effort:

- The Open issues view shows all open issues.
- The Completed view shows merged PRs.
- The PowerShell view shows open issues for documentation in the PowerShell-Docs, PowerShell-Docs-DSC, and PowerShell-Docs-Modules repositories.
- The Windows PowerShell view shows open issues for documentation in the windows-powershell-docs repository.
- The Azure PowerShell view shows open issues for documentation in the azure-docs-powershell repository.
- The Open PRs view shows all open PRs.

Formatting code samples

All code samples should follow the style guidelines for PowerShell content. Those rules are repeated in abbreviated form here for convenience:

- All code blocks should be contained in a triple-backtick code fence (```).

- Line length for code blocks is limited to `90` characters except in About topics, where it's limited to `76` characters.
- Avoid using line continuation characters (`` ` ``) in PowerShell code examples.
  - Use splatting or natural line break opportunities, like after pipe (`|`) characters, opening braces (`}`), parentheses (`(`), and brackets (`[`) to limit line length.
- Only include the PowerShell prompt for illustrative examples where the code is not intended for copy-pasting.
- Don't use aliases in examples unless you're specifically documenting the alias.
- Avoid using positional parameters. Use the parameter name, even if the parameter is positional.

Formatting command syntax

All prose should follow the style guidelines for PowerShell content. Those rules are repeated here for convenience:

- Always use the full name for cmdlets and parameters. Avoid using aliases unless you're specifically demonstrating the alias.
- Property, parameter, object, type names, class names, class methods should be **bold**.
  - Property and parameter values should be wrapped in backticks (`` ` ``).
  - When referring to types using the bracketed style, use backticks. For example: `[System.Io.FileInfo]`
- PowerShell module names should be **bold**.
- PowerShell keywords and operators should be all lowercase.
- Use proper (Pascal) casing for cmdlet names and parameters.
- When referring to a parameter by name, the name should be **bold**. When illustrating the use of a parameter with the hyphen prefix, the parameter should be wrapped in backticks.
- When showing example usage of an external command, the example should be wrapped in backticks. Always include the file extension of the external command.

Link references

For maintainability and readability of the markdown source for our documentation, we're converting our conceptual documentation to use link references instead of inline links.

For example, instead of:

```
```

Markdown

```
The [Packages tab][31] displays all available
packages in the PowerShell Gallery.
```

It should be:

Markdown

```
The [Packages tab][31] displays all available packages in the PowerShell
Gallery.
```

> **Note**
>
> When you replace an inline link, reflow the content to wrap at 100 characters. You can use the **reflow-markdown** VS Code extension to do this quickly.

At the bottom of the file, add a markdown comment before the definition of the links.

Markdown

```
<!-- Link references -->
[01]: https://www.powershellgallery.com/packages
```

Make sure that:

1. The links are defined in the order they appear in the document.
2. Every link points to the correct location.
3. The link reference definitions are at the bottom of the file after the markdown comment and are in the correct order.

Markdown linting

For any article in one of the participating repositories, opening the article in VS Code displays linting warnings. Address any of these warnings you find, except:

- MD022/blanks-around-headings/blanks-around-headers for the `Synopsis` header in cmdlet reference documents. For those items, the rule violation is intentional to ensure the documentation builds correctly with PlatyPS.

Make sure of the line lengths and use the Reflow Markdown extension to fix any long lines.

Spelling

Sometimes, despite our best efforts, typos and misspellings get through and end up in the documentation. These mistakes make documentation harder to follow and localize. Fixing these mistakes makes the documentation more readable, especially for non-English speakers who rely on accurate translations.

Process

We encourage you to choose one or more of the quality areas and an article (or group of articles) to improve. Once you've decided what articles and content areas you want to work on, follow these steps:

1. Check the project for issues filed for this effort to avoid duplicating efforts.

2. Open a new issue in the appropriate repository:

   - Open an issue in MicrosoftDocs/PowerShell-Docs for PowerShell reference and conceptual content.
   - Open an issue in MicrosoftDocs/PowerShell-Docs-Dsc for DSC content
   - Open an issue in MicrosoftDocs/PowerShell-Docs-Modules for Crescendo, PlatyPS, PSScriptAnalyzer, SecretManagement, and SecretStore content.
   - Open an issue in MicrosoftDocs/azure-docs-powershell for Azure PowerShell content.
   - Open an issue in MicrosoftDocs/windows-powershell-docs for Windows PowerShell module content.

