PowerShell Core Fundamentals

WELCOME!

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Over 16 years ago, we embarked on a journey to improve the world by making learning technology easy and accessible to everyone.

...impacts everyone daily.

And it's working. Today, we're known for delivering customized tech learning programs that drive innovation and transform organizations.

In fact, when you talk on the phone, watch a movie, connect with friends on social media, drive a car, fly on a plane, shop online, and order a latte with your mobile app, you are experiencing the impact of our solutions.

Technologies we cover

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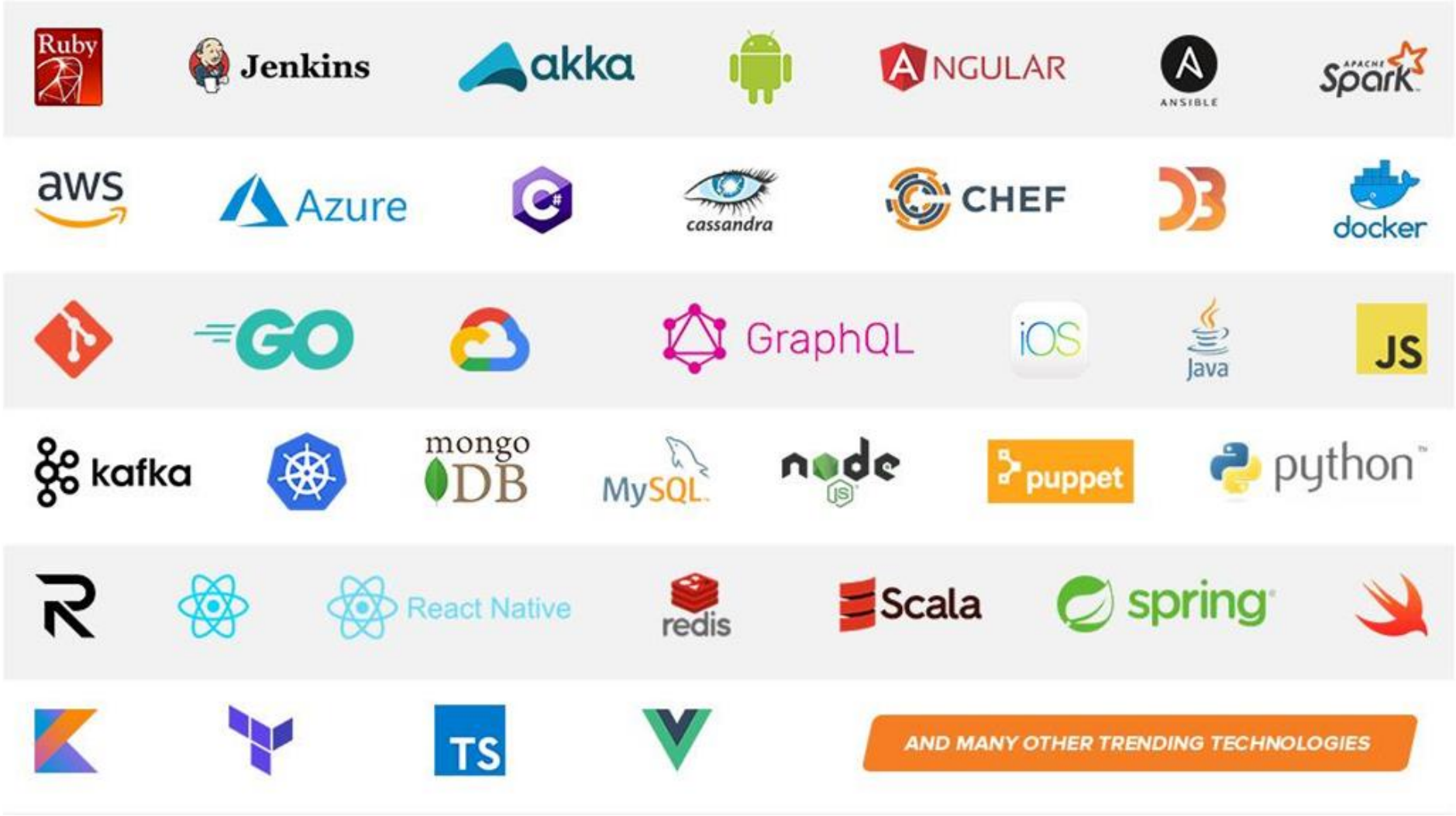
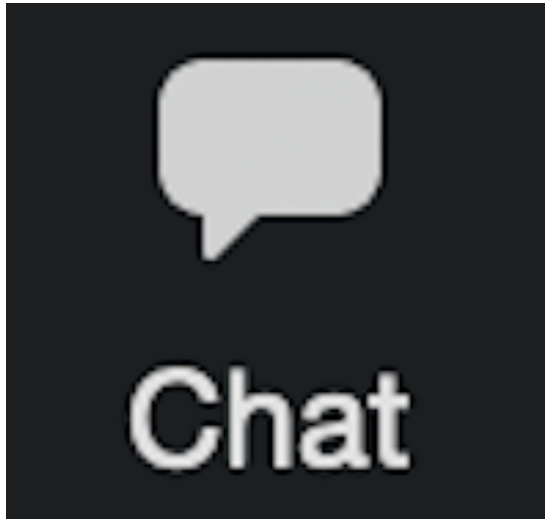


World Class Practitioners

Virtual Training Expectations for You

Arrive on time / return on time

Mute unless speaking



Use chat or ask questions verbally

Virtual Training Expectations for Me

I pledge to:

- Make this as interesting and interactive as possible
- Ask questions in order to stimulate discussion
- Use whatever resources I have at hand to explain the material
- Try my best to manage verbal responses so that everyone who wants to speak can do so

Quick review of key Zoom features that may be helpful for our course

Purpose

- Deepen understanding of PowerShell mechanics and automation options
- Explore various types of ad hoc scripting using PowerShell
- Explore building reusable scripts for execution and schedule
- Explore & practice remote management using PowerShell

Objectives

Upon completion of this course, you should be able to:

- Utilize PowerShell for retrieving key information about a Windows system using various search and filter techniques
- Demonstrate the ability to effectively leverage PowerShell for automating specific tasks
- Combine PowerShell modules and cmdlets to create scripts for automating more sophisticated workflows

Let's Get to Know One Another

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Tell me about you:
- Name
- Current role
- How long you've been at the company
- Development or scripting background?
- What's one thing you're hoping to get out of this course?

I'll tell you a little about me…

Introduction

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What is PowerShell

From Microsoft docs:

What is PowerShell?

05/22/2020 • 5 minutes to read • 

PowerShell is a cross-platform task automation and configuration management framework, consisting of a command-line shell and scripting language. Unlike most shells, which accept and return text, PowerShell is built on top of the .NET Common Language Runtime (CLR), and accepts and returns .NET objects. This fundamental change brings entirely new tools and methods for automation.

PowerShell Features

- Output is object-based vs. scalar-based
- Command family is extensible
- Handles console input and display
- Supports ad hoc and named/reusable scripting

PowerShell Features

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- Supports “piping” for chaining together cmdlets for more complex tasks
- Rich querying and filtering capabilities
- Supports scheduled automation and remote management
- Provides modules for many, many types of admin workloads
- With latest versions, now supports Linux and macOS