3. Follow our contributor's guide to get setup for making your changes.

4. Submit your pull request. Ensure:

   a. Your PR title has the `Quality:` prefix.

   b. Your PR body references the issue it resolves as an unordered list item and uses one of the linking keywords.

      For example, if you're working on issue `123`, the body of your PR should include the following Markdown:

      ```Markdown
      - resolves #123
      ```

The content developers will review your work as soon as they can to help you get it merged.

Hacktoberfest and other hack-a-thon events

Article • 10/04/2022

Hacktoberfest is an annual worldwide event held during October. The event encourages open source developers to contribute to repositories through pull requests (PR). GitHub hosts many open source repositories that contribute to Microsoft Learn content. Several repositories actively participate in Hacktoberfest.

How to contribute

Before you can contribute to an open source repo, you must first configure your account to contribute to Microsoft Learn. If you have never completed this process, start by signing up for a GitHub account. Be sure to install Git and the Markdown tools.

To get credit for participation, register with Hacktoberfest and read their participation guide.

Find a repo that needs your help

The PowerShell-Docs team is supporting Hacktoberfest contributions for several PowerShell documentation repositories. We have defined a set of cleanup tasks designed to be simple for first time contributors. Full information can be found in the Hacktoberfest meta-issue.

To be successful with these tasks, you should:

- Have a general understanding of PowerShell syntax
- Have an understanding of splatting
- Be able to read and follow the PowerShell-Docs style guide and Editorial checklist
- Basic familiarity with Markdown

Before contributing should read the meta-issue. When you are ready to start, open a new issue using the Hacktoberfest issue template (linked below):

- MicrosoftDocs/PowerShell-Docs
- MicrosoftDocs/PowerShell-Docs-DSC
- MicrosoftDocs/PowerShell-Docs-Modules
- MicrosoftDocs/windows-powershell-docs
- MicrosoftDocs/azure-docs-powershell

Quality expectations

To have a successful contribution to an open source Microsoft Learn repository, create a meaningful and impactful PR. The following examples from the official Hacktoberfest site are considered ***low-quality contributions***:

- PRs that are automated (for example, scripted opening PRs to remove whitespace, fix typos, or optimize images)
- PRs that are disruptive (for example, taking someone else's branch or commits and making a PR)
- PRs that are regarded by a project maintainer as a hindrance vs. helping
- A submission that's clearly an attempt to simply +1 your PR count for October

Finally, one PR to fix a typo is fine, but five PRs to remove a stray whitespace are not.

For more information, see Hacktoberfest: Values.

Open a PR

A *PR* provides a convenient way for a contributor to propose a set of changes. When opening a PR, specify in the original comment that it's intended to contribute to *hacktoberfest*. Successful PRs have these common characteristics:

- The PR adds value.
- The contributor is receptive to feedback.
- The intended changes are well articulated.
- The changes are related to an existing issue.

If you're proposing a PR without a corresponding issue, create an issue first. For more information, see GitHub: About pull requests.

See also

- Git and GitHub essentials for Microsoft Learn documentation
- Official Hacktoberfest site

How we manage issues

Article • 11/10/2022

This article documents how we manage issues in the PowerShell-Docs repository. This article is designed to be a job aid for members of the PowerShell-Docs team. It's published here to provide process transparency for our public contributors.

Sources of issues

- Community contributors
- Internal contributors
- Transcriptions of comments from social media channels
- Feedback via the Docs feedback form

Response time targets

80% of new issues are closed within 3 business days.

- Triaged - 1 business days
- Fix or change - 10 business days

Labeling & Milestones

Label Types

- **Area** - Identifies the part of PowerShell or the docs that the issue is discussing
- **Issue** - The type of issue: like bug, feedback, or idea
- **Priority** - The priority of the issue; value range 0-3 (high-low)
- **Quality** - The quality improvement effort the issue commits to resolving
- **Status** - The status of the work item or why it was closed
- **Tag** - Used to for additional classification like availability or doc-a-thons
- **Waiting** - Shows that we're waiting on some external person or event

For more information on specific labels, see Labeling.

Milestones

Issues and PRs should be tagged with the appropriate milestone. If the issue doesn't apply to a specific version, then no milestone is used. PRs and related issues for changes

that have yet to be merged into the PowerShell code base should be assigned to the **Future** milestone. After the code change has been merged, change the milestone to the appropriate version.

Milestone	Description
7.0.0	Work items related to PowerShell 7.0
7.2.0	Work items related to PowerShell 7.2
7.3.0	Work items related to PowerShell 7.3
Future	Work items a future version of PowerShell

Triage process

PowerShell docs team members review the issues daily and triage new issues as they arrive. The team meets weekly to discuss difficult issues need triage and prioritize the work.

Misplaced product feedback

- Enter a comment redirecting the customer to the correct feedback channel.
- Optional: Copy the issue to the appropriate product feedback location, add a link to the copied item, and close the issue.

  The default location for PowerShell issues is https://github.com/PowerShell/PowerShell/issues/new/choose .

Support requests

- If the support question is simple, answer it politely and close the issue.
- If the question is more complicated, or the submitter replies with more questions, redirect them to forums and support channels. Suggested text for redirecting to forums:

  Markdown

  ```
  > This is not the right forum for these kinds of questions. Try posting
  your question in a
  > community support forum. For a list of community forums see:
  > https://learn.microsoft.com/powershell/scripting/community/community-
  support
  ```

Code of conduct violations

- Edit the issue to remove any offensive content, if necessary
- Enter a comment indicating the issue is spam, close the issue, and then lock it to prevent further comments
- Each violation should be discussed in the weekly triage to determine the need for further action

Managing pull requests

Article • 09/19/2022

This article documents how we manage pull requests in the PowerShell-Docs repository. This article is designed to be a job aid for members of the PowerShell-Docs team. It's published here to provide process transparency for our public contributors.

Best practices

- The person submitting the PR shouldn't merge the PR without a peer review.
- Assign the peer reviewer when the PR is submitted. Early assignment allows the reviewer to respond sooner with editorial remarks.
- Use comments to describe the nature of the change being submitted. Be sure to @mention the reviewer. For example, if the change is minor and you don't need a full technical review, explain this in a comment.
- Reviewers should use the comment suggestion feature, when appropriate, to make it easier for the author to accept the suggested change. For more information, see Reviewing proposed changes in a pull request.

PR Process steps

1. Writer: Create PR
    - Fill out the PR template
    - Link any issues resolved by the PR
    - Use GitHub's autoclose feature to close the issue
    - Work through and check off each item in the checklist
2. Writer: Assign peer reviewer
3. Reviewer: proofreads and comments (as necessary)
4. Writer: Incorporate review feedback
5. Both: Review preview rendering
6. Both: Review validation report - fix warnings and errors
7. Reviewer: Mark review "Approved"
8. Repo Admin: Merge PR (see below for criteria)

Content Reviewer Checklist

See the editorial checklist for a more comprehensive list.

- Proofread for grammar, style, concision, technical accuracy
- Ensure examples still apply for the target version
- Check Preview rendering
- Check metadata - ms.date, remove ms.assetid, ensure required fields
- Validate markdown correctness
  - See style guide for content-specific formatting rules
- Reorganize examples as follows:
  - Intro sentence(s)
  - Code and output
  - Detailed explanation of code (as necessary)
- Check hyperlinks for accuracy
  - Replace or remove TechNet/MSDN links
  - Ensure minimum number of redirects to target
  - Ensure HTTPS
  - Correct link type
    - File links for local files
    - URL links for files outside of the docset
  - Remove locales from URLs
  - Simplify URLs pointing to `learn.microsoft.com`
- Verify versioned content is correct across all versions
  - Review the versioned content change report to see summarized changes

Branch Merge Process

The `main` branch is the only branch that's merged into `live`. Merges from short-lived (working) branches should be squashed.