PowerShell – Up and Running

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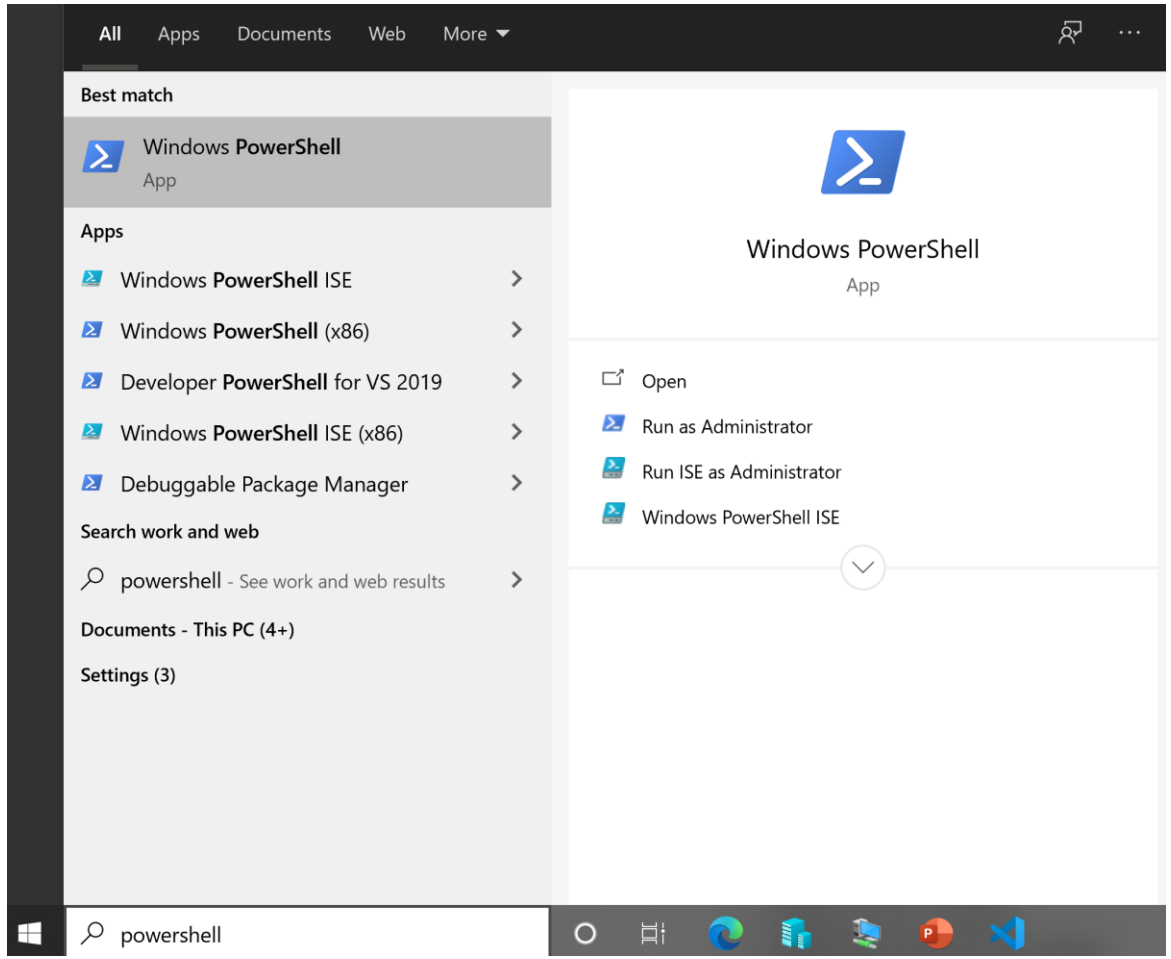
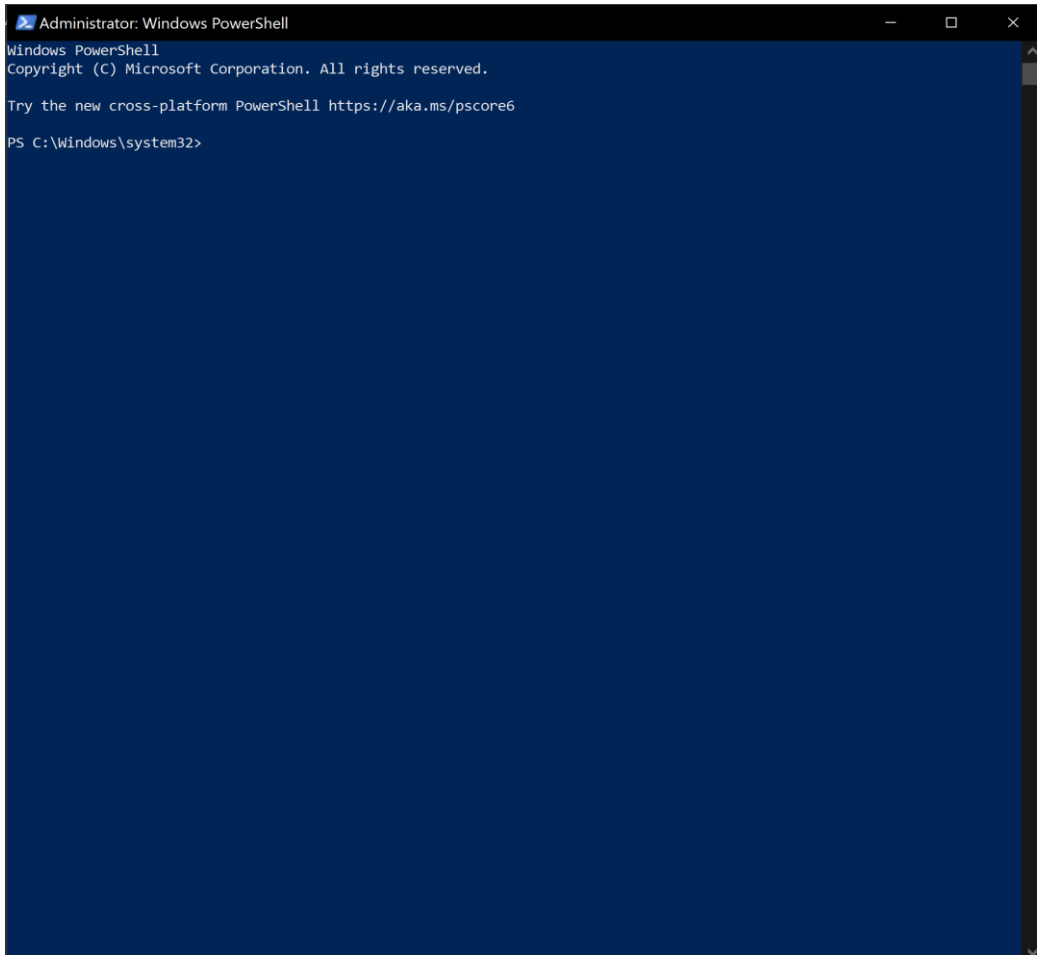
- Since Windows 7 SP1 and Windows Server 2008 R2 SP1, installed by default (v. 5.1)
- For newer versions or other platforms (plus source code) -> https://github.com/PowerShell/PowerShell
- Supports but does not require an IDE
- To launch, click “Start” and enter “powershell” in search box
- Click “Run as Administrator”

PowerShell – Up and Running





PowerShell ISE

- Integrated Scripting Environment for PowerShell (similar to an IDE)
- Provides:
  - Development environment for building out new scripts
  - Quick access to help information for cmdlets
  - Interactive console for command execution
- Enables breakpoints and debugging of a script
- Supports selection of a specific section of code for targeted execution
- Will also need “Run as Adminstrator”

Visual Studio Code

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- Microsoft's recommended approach (with the PowerShell extension)
- Enables same/similar features but in a richer experience
- Still provides:
  - Development environment for building out new scripts
  - Quick access to help information for cmdlets
  - Interactive console for command execution

Visual Studio Code

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- Enables breakpoints and debugging of a script
- Supports selection of a specific section of code for targeted execution
- Richer auto-complete and Intellisense for cmdlets
- Will also need “Run as Adminstrator”

Demo

PowerShell – The Lay of the Land

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Finding Help

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- Universe of available PowerShell cmdlets is large
- Because of that, it will be difficult to remember everything about a command
- Also, you may need to find new commands not previously used
- As with anything, you can Google but there are better, more “PowerShell-y” ways to get help

Get-Help

- Helps you quickly get to docs for another cmdlet (if available)
- Format is *Get-Help –Name <cmdlet name>*
- Displays as much information as it has access to about the command, command-line arguments, etc.

```
PS C:\Users\sysadmin\Downloads\PowerShell Scripts> Get-Help -Name New-Service


NAME
    New-Service

SYNTAX
    New-Service [-Name] <string> [-BinaryPathName] <string> [-DisplayName <string>] [-Description <string>] [-StartupType {Boot | System | Automatic |
    Manual | Disabled}] [-Credential <pscredential>] [-DependsOn <string[]>] [-WhatIf] [-Confirm]  [<CommonParameters>]


ALIASES
    None


REMARKS
    Get-Help cannot find the Help files for this cmdlet on this computer. It is displaying only partial help.
        -- To download and install Help files for the module that includes this cmdlet, use Update-Help.
        -- To view the Help topic for this cmdlet online, type: "Get-Help New-Service -Online" or
           go to https://go.microsoft.com/fwlink/?LinkID=113359.
```

Update-Help

- If *Get-Help* is unable to locate additional information about the requested cmdlet, try running *Update-Help*
- This will download and install the latest help files for PowerShell modules installed on your system
- After executing, try *Get-Help* again to see if additional detail is available

Update-Help

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- You may receive an error for some of the modules during update
- Could be:
  - A transient network issue (retry)
  - Help URL's provided in the manifest for the module are incorrect
- If you haven't done so yet, run *Update-Help* in PowerShell

Get-Help - Redux

- After *Update-Help*, *Get-Help* might return additional detail and options for drilldown
- Additional flags are available for more info (detail increases with each)
  - *-Examples*
  - *-Detailed*
  - *-Full*
  - *-Online*

```
REMARKS
    To see the examples, type: "get-help New-Service -examples".
    For more information, type: "get-help New-Service -detailed".
    For technical information, type: "get-help New-Service -full".
    For online help, type: "get-help New-Service -online"
```

Get-Command

- Like *Get-Help* but provides detail about the command (including syntax) vs. full documentation
- Use *Get-Command* with no parameters to get information about all available commands
- Use the *–Name* parameter to get information about a specific command

Get-Command

- Returns type, name, version and source module/package
- Use –*Syntax* with a specific command to see information about command signature

```
PS C:\Users\a_san\source\repos\pshell> Get-Command -Name New-Service -Syntax


New-Service [-Name] <string> [-BinaryPathName] <string> [-DisplayName <string>] [-Description <string>] [-StartupType
<ServiceStartMode>] [-Credential <pscredential>] [-DependsOn <string[]>] [-WhatIf] [-Confirm] [<CommonParameters>]

PS C:\Users\a_san\source\repos\pshell>
```

Using Wildcards

- Many cmdlets support using wildcards for parameter values
- Asterisk (*) matches zero or more occurrences of any character
- Question mark (?) matches exactly one character
- Left and right brackets ([ ]) surround a set of character options
- Wildcards can be combined

```
PS C:\Users\a_san\source\repos\pshell> Get-Command -Name N[aeiou]w-A?ureStorage*


CommandType     Name                                               Version    Source
-----------     ----                                               -------    ------
Cmdlet          New-AzureStorageAccount                            5.3.1      Azure
Cmdlet          New-AzureStorageAccountSASToken                    4.2.1      Azure.Storage
Cmdlet          New-AzureStorageBlobSASToken                       4.2.1      Azure.Storage
Cmdlet          New-AzureStorageContainer                          4.2.1      Azure.Storage
Cmdlet          New-AzureStorageContainerSASToken                  4.2.1      Azure.Storage
Cmdlet          New-AzureStorageContainerStoredAccessPolicy        4.2.1      Azure.Storage
Cmdlet          New-AzureStorageContext                            4.2.1      Azure.Storage
Cmdlet          New-AzureStorageDirectory                          4.2.1      Azure.Storage
Cmdlet          New-AzureStorageFileSASToken                       4.2.1      Azure.Storage
Cmdlet          New-AzureStorageKey                                5.3.1      Azure
Cmdlet          New-AzureStorageQueue                              4.2.1      Azure.Storage
Cmdlet          New-AzureStorageQueueSASToken                      4.2.1      Azure.Storage
Cmdlet          New-AzureStorageQueueStoredAccessPolicy            4.2.1      Azure.Storage
Cmdlet          New-AzureStorageShare                              4.2.1      Azure.Storage
Cmdlet          New-AzureStorageShareSASToken                      4.2.1      Azure.Storage
Cmdlet          New-AzureStorageShareStoredAccessPolicy            4.2.1      Azure.Storage
Cmdlet          New-AzureStorageTable                              4.2.1      Azure.Storage
Cmdlet          New-AzureStorageTableSASToken                      4.2.1      Azure.Storage
Cmdlet          New-AzureStorageTableStoredAccessPolicy            4.2.1      Azure.Storage
```

Loose Parameter Name Matching

- PowerShell commands only require enough characters in a parameter name to uniquely match
- Names are also case-insensitive
- Can help speed up ad hoc scripting but harder to read
- Truncated parameter names not recommended for reusable scripts