Merge from/to	***release-branch***	***main***	***live***
working-branch	squash and merge	squash and merge	Not allowed
release-branch	—	merge	Not allowed
main	rebase	—	merge

PR Merger checklist

- Content review complete
- Correct target branch for the change
- No merge conflicts
- All validation and build step pass

    - Warnings and suggestions should be fixed (see Notes for exceptions)
    - No broken links
    - The Checklist action ran and passed
    - If an Authorization check was triggered, it passed
- Merge according to table

Notes

The following warnings can be ignored:

```
Can't find service name for `<version>/<modulepath>/About/About.md`
```

```
Metadata with following name(s) are not allowed to be set in Yaml header, or
as file level
metadata in docfx.json, or as global metadata in docfx.json: `locale`. They
are generated by
Docs platform, so the values set in these 3 places will be ignored. Please
remove them from all
3 places to resolve the warning.
```

When a PR is merged, the HEAD of the target branch is changed. Any open PRs that were based on the previous HEAD are now outdated. The outdated PR can be merged using Admin rights to override the merge warnings in GitHub. This is safe to do if the previously merged PRs haven't touched the same files. Clicking the **Update Branch** button is the safest option. Choose **Update with rebase** option. For more information see Updating your pull request branch.

Publishing to Live

Periodically, the changes accumulated in the `main` branch need to be published to the live website.

- The `main` branch is merged to `live` each weekday at 3pm PST.
- The `main` branch should be merged to `live` after any significant change.
    - Changes to 50 or more files
    - After merging a release branch
    - Changes to repo or docset configurations (docfx.json, OPS configs, build scripts, etc.)

- Changes to the redirection file
- Changes to the TOC
- After merging a "project" branch (content reorg, bulk update, etc.)

Labelling in GitHub

Article • 02/03/2023

This article documents how we label issues and pull requests in the PowerShell-Docs repository. This article is designed to be a job aid for members of the PowerShell-Docs team. It's published here to provide process transparency for our public contributors.

Labels always have a name and a description that is prefixed with their type.

Area labels

Area labels identify the parts of PowerShell or the documentation that the issue relates to.

Label	Related Content
`area-about`	The `about_*` topic articles.
`area-archive`	The Microsoft.PowerShell.Archive module.
`area-cim`	The CimCmdlets module.
`area-community`	Community-facing projects, including the contributor's guide and monthly updates.
`area-conceptual`	Conceptual (non-reference) articles.
`area-console`	The console host
`area-core`	The Microsoft.PowerShell.Core module.
`area-crescendo`	The Crescendo module.
`area-debugging`	Debugging PowerShell.
`area-diagnostics`	The Microsoft.PowerShell.Diagnostics module.
`area-dsc`	PowerShell Desired State Configuration.
`area-editorsvcs`	The PowerShell editor services.
`area-engine`	The PowerShell engine.
`area-error-handling`	Error handling in PowerShell
`area-experimental`	PowerShell's experimental features

Label	Related Content
`area-gallery`	The PowerShell Gallery.
`area-helpsystem`	The Help services, including the pipeline and `*-Help` cmdlets.
`area-host`	The Microsoft.PowerShell.Host module.
`area-ise`	The PowerShell ISE.
`area-jea`	The Just Enough Administration feature.
`area-language`	The PowerShell syntax and keywords.
`area-learn`	The structured training content for PowerShell.
`area-localaccounts`	The Microsoft.PowerShell.LocalAccounts module.
`area-localization`	Localization problems or opportunities for the content.
`area-management`	The Microsoft.PowerShell.Management module.
`area-native-cmds`	Using native commands in PowerShell.
`area-omi`	Open Management Infrastructure & CDXML.
`area-ops-issue`	Building and rendering the content on the site.
`area-other`	Miscellaneous modules.
`area-overview`	The overview section in the conceptual content.
`area-packagemanagement`	The PackageManagement module.
`area-parallelism`	Content covering parallel processing, such as using `ForEach-Object` or PowerShell Jobs.
`area-platyps`	The PlatyPS module.
`area-portability`	Cross-platform compatibility.
`area-powershellget`	The PowerShellGet module.
`area-providers`	PowerShell providers.
`area-psreadline`	The PSReadline module.
`area-release-notes`	The PowerShell release notes.
`area-remoting`	The PowerShell remoting feature and cmdlets.

Label	Related Content
`area-scriptanalyzer`	The PSScriptAnalyzer module.
`area-sdk-docs`	The conceptual documentation for the PowerShell SDK.
`area-sdk-ref`	The .NET API reference documentation for the PowerShell SDK.
`area-security`	The Microsoft.PowerShell.Security module and security concepts in general.
`area-setup`	Installing and configuring PowerShell.
`area-threadjob`	The ThreadJob module.
`area-utility`	The Microsoft.PowerShell.Utility module.
`area-versions`	Issues with the versioning of the documentation.
`area-vscode`	The VS Code PowerShell extension.
`area-wincompat`	The Windows Compatibility feature.
`area-wmf`	The Windows Management Framework.
`area-workflow`	The Windows PowerShell Workflow feature.

Issue labels

Issue labels distinguish issues by purpose.

Label	Issue Category
`issue-doc-bug`	Errors or ambiguities in the content
`issue-doc-idea`	Requests for new content
`issue-kudos`	Praise, positive feedback, or thanks rather than work items
`issue-product-feedback`	Feedback or problems with the product itself
`issue-question`	Support questions

Priority labels

Priority labels rank which work items need to be worked on before others. These labels are only used when needed to manage large sets of work items.

Label	Priority Level
`Pri0`	Highest
`Pri1`	High
`Pri2`	Medium
`Pri3`	Low

Project Labels

Project labels indicate what ongoing GitHub Project a work item is related to. These labels are used for automatically adding work items to a project on creation.

Label	Project
`project-quality`	The quality improvement project

Quality labels

Quality labels categorize work items for the quality improvement effort.

Label	Improvement
`quality-aliases`	Ensure cmdlet aliases are documented
`quality-format-code-samples`	Ensure proper casing, line length, and other formatting in code samples
`quality-format-command-syntax`	Ensure proper casing and formatting for command syntax
`quality-link-references`	Ensure links in conceptual docs are defined as numbered references
`quality-markdownlint`	Ensure content follows markdownlint rules
`quality-spelling`	Ensure proper casing and spelling for words

Status labels

Status labels indicate why a work item was closed or shouldn't be merged. Issues are only given status labels when they're closed without a related PR.

Label	Status
`resolution-answered`	Closed by existing documentation
`resolution-duplicate`	Closed as duplicate issue
`resolution-external`	Closed by customer or outside resource
`resolution-no-repro`	Unable to reproduce the reported issue
`resolution-refer-to-support`	Closed and referred to community or product support
`resolution-wont-fix`	Closed as won't fix

Tag labels

Tag labels add independent context for work items.

Label	Purpose
`in-progress`	Someone is actively working on the item
`go-live`	The work item is related to a specific release
`doc-a-thon`	The work item is related to a doc-a-thon
`up-for-grabs`	Any contributor may volunteer to resolve the work item
`hacktoberfest-accepted`	The PR is accepted for inclusion in #hacktoberfest
`hacktoberfest-candidate`	The PR is a candidate for inclusion in #hacktoberfest
`needs-triage`	The issue needs to be triaged by the team before it is ready to be worked
`code-of-conduct`	Closed for spam, trolling, or code of conduct violations
`do-not-merge`	The PR isn't meant to be merged

Waiting labels

Waiting labels indicate that a work item can't be resolved until an external condition is met.

Label	Waiting For

Label	Waiting For
`hold-for-pr`	Upstream PR to be merged
`hold-for-release`	Upstream product to release
`needs-investigation`	Waiting for team member to verify or research
`needs-more-info`	Additional details or clarification from work item author
`needs-response`	Response from work item author
`review-shiproom`	Shiproom discussion with the PowerShell team

PowerShell Support Lifecycle

Article • 06/22/2023

> **Note**
>
> This document is about support for PowerShell. Windows PowerShell (1.0 - 5.1) is a component of the Windows operating system. Components receive the same support as their parent product or platform. For more information, see **Product and Services Lifecycle Information**.

PowerShell is supported under the Microsoft Modern Lifecycle Policy, but support dates are linked to .NET and .NET Core Support Policy. In this servicing approach, customers can choose Long Term Support (LTS) releases or current releases.