Loose Parameter Name Matching

```
PS C:\Users\a_san\source\repos\pshell> Get-Service -inc w* -exc w32*


Status   Name               DisplayName
------   ----               -----------
Stopped  WaaSMedicSvc       Windows Update Medic Service
Stopped  WalletService      WalletService
Stopped  WarpJITSvc         WarpJITSvc
Stopped  wbengine           Block Level Backup Engine Service
Running  WbioSrvc           Windows Biometric Service
Running  Wcmsvc             Windows Connection Manager
Running  wcncsvc            Windows Connect Now - Config Registrar
Running  WdiServiceHost     Diagnostic Service Host
Running  WdiSystemHost      Diagnostic System Host
Stopped  WdNisSvc           Microsoft Defender Antivirus Networ...
Running  WebClient          WebClient
Stopped  Wecsvc             Windows Event Collector
Stopped  WEPHOSTSVC         Windows Encryption Provider Host Se...
Stopped  wercplsupport      Problem Reports Control Panel Support
Stopped  WerSvc             Windows Error Reporting Service
Stopped  WFDSConMgrSvc      Wi-Fi Direct Services Connection Ma...
Stopped  WiaRpc             Still Image Acquisition Events
Stopped  WinDefend          Microsoft Defender Antivirus Service
Running  WinHttpAutoProx... WinHTTP Web Proxy Auto-Discovery Se...
Running  Winmgmt            Windows Management Instrumentation
Running  WinRM              Windows Remote Management (WS-Manag...
Stopped  wisvc              Windows Insider Service
Running  WlanSvc            WLAN AutoConfig
Stopped  wlidsvc            Microsoft Account Sign-in Assistant
Stopped  wlpasvc            Local Profile Assistant Service
Stopped  WManSvc            Windows Management Service
Running  wmiApSrv           WMI Performance Adapter
Stopped  WMPNetworkSvc      Windows Media Player Network Sharin...
Stopped  workfolderssvc     Work Folders
Stopped  WpcMonSvc          Parental Controls
Stopped  WPDBusEnum         Portable Device Enumerator Service
Running  WpnService         Windows Push Notifications System S...
Running  WpnUserService_... WpnUserService_54801
Running  wscsvc             Security Center
Running  WSearch            Windows Search
Running  wuauserv           Windows Update
Stopped  WwanSvc            WWAN AutoConfig
```

```
ell> Get-Service -inc w* -exc w32*
```

Loose Parameter Name Matching

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```
PS C:\Users\a_san\source\repos\pshell> Get-Service -in w* -exc w32*

Get-Service : Parameter cannot be processed because the parameter name 'in' is ambiguous. Possible matches include: -Include -InputObject -InformationAction
-InformationVariable.
At line:1 char:13
+ Get-Service -in w* -exc w32*
+             ~~~
    + CategoryInfo          : InvalidArgument: (:) [Get-Service], ParameterBindingException
    + FullyQualifiedErrorId : AmbiguousParameter,Microsoft.PowerShell.Commands.GetServiceCommand
```

Get-Member

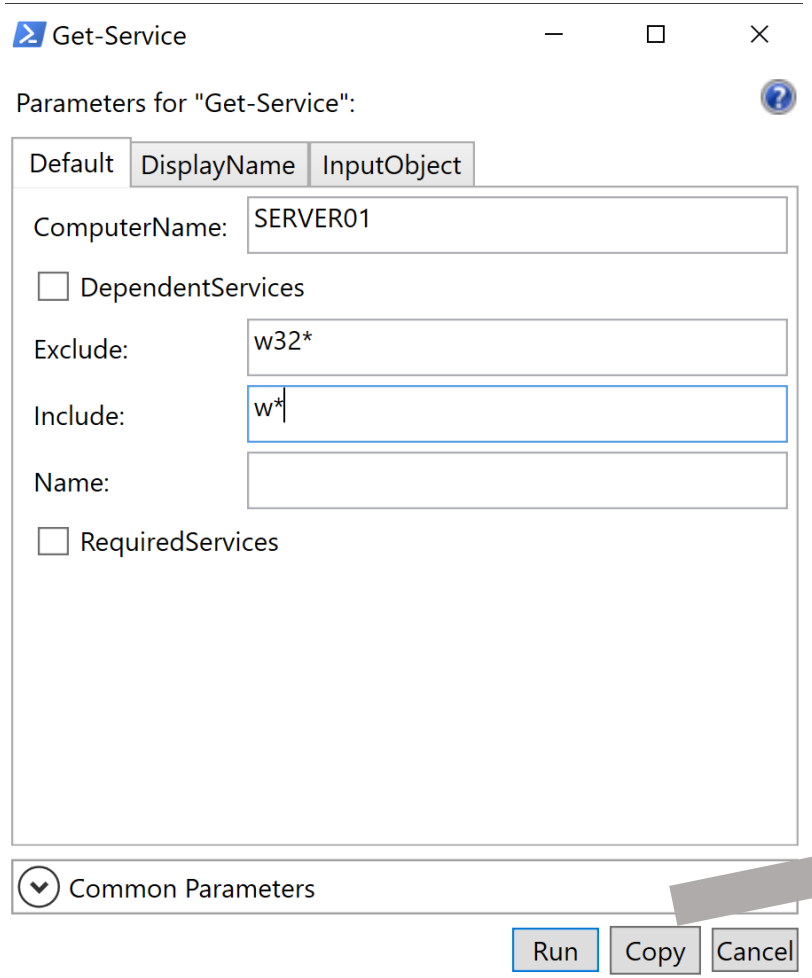
- Displays underlying .NET type for an object
- Lists properties and methods available for an object
- Can be helpful for determining what's possible with a variable of a given type
- Results will be reflective of underlying .NET type

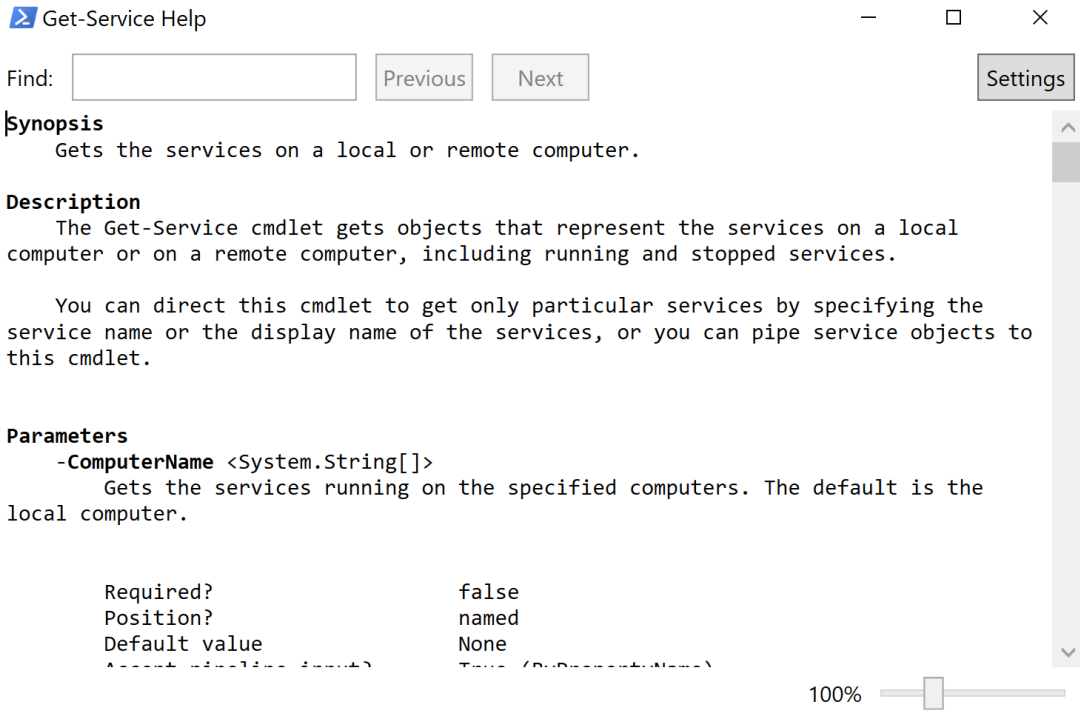
```
PS C:\Users\a_san\source\repos> Get-Command -Name Get-Member -Syntax


Get-Member [[-Name] <string[]>] [-InputObject <psobject>] [-MemberType <PSMemberTypes>] [-View <PSMemberViewTypes>] [-Static] [-Force] [<CommonParameters>]

PS C:\Users\a_san\source\repos> $var = 19

PS C:\Users\a_san\source\repos> Get-Member -InputObject $var



   TypeName: System.Int32

Name        MemberType Definition
----        ---------- ----------
CompareTo   Method     int CompareTo(System.Object value), int CompareTo(int value), int IComparable.CompareTo(System.Object obj), int IComparable[int].CompareTo(int other)
Equals      Method     bool Equals(System.Object obj), bool Equals(int obj), bool IEquatable[int].Equals(int other)
GetHashCode Method     int GetHashCode()
GetType     Method     type GetType()
GetTypeCode Method     System.TypeCode GetTypeCode(), System.TypeCode IConvertible.GetTypeCode()
ToBoolean   Method     bool IConvertible.ToBoolean(System.IFormatProvider provider)
ToByte      Method     byte IConvertible.ToByte(System.IFormatProvider provider)
ToChar      Method     char IConvertible.ToChar(System.IFormatProvider provider)
ToDateTime  Method     datetime IConvertible.ToDateTime(System.IFormatProvider provider)
```

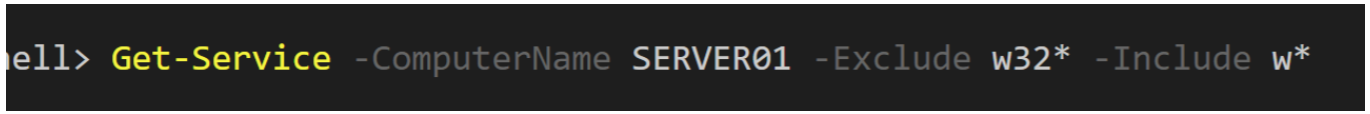
Show-Command

- Launches a dialog for guided definition of a command
- User can set values for various parameters in the UI
- “Run” will execute with user-provided inputs
- “Copy” will copy for use in a script or scripting session
- Also, provides a link to help for the command