An **LTS** release of PowerShell is built on an LTS release of .NET. Updates to an LTS release only contain critical security updates and servicing fixes that are designed to minimize impact to existing workloads. LTS releases of PowerShell are supported until the end-of-support for .NET.

A **current** release is a release that occurs between LTS releases. Current releases can contain critical fixes, innovations, and new features. A current release is supported for six months after the next release (current or LTS).

> **Important**
>
> You must have the latest patch update installed to qualify for support. For example, if you're running PowerShell 7.3 and 7.3.1 has been released, you must update to 7.3.1 to qualify for support.

Supported platforms

PowerShell runs on multiple operating systems (OS) and processor architectures. To be supported by Microsoft, the OS must meet the following criteria:

- The version and processor architecture of the OS is supported by .NET Core.
- The version of the OS is supported for at least one year.
- The version of the OS isn't an interim release or equivalent.
- The version of the OS is currently supported by the OS publisher.
- The PowerShell team has tested the version of the distribution.

When a platform version reaches end-of-life as defined by the platform owner, PowerShell also ends support on that platform version. Previously released packages remain available for customers needing access but formal support and updates of any kind are no longer be provided.

Windows

The following table is a list of PowerShell releases and the versions of Windows they're supported on. These versions are supported until either the version of PowerShell reaches end-of-support or the version of Windows reaches end-of-support.

- The ✅ icon indicates that the version of the OS or PowerShell is still supported
- The 🟡 icon indicates the version of PowerShell is no longer supported on that version of the OS
- The 🚧 icon indicates that we haven't finished testing PowerShell on that OS
- The ❌ icon indicates that the version of the OS or PowerShell isn't supported
- When both the version of the OS and the version of PowerShell have a ✅ icon, that combination is supported

Windows	7.2 (LTS-current)	7.3	7.4 (preview)
✅ Windows Server 2016, 2019, or 2022	✅	✅	✅
✅ Windows Server 2012 R2	✅	✅	✅
✅ Windows Server Core (2012 R2 or higher)	✅	✅	✅
✅ Windows Server Nano (1809 or higher)	✅	✅	✅
✅ Windows 11	✅	✅	✅
✅ Windows 10 1607+	✅	✅	✅

> ⓘ Note
>
> Support for a specific version of Windows is determined by the Microsoft Support Lifecycle policies. For more information, see:
>
> - Windows client lifecycle FAQ
> - Modern Lifecycle Policy FAQ

PowerShell is supported on Windows for the following processor architectures.

Windows	7.2 (LTS-current)	7.3	7.4 (preview)

Windows	7.2 (LTS-current)	7.3	7.4 (preview)
Nano Server Version 1803+	x64	x64	x64
Windows Server 2012 R2+	x64, x86	x64, x86	x64, x86
Windows Server Core 2012 R2+	x64, x86	x64, x86	x64, x86
Windows 10 or 11 Client	x64, x86, Arm64	x64, x86, Arm64	x64, x86, Arm64

macOS

The following table contains a list of PowerShell releases and the status of support for versions of macOS. These versions remain supported until either the version of PowerShell reaches end-of-support or the version of macOS reaches end-of-support.

- The ✅ icon indicates that the version of the OS or PowerShell is still supported
- The 🟡 icon indicates the version of PowerShell is no longer supported on that version of the OS
- The 🚧 icon indicates that we haven't finished testing PowerShell on that OS
- The ❌ icon indicates that the version of the OS or PowerShell isn't supported
- When both the version of the OS and the version of PowerShell have a ✅ icon, that combination is supported

macOS	7.2 (LTS-current)	7.3	7.4 (preview)
✅ Big Sur 11.5	✅	✅	✅

macOS 12 (Monterey) and macOS 13 (Ventura) have not been tested.

Support of macOS is defined by Apple. For more information, see:

- macOS release notes
- Apple Security Updates

PowerShell is supported on macOS for the following processor architectures:

macOS	7.2 (LTS-current)	7.3	7.4 (preview)
macOS Big Sur 11.5	x64, Arm64	x64, Arm64	x64, Arm64

Alpine Linux

The following table lists the supported PowerShell releases and the versions of Alpine they're supported on. These versions are supported until either the version of PowerShell reaches end-of-support or the version of Alpine reaches end-of-life.