Show-Command







-WhatIf and -Confirm

- Cmdlets that make changes often include two additional parameters
- *-WhatIf* provides info on what will happen without executing
- *-Confirm* allows user to verify intent to proceed
- There are ways to include the same for our own functions

```
PS C:\Users\a_san\source\repos\pshell> Get-ChildItem -Path C:\Users\a_san\Downloads\*.* -Recurse | Remove-Item -WhatIf

What if: Performing the operation "Remove File" on target "C:\Users\a_san\Downloads\2018090513375114894.pdf".
What if: Performing the operation "Remove File" on target "C:\Users\a_san\Downloads\File 1.txt".
What if: Performing the operation "Remove File" on target "C:\Users\a_san\Downloads\File 2.txt".
What if: Performing the operation "Remove File" on target "C:\Users\a_san\Downloads\File 3.txt".
What if: Performing the operation "Remove File" on target "C:\Users\a_san\Downloads\Image.bmp".
PS C:\Users\a_san\source\repos\pshell>
```

```
PS C:\Users\a_san\source\repos\pshell> Get-ChildItem -Path C:\Users\a_san\Downloads\*.* -Recurse | Remove-Item -Confirm

Confirm
Are you sure you want to perform this action?
Performing the operation "Remove File" on target "C:\Users\a_san\Downloads\2018090513375114894.pdf".
[Y] Yes [A] Yes to All [N] No [L] No to All [S] Suspend [?] Help (default is "Yes"): n
Confirm
Are you sure you want to perform this action?
Performing the operation "Remove File" on target "C:\Users\a_san\Downloads\File 1.txt".
[Y] Yes [A] Yes to All [N] No [L] No to All [S] Suspend [?] Help (default is "Yes"): n
Confirm
Are you sure you want to perform this action?
Performing the operation "Remove File" on target "C:\Users\a_san\Downloads\File 2.txt".
[Y] Yes [A] Yes to All [N] No [L] No to All [S] Suspend [?] Help (default is "Yes"):
```

Miscellaneous Info

- A backtick (`) can be used to span multiple lines with a command
- Multiple variables can be declared and initialized with same or different values in one line of code
- When working in PowerShell, Ctrl+Space auto-completes if able or shows available auto-completions (for selection)

Miscellaneous Info

```
PS C:\Users\a_san\source\repos\pshell> Get-Service `
>> -Include w* `
>> -Exclude w32*


Status   Name               DisplayName
------   ----               -----------
Stopped  WaaSMedicSvc       Windows Update Medic Service
Stopped  WalletService      WalletService
Stopped  WarpJITSvc         WarpJITSvc
Stopped  wbengine           Block Level Backup Engine Service
Running  WbioSrvc           Windows Biometric Service
Running  Wcmsvc             Windows Connection Manager
Running  wcncsvc            Windows Connect Now - Config Registrar
Running  WdiServiceHost     Diagnostic Service Host
Running  WdiSystemHost      Diagnostic System Host
Stopped  WdNisSvc           Microsoft Defender Antivirus Networ...
Running  WebClient          WebClient
```

```
PS C:\Users\a_san\source\repos\pshell> $var1, $var2, $var3 = "A", 1, "C"

PS C:\Users\a_san\source\repos\pshell> $var1

A
PS C:\Users\a_san\source\repos\pshell> $var2

1
PS C:\Users\a_san\source\repos\pshell> $var3

C
PS C:\Users\a_san\source\repos\pshell> $var4, $var5 = "D"

PS C:\Users\a_san\source\repos\pshell> $var4

D
PS C:\Users\a_san\source\repos\pshell> $var5
```

```
PS C:\Users\a_san\source\repos\pshell> [System.MidpointRounding]::AwayFromZero
AwayFromZero        Equals              GetName             GetUnderlyingType   IsDefined           ReferenceEquals     TryParse
ToEven              Format              GetNames            GetValues           Parse               ToObject

static System.MidpointRounding AwayFromZero {get;}
```

Variables & Data Types

Declaring Variables in PowerShell

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- To create a variable in PowerShell, you use $ + variable name and assign an initial value
- PowerShell infers data type from the assigned value
- If you assign the variable to a different type, data type is silently changed

Declaring Variables in PowerShell

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```
PS C:\Users\a_san\source\repos\pshell> $numHours = 12

PS C:\Users\a_san\source\repos\pshell> $numHours

12
PS C:\Users\a_san\source\repos\pshell> $numHours.GetType().FullName

System.Int32
PS C:\Users\a_san\source\repos\pshell> $numHours = 13.8

PS C:\Users\a_san\source\repos\pshell> $numHours

13.8
PS C:\Users\a_san\source\repos\pshell> $numHours.GetType().FullName

System.Double
PS C:\Users\a_san\source\repos\pshell> $numHours = "Eleven"

PS C:\Users\a_san\source\repos\pshell> $numHours

Eleven
PS C:\Users\a_san\source\repos\pshell> $numHours.GetType().FullName

System.String
PS C:\Users\a_san\source\repos\pshell>
```

Declaring Variables in PowerShell

- There may be times when you want to set a specific type
- To do that, you use *[<typename>]$<variablename>*
- Once declared with a specific type, the variable will keep that type for the current scope
- To recreate the same variable with a different type, first remove the existing one
- To delete a variable, you can use *Remove-Variable –Name <variablename>*

Declaring Variables in PowerShell

```
PS C:\Users\a_san\source\repos\pshell> [int]$wholeNumbersOnly = 12

PS C:\Users\a_san\source\repos\pshell> $wholeNumbersOnly

12
PS C:\Users\a_san\source\repos\pshell> $wholeNumbersOnly.GetType().FullName

System.Int32
PS C:\Users\a_san\source\repos\pshell> $wholeNumbersOnly = 13.85

PS C:\Users\a_san\source\repos\pshell> $wholeNumbersOnly

14
PS C:\Users\a_san\source\repos\pshell> $wholeNumbersOnly.GetType().FullName

System.Int32
PS C:\Users\a_san\source\repos\pshell> $wholeNumbersOnly = "Eleven"

Cannot convert value "Eleven" to type "System.Int32". Error: "Input string was not in a correct format."
At line:1 char:1
+ $wholeNumbersOnly = "Eleven"
+ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~
    + CategoryInfo          : MetadataError: (:) [], ArgumentTransformationMetadataException
    + FullyQualifiedErrorId : RuntimeException

PS C:\Users\a_san\source\repos\pshell> Remove-Variable -Name wholeNumbersOnly

PS C:\Users\a_san\source\repos\pshell> $wholeNumbersOnly = "Eleven"

PS C:\Users\a_san\source\repos\pshell> $wholeNumbersOnly

Eleven
PS C:\Users\a_san\source\repos\pshell>
```

Declaring Variables in PowerShell

- Available types include .NET types defined in installed/imported modules
- .NET types may include namespace plus type name
- For standard types, you can use formal .NET type or simplified equivalent
- Explicit types improve readability and can help protect against errors

Declaring Variables in PowerShell

```
PS C:\Users\a_san\source\repos\pshell> [System.Int32]$numVar1 = 12

PS C:\Users\a_san\source\repos\pshell> [int]$numVar2 = 13

PS C:\Users\a_san\source\repos\pshell> $numVar1.GetType().FullName

System.Int32
PS C:\Users\a_san\source\repos\pshell> $numVar2.GetType().FullName

System.Int32
PS C:\Users\a_san\source\repos\pshell> $dictionary = New-Object 'System.Collections.Generic.Dictionary[System.String, System.Object]]'

PS C:\Users\a_san\source\repos\pshell> $dictionary.Add("One", 1)

PS C:\Users\a_san\source\repos\pshell> $dictionary.Add("Two", 2)

PS C:\Users\a_san\source\repos\pshell> $dictionary


Key Value
--- -----
One     1
Two     2
```

Declaring Variables in PowerShell

- Variables in PowerShell can also be used to store the results of a command for use later

```
PS C:\Users\a_san\source\repos\pshell> $serviceData = Get-Service -Name wm*

PS C:\Users\a_san\source\repos\pshell> $serviceData


Status   Name               DisplayName
------   ----               -----------
Stopped  WManSvc            Windows Management Service
Stopped  wmiApSrv           WMI Performance Adapter
Stopped  WMPNetworkSvc      Windows Media Player Network Sharin...
```

Automatic Variables in PowerShell

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- Several pre-existing variables installed with PowerShell (akin to environment variables)
- Among other things:
  - Provide shortcut access to things like file paths
  - Used to represent certain “constant” values in PowerShell
- Conceptually, should be considered read-only

Automatic Variables in PowerShell

- Path-like examples include:
  - *$HOME* – full path of user's home directory
  - *$PROFILE* – full path of PowerShell profile for current user; includes sub-properties to account for variations in user and host
  - *$PSHOME* – full path of installation directory for PowerShell
  - *$PWD* – full path of current directory
- Constant-like examples include:
  - *$true*
  - *$false*
  - *$null*
- *$PSVersionTable* provides info about PowerShell version for session

Operators

Arithmetic Operators

- PowerShell includes standard arithmetic operators

Operator	Description
+	Adds numbers and concatenates strings, arrays and hash tables
-	Subtracts numbers
-	Unary version used to negate a number
*	Multiples numbers or copies strings and arrays specified number of times
/	Divides numbers
%	Modulus – returns remainder of a division operation

Additional Operators

- PowerShell also includes other operators

Operator	Description
-band	Bitwise AND
-bnot	Bitwise NOT
-bor	Bitwise OR (standard)
-bxor	Bitwise OR (exclusive)
-shl	Left shift operator for bits
-shr	Right shift operator for bits

Operator Precedence

- When operators are combined, PowerShell evaluates in a specific order

Precedence	Operator	Description
1	()	Grouping parentheses; can be used with commands also
2	-	Unary negation
3	*, /, %	Multiplication, division and modulus
4	+, -	Addition and subtraction
5	-band, -bnot, -bor, -bxor, -shr, -shl	Bitwise operations

Division and Rounding

- When the results of division are stored in an integer variable, PowerShell will round (if required)
- Follows most standard rounding rules
- If result includes .5, the number will be rounded to the nearest even integer
- The [Math] class can be used to modify rounding behavior

```
PS C:\Users\a_san\source\repos\pshell> [int]$result1 = 5 / 2

PS C:\Users\a_san\source\repos\pshell> [int]$result2 = 7 / 2

PS C:\Users\a_san\source\repos\pshell> $result1

2
PS C:\Users\a_san\source\repos\pshell> $result2

4
PS C:\Users\a_san\source\repos\pshell> [int][Math]::Round(5 / 2, [MidpointRounding]::AwayFromZero)

3
PS C:\Users\a_san\source\repos\pshell> [int][Math]::Round(7 / 2, [MidpointRounding]::AwayFromZero)

4
PS C:\Users\a_san\source\repos\pshell>
```

Adding and Multiplying Non-Numeric Types

- When using + with strings, arrays, and hash tables, operands are concatenated
- When using * with strings and arrays, the operand is repeated
- For hash tables, you can only add other hash tables to a hash table and the repeat operator is not supported
- When adding hash table to array, hash tables becomes array item
- With hash tables, attempts to add a hash table with duplicate key will fail

Adding and Multiplying Non-Numeric Types

```
PS C:\Users\a_san\source\repos\pshell> $partOne = "Hello"

PS C:\Users\a_san\source\repos\pshell> $partTwo = "World!"

PS C:\Users\a_san\source\repos\pshell> $partOne + " " + $partTwo

Hello World!
PS C:\Users\a_san\source\repos\pshell> $array1 = 1, 2, 3

PS C:\Users\a_san\source\repos\pshell> $array2 = "A", "B", "C"

PS C:\Users\a_san\source\repos\pshell> $array1 + $array2

1
2
3
A
B
C
PS C:\Users\a_san\source\repos\pshell>
```

Adding and Multiplying Non-Numeric Types

```
PS C:\Users\a_san\source\repos\pshell> $repeat = "PowerShell"

PS C:\Users\a_san\source\repos\pshell> $repeat * 3

PowerShellPowerShellPowerShell
PS C:\Users\a_san\source\repos\pshell> $array = "A", 1, "C"

PS C:\Users\a_san\source\repos\pshell> $array * 4

A
1
C
A
1
C
A
1
C
A
1
C
PS C:\Users\a_san\source\repos\pshell>
```

Adding and Multiplying Non-Numeric Types

```
PS C:\Users\a_san\source\repos\pshell> $hash1 = @{ "One" = 1; "Two" = 2; "Three" = 3 }

PS C:\Users\a_san\source\repos\pshell> $hash2 = @{ "Four" = 4; "Five" = 5 }

PS C:\Users\a_san\source\repos\pshell> $hash1 + $hash2


Name                           Value
----                           -----
Four                           4
Five                           5
One                            1
Three                          3
Two                            2


PS C:\Users\a_san\source\repos\pshell> $hash3 = @{ "One" = 14; "Six" = 6 }

PS C:\Users\a_san\source\repos\pshell> $hash1 + $hash3

Item has already been added. Key in dictionary: 'One'  Key being added: 'One'
At line:1 char:1
+ $hash1 + $hash3
+ ~~~~~~~~~~~~~~~
    + CategoryInfo          : OperationStopped: (:) [], ArgumentException
    + FullyQualifiedErrorId : System.ArgumentException
```

Combining Different Types

- When combining values of different types (non-numeric with numeric), PowerShell targets type of leftmost operand
- PowerShell tries to convert all operands to that type before combining
- As a result, + and * are not necessarily commutative when used this way

```
PS C:\Users\a_san\source\repos\pshell> 'string value' + 42

string value42
PS C:\Users\a_san\source\repos\pshell> 42 + 'string value'

Cannot convert value "string value" to type "System.Int32". Error: "Input string was not in a correct format."
At line:1 char:1
+ 42 + 'string value'
+ ~~~~~~~~~~~~~~~~~~~
    + CategoryInfo          : InvalidArgument: (:) [], RuntimeException
    + FullyQualifiedErrorId : InvalidCastFromStringToInteger
```

Combining Different Types

- When combining values of different numeric types, PowerShell selects the type that minimizes precision loss
- If the result of the operation is too large for the largest type of the operands, PowerShell will automatically widen to accommodate
- This means that result may not match the type of any of the operands

```
PS C:\Users\a_san\source\repos\pshell> 29 * [Math]::PI

91.106186954104
PS C:\Users\a_san\source\repos\pshell> (29).GetType().FullName

System.Int32
PS C:\Users\a_san\source\repos\pshell> (29 * [Math]::PI).GetType().FullName

System.Double
PS C:\Users\a_san\source\repos\pshell> (1024MB).GetType().FullName

System.Int32
PS C:\Users\a_san\source\repos\pshell> (1024MB * 1024MB).GetType().FullName

System.Double
PS C:\Users\a_san\source\repos\pshell>
```

Assignment Operators

Develop Intelligence

- PowerShell includes various assignment operators (including shortcuts)

Operator	Description
=	Sets variable to specific value (lowest precedence)
+=	Adds value to variable and assigns result to variable; with non-numeric type, appends and assigns
-=	Subtracts value from variable and assigns result to variable
*=	Multiplies variable by a value and assigns result to variable; with non-numeric type, appends repeating occurrences and assigns
/=	Divides variable by a value and assigns result to variable
%=	Divides variable by a value and assigns remainder to variable
++	Increase value of variable by 1 (includes prefix and postfix versions)
--	Decreases value of variable by 1 (includes prefix and postfix versions)

Assignment Operators

```
PS C:\Users\a_san\source\repos\pshell> $cost = 19.99

PS C:\Users\a_san\source\repos\pshell> $tax = 0.075

PS C:\Users\a_san\source\repos\pshell> $cost += ($cost * $tax)

PS C:\Users\a_san\source\repos\pshell> $cost

21.48925
PS C:\Users\a_san\source\repos\pshell> "{0:C}" -f $cost

$21.49
PS C:\Users\a_san\source\repos\pshell>
```

```
PS C:\Users\a_san\source\repos\pshell> $array3 = 13, -18

PS C:\Users\a_san\source\repos\pshell> $array3 *= 2

PS C:\Users\a_san\source\repos\pshell> $array3

13
-18
13
-18
PS C:\Users\a_san\source\repos\pshell>
```

```
PS C:\Users\a_san\source\repos\pshell> $index = 0

PS C:\Users\a_san\source\repos\pshell> $array1 = @(24, -8)

PS C:\Users\a_san\source\repos\pshell> $array2 = @(-3, 14)

PS C:\Users\a_san\source\repos\pshell> $array1[$index] = $array2[$index++]

PS C:\Users\a_san\source\repos\pshell> $index, $array1, $array2

1
24
-3
-3
14
PS C:\Users\a_san\source\repos\pshell>
```

Aliases

Develop Intelligence

What is an Alias in PowerShell?

- An alternate name or nickname for a command
- Can use the alias anywhere you would normally use the command
- There are predefined aliases, or you can create your own
- Aliases created by you only exist in current session (unless added to profile or exported for import in a new session)

```
PS C:\Users\a_san\source\repos\pshell> dir

PS C:\Users\a_san\source\repos\pshell> cd ..

PS C:\Users\a_san\source\repos> dir


    Directory: C:\Users\a_san\source\repos


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
d-----         12/6/2020   1:13 PM                pshell
d-----         12/6/2020   1:27 PM                pshell-core


PS C:\Users\a_san\source\repos> ls


    Directory: C:\Users\a_san\source\repos


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
d-----         12/6/2020   1:13 PM                pshell
d-----         12/6/2020   1:27 PM                pshell-core


PS C:\Users\a_san\source\repos>
```

Get-Alias

- Lists all aliases available in current session
- Supports parameters for filtering and wildcards for searching

```
PS C:\Users\a_san\source\repos> Get-Command -Name Get-Alias -Syntax


Get-Alias [[-Name] <string[]>] [-Exclude <string[]>] [-Scope <string>] [<CommonParameters>]

Get-Alias [-Exclude <string[]>] [-Scope <string>] [-Definition <string[]>] [<CommonParameters>]

PS C:\Users\a_san\source\repos> Get-Alias -Name 'c*'


CommandType     Name                                               Version    Source
-----------     ----                                               -------    ------
Alias           cat -> Get-Content
Alias           cd -> Set-Location
Alias           CFS -> ConvertFrom-String                          3.1.0.0    Microsoft.PowerShell.Utility
Alias           chdir -> Set-Location
Alias           clc -> Clear-Content
Alias           clear -> Clear-Host
Alias           clhy -> Clear-History
Alias           cli -> Clear-Item
Alias           clp -> Clear-ItemProperty
Alias           cls -> Clear-Host
Alias           clv -> Clear-Variable
Alias           cnsn -> Connect-PSSession
Alias           compare -> Compare-Object
Alias           copy -> Copy-Item
Alias           cp -> Copy-Item
Alias           cpi -> Copy-Item
Alias           cpp -> Copy-ItemProperty
Alias           curl -> Invoke-WebRequest
Alias           cvpa -> Convert-Path
```

New-Alias

- Creates a new custom alias or nickname for a specific command
- By default, exists only in current session
- Once defined, can be used in place of the command name

```
PS C:\Users\a_san\source\repos> New-Alias -Name ghelp -Value Get-Help

PS C:\Users\a_san\source\repos> Get-Alias -Name ghelp


CommandType     Name                                               Version    Source
-----------     ----                                               -------    ------
Alias           ghelp -> Get-Help


PS C:\Users\a_san\source\repos> ghelp New-Alias -Examples


NAME
    New-Alias

SYNOPSIS
    Creates a new alias.


    ---------- Example 1: Create an alias for a cmdlet ----------

    PS C:\> New-Alias -Name "List" Get-ChildItem

    This command creates an alias named List to represent the Get-ChildItem cmdlet.
    ------- Example 2: Create a read-only alias for a cmdlet -------

    PS C:\> New-Alias -Name "W" -Value Get-WmiObject -Description "quick wmi alias" -Option ReadOnly
    PS C:\> Get-Alias -Name "W" | Format-List *

    This command creates an alias named W to represent the Get-WmiObject cmdlet. It creates a description, quick wmi alias,
    pipes it to Format-List to display all of the information about it.



PS C:\Users\a_san\source\repos>
```

Set-Alias

- Creates or changes a custom alias
- Aliases can be used for user-defined functions as well

```
PS C:\Users\a_san\source\repos> New-Alias -Name slog -Value Get-EventLog

PS C:\Users\a_san\source\repos> slog -LogName System | Select-Object -First 3


   Index Time          EntryType   Source                 InstanceID Message
   ----- ----          ---------   ------                 ---------- -------
   13179 Dec 06 20:55  Information Service Control M...   1073748864 The start type of the Background Intelligent Transfer Service serv
   13178 Dec 06 20:54  Warning     DCOM                       10016 The description for Event ID '10016' in Source 'DCOM' cannot be fo
   13177 Dec 06 20:51  Warning     DCOM                       10016 The description for Event ID '10016' in Source 'DCOM' cannot be fo


PS C:\Users\a_san\source\repos> function Get-SystemLog { Get-EventLog -LogName System }