- The ✅ icon indicates that the version of the OS or PowerShell is still supported
- The 🟡 icon indicates the version of PowerShell is no longer supported on that version of the OS
- The 🚧 icon indicates that we haven't finished testing PowerShell on that OS
- The ❌ icon indicates that the version of the OS or PowerShell isn't supported
- When both the version of the OS and the version of PowerShell have a ✅ icon, that combination is supported

Alpine	7.2 (LTS-current)	7.3	7.4 (preview)
✅ 3.15	🚧	🚧	🚧
✅ 3.14	✅	✅	✅

Alpine 3.15 is in the process of being tested.

PowerShell is supported on Alpine for the following processor architectures.

Alpine	7.2 (LTS-current)	7.3	7.4 (preview)
All supported versions	x64	x64	x64

PowerShell hasn't been tested on Alpine using Arm processors.

Debian Linux

The following table is a list of currently supported PowerShell releases and the versions of Debian they're supported on. These versions remain supported until either the version of PowerShell reaches end-of-support or the version of Debian reaches end-of-life.

- The ✅ icon indicates that the version of the OS or PowerShell is still supported
- The 🟡 icon indicates the version of PowerShell is no longer supported on that version of the OS
- The 🚧 icon indicates that we haven't finished testing PowerShell on that OS
- The ❌ icon indicates that the version of the OS or PowerShell isn't supported
- When both the version of the OS and the version of PowerShell have a ✅ icon, that combination is supported

Debian	7.2 (LTS-current)	7.3	7.4 (preview)
✅ 11	✅	✅	✅
✅ 10	✅	✅	✅

PowerShell is supported on Debian for the following processor architectures.

Debian	7.2 (LTS-current)	7.3	7.4 (preview)
Version 9+	x64	x64	x64

Red Hat Enterprise Linux (RHEL)

The following table is a list of currently supported versions of PowerShell and the versions of RHEL they're supported on. These versions remain supported until either the version of PowerShell reaches end-of-support or the version of RHEL reaches end-of-support.

- The ✅ icon indicates that the version of the OS or PowerShell is still supported
- The 🟡 icon indicates the version of PowerShell is no longer supported on that version of the OS
- The 🚧 icon indicates that we haven't finished testing PowerShell on that OS
- The ❌ icon indicates that the version of the OS or PowerShell isn't supported
- When both the version of the OS and the version of PowerShell have a ✅ icon, that combination is supported

RHEL	7.2 (LTS-current)	7.3	7.4 (preview)
✅ 9	✅	✅	✅
✅ 8	✅	✅	✅
✅ 7	✅	✅	❌

PowerShell is supported on RHEL for the following processor architectures.

RHEL	7.2 (LTS-current)	7.3	7.4 (preview)
All supported versions	x64	x64	x64

Ubuntu Linux

The following table is a list of currently supported PowerShell releases and the versions of Ubuntu they're supported on. These versions remain supported until either the version of PowerShell reaches end-of-support or the version of Ubuntu reaches end-of-support.

- The ✅ icon indicates that the version of the OS or PowerShell is still supported
- The 🟡 icon indicates the version of PowerShell is no longer supported on that version of the OS
- The 🚧 icon indicates that we haven't finished testing PowerShell on that OS
- The ❌ icon indicates that the version of the OS or PowerShell isn't supported
- When both the version of the OS and the version of PowerShell have a ✅ icon, that combination is supported

Ubuntu	7.2 (LTS-current)	7.3	7.4 (preview)
✅ 22.04 (LTS)	✅	✅	✅
✅ 20.04 (LTS)	✅	✅	✅
✅ 18.04 (LTS)	✅	✅	✅

Only the LTS releases of Ubuntu are officially supported. Microsoft does not support interim releases or their equivalent. Interim releases are community supported. For more information, see Community supported distributions.

PowerShell is supported on Ubuntu for the following processor architectures.