PS C:\Users\a_san\source\repos> Set-Alias -Name slog -Value Get-SystemLog

PS C:\Users\a_san\source\repos> slog | Select-Object -First 3


   Index Time          EntryType   Source                 InstanceID Message
   ----- ----          ---------   ------                 ---------- -------
   13179 Dec 06 20:55  Information Service Control M...   1073748864 The start type of the Background Intelligent Transfer Service serv
   13178 Dec 06 20:54  Warning     DCOM                       10016 The description for Event ID '10016' in Source 'DCOM' cannot be fo
   13177 Dec 06 20:51  Warning     DCOM                       10016 The description for Event ID '10016' in Source 'DCOM' cannot be fo
```

Exporting and Importing

Develop Intelligence

- As mentioned, by default, custom aliases only exist in current session
- To make available for other sessions, can add *New-Alias* or *Set-Alias* to profile
- Alternatively, can export aliases to a file using *Export-Alias*
- Subsequently, can import into a new PowerShell session

The Alias Provider

- We'll discuss PowerShell providers later
- For now, know that PowerShell includes a provider for defined aliases
- Provider allows us to reference available aliases as if contained in a drive

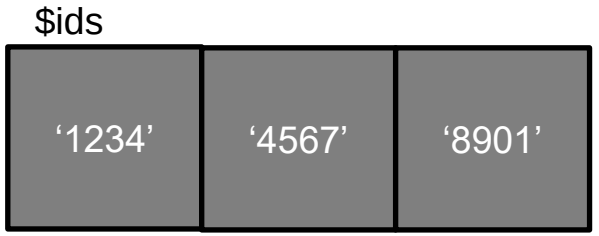
```
PS C:\Users\a_san\source\repos> Get-ChildItem -Path Alias: | Select-Object -First 10


CommandType     Name                                               Version    Source
-----------     ----                                               -------    ------
Alias           % -> ForEach-Object
Alias           ? -> Where-Object
Alias           ac -> Add-Content
Alias           asnp -> Add-PSSnapin
Alias           cat -> Get-Content
Alias           cd -> Set-Location
Alias           CFS -> ConvertFrom-String                          3.1.0.0    Microsoft.PowerShell.Utility
Alias           chdir -> Set-Location
Alias           clc -> Clear-Content
Alias           clear -> Clear-Host
```

Arrays, ArrayLists and Hash Tables

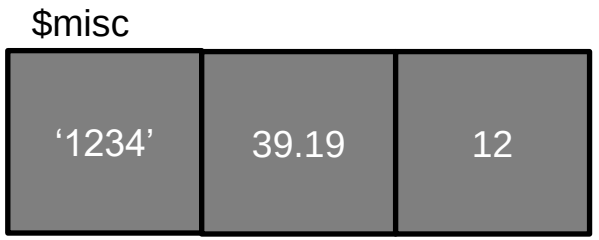
Arrays

- Fixed-size data structures
- Used to store a collection of related values of the same type
- Stored contiguously in memory
- By default, stored as collection of objects (but can defined with specific type)

```
$ids = @('1234', '4567', '8901')
```




```
$misc = @('1234', 39.19, 12)
```



Defining Arrays

- To initialize an array variable, you can use @, ( ), and comma-separated values
- Alternatively, you can omit the @ and ( )

```
PS C:\Users\a_san\source\repos> $array1 = @('A', 'B', 'C')

PS C:\Users\a_san\source\repos> $array2 = 'D', 'E', 'F'

PS C:\Users\a_san\source\repos> $array1.GetType().FullName

System.Object[]
PS C:\Users\a_san\source\repos> $array2.GetType().FullName

System.Object[]
PS C:\Users\a_san\source\repos>
```

Reading Array Elements

- Outputting an array variable to the console will list all values
- To read a specific element of the array, you use [ ] and a numeric index
- Index is 0-based (i.e., first element is [0] and last element is [length – 1])
- -1 will also return the last element
- … can be used for the index to access a range of elements at once

Reading Array Elements

```
PS C:\Users\a_san\source\repos> $newArray = '1234', '4567', '8901'

PS C:\Users\a_san\source\repos> $newArray

1234
4567
8901
PS C:\Users\a_san\source\repos> $length = $newArray.Length

PS C:\Users\a_san\source\repos> $newArray[0]

1234
PS C:\Users\a_san\source\repos> $newArray[$length - 1]

8901
PS C:\Users\a_san\source\repos> $newArray[-1]

8901
PS C:\Users\a_san\source\repos> $newArray[1..2]

4567
8901
PS C:\Users\a_san\source\repos>
```

Modifying Array Elements

- To change an array element, you can assign a new value to its index
- Data type must match type of elements in array
- Valid values for index are 0 to length – 1
- If assignment attempted for index out of valid range, an error occurs

```
PS C:\Users\a_san\source\repos> $newArray

1234
4567
8901
PS C:\Users\a_san\source\repos> $newArray[0] = '4321'

PS C:\Users\a_san\source\repos> $newArray[$newArray.Length - 1] = '1098'

PS C:\Users\a_san\source\repos> $newArray

4321
4567
1098
PS C:\Users\a_san\source\repos>
```

```
PS C:\Users\a_san\source\repos> $newArray

4321
4567
1098
PS C:\Users\a_san\source\repos> $newArray[$newArray.Length] = 'bad!'

Index was outside the bounds of the array.
At line:1 char:1
+ $newArray[$newArray.Length] = 'bad!'
+ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
    + CategoryInfo          : OperationStopped: (:) [], IndexOutOfRangeException
    + FullyQualifiedErrorId : System.IndexOutOfRangeException
```

Adding Elements to an Array

- To add an element to an array, you use the + operator
- New value will be appended to end of array
- += can be used to append value and update an existing array
- + and += can be used with other arrays as well

```
PS C:\Users\a_san\source\repos> $newArray

4321
4567
1098
PS C:\Users\a_san\source\repos> $newArray += '0007'

PS C:\Users\a_san\source\repos> $newArray

4321
4567
1098
0007
PS C:\Users\a_san\source\repos> $newArray.Length

4
PS C:\Users\a_san\source\repos>
```

```
PS C:\Users\a_san\source\repos> $newArray

4321
4567
1098
0007
PS C:\Users\a_san\source\repos> $newArray += '0003', '00004'

PS C:\Users\a_san\source\repos> $newArray

4321
4567
1098
0007
0003
00004
PS C:\Users\a_san\source\repos> $newArray.Length

6
PS C:\Users\a_san\source\repos>
```

Removing Elements from an Array

- To remove an element from an array, you can't use the – operator
- Instead, you can assign the element the value *$null*
- The element will still exist, it will just have an empty value
- Will not be displayed in out but will be reflected in length

```
PS C:\Users\a_san\source\repos> $newArray

4321
4567
1098
0007
0003
00004
PS C:\Users\a_san\source\repos> $newArray[3] = $null

PS C:\Users\a_san\source\repos> $newArray

4321
4567
1098
0003
00004
PS C:\Users\a_san\source\repos> $newArray.Length

6
PS C:\Users\a_san\source\repos>
```

ArrayLists

- Arrays are fixed-size (i.e., += was not changing existing array but creating a new array object to contain the result)
- With arrays of large size, this ongoing creation of new array objects to hold added elements will get costly
- ArrayLists provide an alternative data structure that can dynamically grow or shrink (not fixed-size)
- Performance and memory management is much more efficient with large collections

Defining ArrayLists

- Created in a similar way as Arrays
- Cast as type *[System.Collections.ArrayList]*
- Because of cast, will require ( ) or @( ) to wrap values

```
PS C:\Users\a_san\source\repos> $arrayList = [System.Collections.ArrayList]@('1234', '4567', '8901')

PS C:\Users\a_san\source\repos> $arrayList

1234
4567
8901
PS C:\Users\a_san\source\repos> $arrayList.Count

3
PS C:\Users\a_san\source\repos> $arrayList.GetType().FullName

System.Collections.ArrayList
PS C:\Users\a_san\source\repos>
```

Reading & Modifying ArrayList Elements

- Will use same syntax as was used with Arrays – [ ] and numeric index
- The key difference is that ArrayLists use *Count* instead of *Length* for # of elements

Adding & Removing Elements in an ArrayList

- To add an element to an ArrayList, you use the *Add* method
- *Add* will return the index of the newly added element
- To remove, you use *Remove*
- *Remove* operates against the matched value, not an index
- Unlike Arrays, *Remove* for ArrayLists will truly reduce the size of the collection

Adding & Removing Elements in an ArrayList

```
PS C:\Users\a_san\source\repos> $arrayList

1234
4567
8901
PS C:\Users\a_san\source\repos> $arrayList.Add('0007')

3
PS C:\Users\a_san\source\repos> $arrayList.Add('0003')

4
PS C:\Users\a_san\source\repos> $arrayList.Add('00004')

5
PS C:\Users\a_san\source\repos> $arrayList

1234
4567
8901
0007
0003
00004
PS C:\Users\a_san\source\repos> $arrayList.Count

6
PS C:\Users\a_san\source\repos>
```

```
PS C:\Users\a_san\source\repos> $arrayList

1234
4567
8901
0007
0003
00004
PS C:\Users\a_san\source\repos> $arrayList.Remove('0007')

PS C:\Users\a_san\source\repos> $arrayList

1234
4567
8901
0003
00004
PS C:\Users\a_san\source\repos> $arrayList.Count

5
PS C:\Users\a_san\source\repos>
```

Hashtables

- Aka dictionary – enables storage of a collection of key-value pairs
- Enables reference to elements by a key instead of numeric index
- Useful for storing related data together – e.g., counts by product number

Defining Hashtables

- Created using @ and { } to wrap key-value combinations
- Each key-value combination can be defined on a separate line
- Alternatively, each key-value combination can be separated with a ;
- Order of elements not always in order added

```
PS C:\Users\a_san\source\repos> $productCounts1 = @{
>> '12345' = 89
>> '67890' = 101
>> }

PS C:\Users\a_san\source\repos> $productCounts2 = @{'00003' = 99; '0000032' = 3}

PS C:\Users\a_san\source\repos> $productCounts = $productCounts1 + $productCounts2

PS C:\Users\a_san\source\repos> $productCounts


Name                           Value
----                           -----
67890                          101
12345                          89
00003                          99
0000032                        3


PS C:\Users\a_san\source\repos>
```

Keys & Values

- Hashtables include a property for the collection of keys
- Hashtables also include a separate property for the collection of values
- Order of the 2 collections will correlate

```
PS C:\Users\a_san\source\repos> $productCounts.Keys

67890
12345
00003
0000032
PS C:\Users\a_san\source\repos> $productCounts.Values

101
89
99
3
PS C:\Users\a_san\source\repos> $productCounts


Name                           Value
----                           -----
67890                          101
12345                          89
00003                          99
0000032                        3


PS C:\Users\a_san\source\repos>
```

Reading Hashtable Elements

- To reference elements of a hashtable, you can use [ ] notation or . notation
- In either case, the reference is to the key associated to the target element
- The *ContainsKey* method can be used to check for presence of a key

```
PS C:\Users\a_san\source\repos> $productCounts


Name                           Value
----                           -----
67890                          101
12345                          89
00003                          99
0000032                        3


PS C:\Users\a_san\source\repos> $productCounts['00003']

99
PS C:\Users\a_san\source\repos> $productCounts.'00003'

99
PS C:\Users\a_san\source\repos> $productCounts['99999']

PS C:\Users\a_san\source\repos> $productCounts.Contains('0000032')

True
PS C:\Users\a_san\source\repos>
```

Adding & Modifying Hashtable Elements

- To add a new element to hashtable, you can use the *Add* method
- Add accepts an argument for new key and value to be associated
- Alternatively, you can add a new element using the [<key>] notation
- Any attempts to add an element with a duplicate key will fail

Adding & Modifying Hashtable Elements

```
PS C:\Users\a_san\source\repos> $productCounts.Add('983392', 1008)

PS C:\Users\a_san\source\repos> $productCounts['9993234'] = 11

PS C:\Users\a_san\source\repos> $productCounts


Name                           Value
----                           -----
12345                          89
00003                          99
983392                         1008
9993234                        11
0000032                        3
67890                          101


PS C:\Users\a_san\source\repos> $productCounts.Add('983392', 1000)

Exception calling "Add" with "2" argument(s): "Item has already been added. Key in dictionary: '983392'  Key being added: '983392'"
At line:1 char:1
+ $productCounts.Add('983392', 1000)
+ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
    + CategoryInfo          : NotSpecified: (:) [], MethodInvocationException
    + FullyQualifiedErrorId : ArgumentException

PS C:\Users\a_san\source\repos>
```

Adding & Modifying Hashtable Elements

- To modify an existing element, you use the [<key>] notation
- You can use ContainsKey first to confirm exists before updating
- Otherwise, [<key>] notation will add a new element

```
PS C:\Users\a_san\source\repos> if ($productCounts.ContainsKey('983392')) { $productCounts['983392'] = 1007 }

PS C:\Users\a_san\source\repos> $productCounts


Name                           Value
----                           -----
12345                          89
00003                          99
983392                         1007
9993234                        11
0000032                        3
67890                          101


PS C:\Users\a_san\source\repos>
```

Removing Elements from a Hashtable

- To remove an element from a hashtable, you use the *Remove* method
- *Remove* accepts an argument for the key to the element to be removed
- As with ArrayLists, *Remove* operates against the matched key value
- Attempts to remove a key that does not exist has no effect

```
PS C:\Users\a_san\source\repos> $productCounts.Remove('9993234')

PS C:\Users\a_san\source\repos> $productCounts


Name                           Value
----                           -----
12345                          89
00003                          99
983392                         1007
0000032                        3
67890                          101


PS C:\Users\a_san\source\repos> $productCounts.Count

5
PS C:\Users\a_san\source\repos> $productCounts.Remove('99999999999')
```

“Splatting” with Hashtables

- A hashtable can be used to encapsulate the parameters for a command
- The hashtable is passed as an argument to the command
- The command will map values in the hashtable to parameters on the command by name/key
- To pass the hashtable, use @<hashtablename>

```
PS C:\Users\a_san\source\repos> $cmdArgs = @{
>> Include = 'w*'
>> Exclude = 'w32*'
>> }

PS C:\Users\a_san\source\repos> Get-Service @cmdArgs


Status   Name               DisplayName
------   ----               -----------
Stopped  WaaSMedicSvc       Windows Update Medic Service
Stopped  WalletService      WalletService
Stopped  WarpJITSvc         WarpJITSvc
Stopped  wbengine           Block Level Backup Engine Service
Running  WbioSrvc           Windows Biometric Service
Running  Wcmsvc             Windows Connection Manager
```

Custom Objects

Creating Custom Objects

- Uses the *PSCustomObject* type
- Enables the creation of user-defined structures with related properties
- Custom object will include common properties and methods alongside custom properties
- *Get-Member* can be used to view available members

Creating Custom Objects

```
PS C:\Users\a_san\source\repos> $person = [PSCustomObject]@{
>> FirstName = 'Melissa'
>> LastName = 'Testing'
>> Age = 32
>> }

PS C:\Users\a_san\source\repos> $person.GetType().FullName

System.Management.Automation.PSCustomObject
PS C:\Users\a_san\source\repos> Get-Member -InputObject $person



   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()
Age         NoteProperty int Age=32
FirstName   NoteProperty string FirstName=Melissa
LastName    NoteProperty string LastName=Testing
```

Referencing Properties of Custom Object

- Use . notation to reference user-defined properties
- Same notation used to reference common properties and methods

```
PS C:\Users\a_san\source\repos> Write-Host "$($person.FirstName) $($person.LastName) is $($person.Age) year(s) old..."

Melissa Testing is 32 year(s) old...
PS C:\Users\a_san\source\repos>
```

Single Quotes vs. Double Quotes

- When working with strings, you have the option of single or double quotes
- If dealing with a simple string (static, no substitutions), either will work
- If you need to substitute runtime values for variable placeholders in strings, you must use double quotes
- This is what's known as string interpolation

```
PS C:\Users\a_san\source\repos> Write-Host '$($person.FirstName) $($person.LastName) is $($person.Age) year(s) old...'

$($person.FirstName) $($person.LastName) is $($person.Age) year(s) old...
PS C:\Users\a_san\source\repos> Write-Host "($person.FirstName) ($person.LastName) is ($person.Age) year(s) old..."

(@{FirstName=Melissa; LastName=Testing; Age=32}.FirstName) (@{FirstName=Melissa; LastName=Testing; Age=32}.LastName) is (@{FirstName=Melissa; Las
PS C:\Users\a_san\source\repos> Write-Host "$person.FirstName $person.LastName is $person.Age year(s) old..."

@{FirstName=Melissa; LastName=Testing; Age=32}.FirstName @{FirstName=Melissa; LastName=Testing; Age=32}.LastName is @{FirstName=Melissa; LastName
PS C:\Users\a_san\source\repos> Write-Host "$($person.FirstName) $($person.LastName) is $($person.Age) year(s) old..."

Melissa Testing is 32 year(s) old...
PS C:\Users\a_san\source\repos>
```

The PowerShell Pipeline

Develop Intelligence

The Pipe Operator

- Using the PowerShell pipeline, we can chain commands together
- With the | operator between 2 commands, output from the first will act as input to the second
- Multiple commands can be piped together
- Last “link in the chain” pipes output to the console

```
PS C:\Users\a_san\source\repos> Get-Content -Path .\pshell\services.txt | Get-Service

Status   Name               DisplayName
------   ----               -----------
Running  MSDTC              Distributed Transaction Coordinator
Running  WSearch            Windows Search
Running  WinRM              Windows Remote Management (WS-Manag...


PS C:\Users\a_san\source\repos>
```

The Pipe Operator

- Helps keep our code more concise
- Should probably limit chains to ~ 5 commands at most
- Literals and variables can be used as starting points for piping
- Key is that objects (rather than values) are piped between the commands

```
PS C:\Users\a_san\source\repos> 'WinRM', 'WSearch' | Get-Service | Start-Service

PS C:\Users\a_san\source\repos> $services = 'MSDTC', 'WSearch', 'WinRM'

PS C:\Users\a_san\source\repos> $services[0..1] | Get-Service | Start-Service

PS C:\Users\a_san\source\repos>
```

Parameter Binding

Develop Intelligence

- During piping, PowerShell leverages parameter binding
- Tries to match object passed in on pipe to parameters on target command
- For piping to be successful:
  - Pipeline support must be defined for at least one of the command's parameters
  - PowerShell must be able to bind according to a set of defined rules

Parameter Binding

Develop Intelligence

- Get-Help can be used to explore pipeline support for a command
- In definition of parameter, there will be an “Accept pipeline input?” entry
- If true, pipeline input is supported
- Will also indicate types of binding supported

Name parameter on *Get-Service* cmdlet

```
-Name <System.String[]>
    Specifies the service names of services to be retrieved. Wildcards are permitted. By default, this cmdlet gets all of the services on the computer.

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

ByValue

- Will match type of input to parameter
- Because match depends on type, only one parameter can be passed *ByValue*

ByPropertyName

- Will look at object piped to command
- If input object has property with same name as parameter of command, command will use that property value

```
PS C:\Users\a_san\source\repos> $service = [PSCustomObject]@{Name = 'WinRM'; ComputerName = 'DESKTOP-QJENT2P'}

PS C:\Users\a_san\source\repos> $service | Get-Service


Status   Name               DisplayName
------   ----               -----------
Running  WinRM              Windows Remote Management (WS-Manag...


PS C:\Users\a_san\source\repos>
```

Processing Command Results

Select-Object

- Command can be piped to *Select-Object* to project results to a specific set of fields
- Uses a comma-delimited list of field names for defining the set of fields on output
- Collection results can be limited using parameters (-First, -Last, -Unique, and -Skip)
- Results can be piped from and to other commands for additional processing

```
PS C:\Users\a_san\source\repos> Get-Command -Name Select-Object -Syntax

Select-Object [[-Property] <Object[]>] [-InputObject <psobject>] [-ExcludeProperty <string[]>] [-ExpandProperty <string>] [-Unique] [-Last <int>] [-First <int>] [-Skip <int>] [-Wait] [<CommonParameters>]

Select-Object [[-Property] <Object[]>] [-InputObject <psobject>] [-ExcludeProperty <string[]>] [-ExpandProperty <string>] [-Unique] [-SkipLast <int>] [<CommonParameters>]

Select-Object [-InputObject <psobject>] [-Unique] [-Wait] [-Index <int[]>] [<CommonParameters>]
```