Ubuntu	7.2 (LTS-current)	7.3	7.4 (preview)
All supported versions	x64, Arm32	x64, Arm32	x64, Arm32

Raspberry Pi OS

Raspberry Pi OS (formerly Raspbian) is a free operating system based on Debian.

> **Important**
>
> .NET isn't supported on ARMv6 architecture devices, including Raspberry Pi Zero and Raspberry Pi devices prior to Raspberry Pi 2.

Windows PowerShell Compatibility

The support lifecycle for PowerShell doesn't cover modules that ship outside of the PowerShell release package. For example, using the `ActiveDirectory` module that ships as part of Windows Server is supported under the Windows Support Lifecycle.

Experimental features

Experimental features are limited to community support.

Notes on licensing

PowerShell is released under the MIT license. Under this license, and without a paid support agreement, users are limited to community support. With community support, Microsoft makes no guarantees of responsiveness or fixes.

Getting support

Support for PowerShell is delivered via traditional Microsoft support agreements, including paid support, Microsoft Enterprise Agreements, and Microsoft Software Assurance. You can also pay for assisted support for PowerShell by filing a support request for your problem.

There are also community support options. You can file an issue, bug, or feature request on GitHub. Also, you can get help from other members of the community in the Microsoft PowerShell Tech Community or any of the community forums listed on the PowerShell hub page. If you have a problem that requires immediate attention, you should use the traditional, paid support options.

> **Important**
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PowerShell End-of-support dates

Based on these lifecycle policies, the following table lists the dates when support for the current versions of PowerShell end:

Version	Release Date	End-of-support

Version	Release Date	End-of-support
7.4 (preview)	December 20, 2022	TBD
7.3 (Stable)	November 9, 2022	May 8, 2024
7.2 (LTS-current)	November 8, 2021	November 8, 2024

Support for PowerShell on a specific platform is based on the support policy of the version of .NET used.

- PowerShell 7.3 (Stable) is based on the .NET 7.0 Supported OS Lifecycle Policy
- PowerShell 7.2 (LTS-current) is based on the .NET 6.0 Supported OS Lifecycle Policy

End of support dates for already retired versions were:

Version	Release Date	End-of-support
7.0 (LTS)	March 4, 2020	December 3, 2022
7.1	November 11, 2020	May 8, 2022
6.2	March 28, 2019	September 4, 2020
6.1	September 13, 2018	September 28, 2019
6.0	January 20, 2018	February 13, 2019

Release history

The following table contains a timeline of the major releases of PowerShell. This table is provided for historical reference. It isn't intended for use to determine the support lifecycle.

Version	Release Date	Note
PowerShell 7.4 (preview)	Dec-2022	Built on .NET 8.0.0-preview
PowerShell 7.3	Nov-2022	Built on .NET 7.0
PowerShell 7.2 (LTS-current)	Nov-2021	Built on .NET 6.0 (LTS-current)

Version	Release Date	Note
PowerShell 7.1	Nov-2020	Built on .NET 5.0
PowerShell 7.0 (LTS)	Mar-2020	Built on .NET Core 3.1 (LTS)
PowerShell 6.2	Mar-2019	Built on .NET Core 2.1
PowerShell 6.1	Sep-2018	Built on .NET Core 2.1
PowerShell 6.0	Jan-2018	First release, built on .NET Core 2.0. Installable on Windows, Linux, and macOS
Windows PowerShell 5.1	Aug-2016	Released in Windows 10 Anniversary Update and Windows Server 2016, WMF 5.1
Windows PowerShell 5.0	Feb-2016	Released in Windows Management Framework (WMF) 5.0
Windows PowerShell 4.0	Oct-2013	Integrated in Windows 8.1 and with Windows Server 2012 R2, WMF 4.0
Windows PowerShell 3.0	Oct-2012	Integrated in Windows 8 and with Windows Server 2012 WMF 3.0
Windows PowerShell 2.0	Jul-2009	Integrated in Windows 7 and Windows Server 2008 R2, WMF 2.0
Windows PowerShell 1.0	Nov-2006	Optional component of Windows Server 2008

Run the following command to see the full version number of .NET used by the version of PowerShell you're running:

PowerShell

```
[System.Runtime.InteropServices.RuntimeInformation]::FrameworkDescription
```