Select-Object

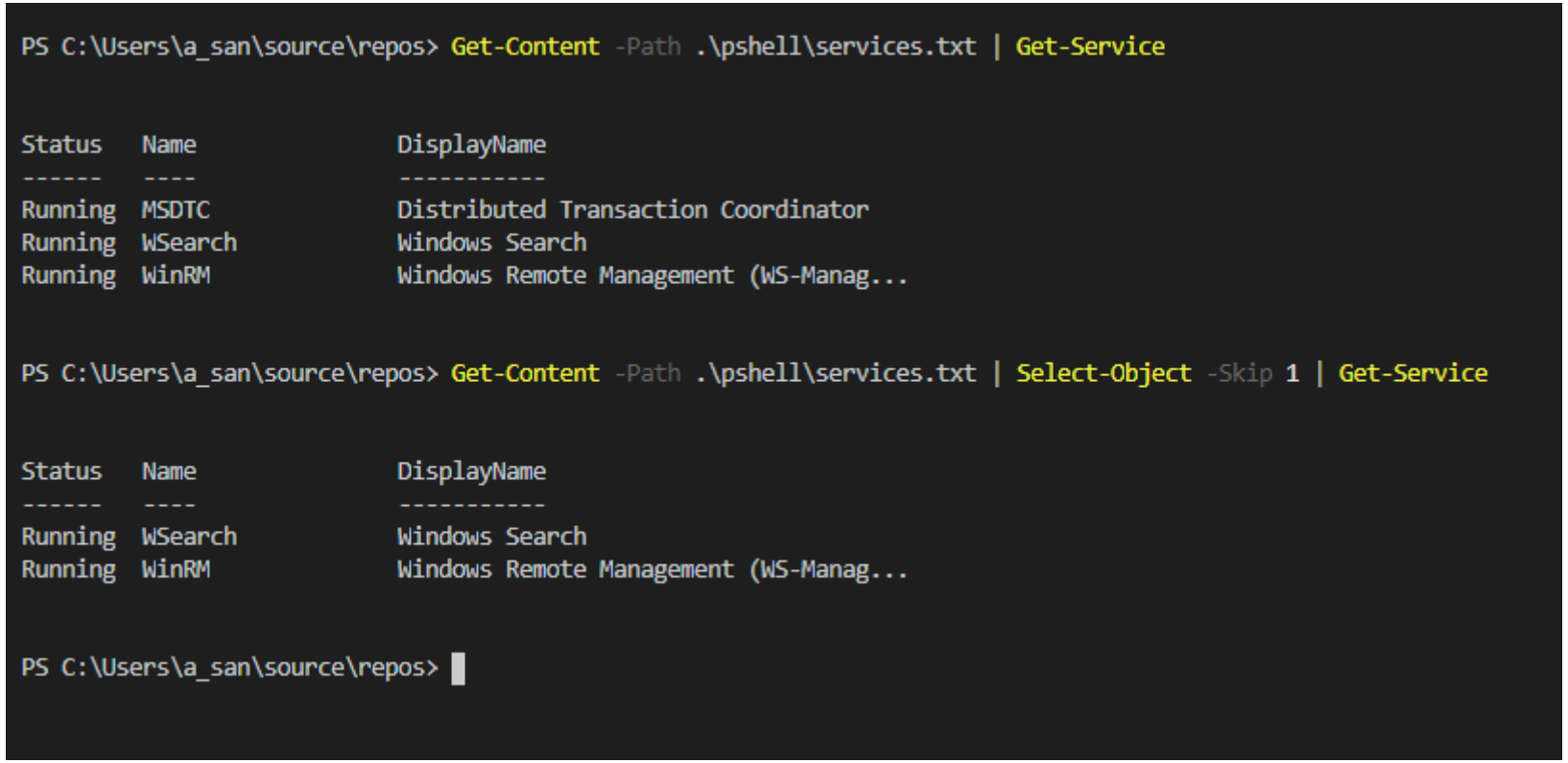
Develop Intelligence

```
PS C:\Users\a_san\source\repos> Get-Service | Select-Object -First 1 | Get-Member


   TypeName: System.ServiceProcess.ServiceController

Name                      MemberType    Definition
----                      ----------    ----------
Name                      AliasProperty Name = ServiceName
RequiredServices          AliasProperty RequiredServices = ServicesDependedOn
Disposed                  Event         System.EventHandler Disposed(System.Object, System.EventArgs)
Close                     Method        void Close()
Continue                  Method        void Continue()
CreateObjRef              Method        System.Runtime.Remoting.ObjRef CreateObjRef(type requestedType)
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.ServiceControllerStatus desiredStatus), void WaitForS
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[] DependentServices {get;}
DisplayName               Property      string DisplayName {get;set;}
MachineName               Property      string MachineName {get;set;}
ServiceHandle             Property      System.Runtime.InteropServices.SafeHandle ServiceHandle {get;}
ServiceName               Property      string ServiceName {get;set;}
ServicesDependedOn        Property      System.ServiceProcess.ServiceController[] ServicesDependedOn {get;}
ServiceType               Property      System.ServiceProcess.ServiceType ServiceType {get;}
Site                      Property      System.ComponentModel.ISite Site {get;set;}
StartType                 Property      System.ServiceProcess.ServiceStartMode StartType {get;}
Status                    Property      System.ServiceProcess.ServiceControllerStatus Status {get;}
ToString                  ScriptMethod  System.Object ToString();
```

Select-Object

```
PS C:\Users\a_san\source\repos> Get-Service | Select-Object -First 5 -Property Name, DisplayName, MachineName, Status, DependentServices



Name              : AarSvc_54801
DisplayName       : AarSvc_54801
MachineName       : .
Status            : Stopped
DependentServices : {}

Name              : AJRouter
DisplayName       : AllJoyn Router Service
MachineName       : .
Status            : Stopped
DependentServices : {}

Name              : ALG
DisplayName       : Application Layer Gateway Service
MachineName       : .
Status            : Stopped
DependentServices : {}

Name              : Alienware Digital Delivery Services
DisplayName       : Alienware Digital Delivery Services
MachineName       : .
Status            : Running
DependentServices : {}

Name              : Alienware SupportAssist Remediation
DisplayName       : Alienware SupportAssist Remediation
MachineName       : .
Status            : Running
DependentServices : {}
```

Select-Object



Select-Object

```
PS C:\Users\a_san\source\repos> 'WSearch', 'WinRM' | Get-Service | Select-Object -Property Name, DisplayName, MachineName, Status, @{label='Num Dep Service'; expression={($_.DependentServices.Length)}}


Name            : WSearch
DisplayName     : Windows Search
MachineName     : .
Status          : Running
Num Dep Service : 2

Name            : WinRM
DisplayName     : Windows Remote Management (WS-Management)
MachineName     : .
Status          : Running
Num Dep Service : 0


PS C:\Users\a_san\source\repos>
```

Select-Object

```
PS C:\Users\a_san\source\repos> 'WSearch' | Get-Service | Select-Object -ExpandProperty DependentServices


Status   Name               DisplayName
------   ----               -----------
Stopped  workfolderssvc     Work Folders
Stopped  WMPNetworkSvc      Windows Media Player Network Sharin...


PS C:\Users\a_san\source\repos>
```

Sort-Object

- Command can be piped to *Sort-Object* to sort results by property values
- Able to define property on which results should be sorted
- Default sort order is ascending but a “switch” parameter can be used to change sort order to descending

Sort-Object

- By default, sorts are case-insensitive but “switch” parameter can be used to modify
- If intent is to sort by multiple properties, use a hashtable

```
PS C:\Users\a_san\source\repos> Get-Command -Name Sort-Object -Syntax


Sort-Object [[-Property] <Object[]>] [-Descending] [-Unique] [-InputObject <psobject>] [-Culture <string>] [-CaseSensitive] [<CommonParameters>]

PS C:\Users\a_san\source\repos>
```

Sort-Object

```
PS C:\Users\a_san\source\repos> Get-Process | Sort-Object -Property CPU -Descending | Select-Object -First 10


Handles  NPM(K)    PM(K)      WS(K)     CPU(s)     Id  SI ProcessName
-------  ------    -----      -----     ------     --  -- -----------
   2720     127  1699696     415124   5,552.72   1828   1 dwm
    827      83   693484     125536   4,302.44   6620   0 sqlservr
   1660      57   673200      66548   4,135.41  16056   1 googledrivesync
   8527       0      236      19612   3,291.47      4   0 System
   2886      23    41916      41752   2,808.06   2796   0 svchost
   1754     127   308976     253768   2,193.44  17196   1 Skype
   3619     105   292376     373012   2,008.72  25068   1 POWERPNT
   7759     916   210360     295440   1,906.78   5392   1 msedge
    865      46    45584      50676   1,888.72  16072   0 XtuService
   3831     122   392224      40048   1,870.55   5776   0 NortonSecurity


PS C:\Users\a_san\source\repos>
```

Where-Object

- Selects objects from a collection using different types of comparison against property values
- Includes a pretty feature-rich set of comparison operators (equals, like, not like, less than, greater than, etc.)
- Comparison operations also include case-sensitive versions (prepended with a “c”)

Where-Object

- Comparison supports a couple of different formats:
  - *-Property Name –EQ –Value "win"*
  - *{$_.Name –eq "win"}*
- Piping to Where-Object commands can be chained to narrow the filter against a collection
- Alternatively, you can leverage combinations of –and and –or operators to build a multi-condition filter

Run *Get-Command –Name Where-Object –Syntax* to see options

Where-Object

```
PS C:\Users\a_san\source\repos> Get-Service | Where-Object {$_.Status -eq 'Stopped'} | Select-Object -First 10


Status   Name               DisplayName
------   ----               -----------
Stopped  AarSvc_54801       AarSvc_54801
Stopped  AJRouter           AllJoyn Router Service
Stopped  ALG                Application Layer Gateway Service
Stopped  AppIDSvc           Application Identity
Stopped  AppMgmt            Application Management
Stopped  AppReadiness       App Readiness
Stopped  AppVClient         Microsoft App-V Client
Stopped  aspnet_state       ASP.NET State Service
Stopped  AssignedAccessM... AssignedAccessManager Service
Stopped  autotimesvc        Cellular Time


PS C:\Users\a_san\source\repos>
```

Where-Object

```
PS C:\Users\a_san\source\repos> Get-Service | Where-Object Status -eq 'Stopped' | Select-Object -First 10


Status   Name               DisplayName
------   ----               -----------
Stopped  AarSvc_54801       AarSvc_54801
Stopped  AJRouter           AllJoyn Router Service
Stopped  ALG                Application Layer Gateway Service
Stopped  AppIDSvc           Application Identity
Stopped  AppMgmt            Application Management
Stopped  AppReadiness       App Readiness
Stopped  AppVClient         Microsoft App-V Client
Stopped  aspnet_state       ASP.NET State Service
Stopped  AssignedAccessM... AssignedAccessManager Service
Stopped  autotimesvc        Cellular Time


PS C:\Users\a_san\source\repos>
```

Where-Object

```
PS C:\Users\a_san\source\repos> Get-Module -ListAvailable | Where-Object {$_.Name -notlike "Microsoft*" -and !$_.HelpInfoUri} | Select-Object -Property Name, HelpInfoUri


Name                                HelpInfoUri
----                                -----------
Azure
Azure
Azure.AnalysisServices
Azure.Storage
AzureRM
AzureRM.AnalysisServices
AzureRM.ApiManagement
AzureRM.ApplicationInsights
AzureRM.Automation
AzureRM.Backup
AzureRM.Batch
AzureRM.Billing
AzureRM.Cdn
AzureRM.CognitiveServices
AzureRM.Compute
AzureRM.Consumption
AzureRM.ContainerInstance
AzureRM.ContainerRegistry
AzureRM.DataFactories
AzureRM.DataFactoryV2
AzureRM.DataLakeAnalytics
AzureRM.DataLakeStore
```

Where-Object

Develop Intelligence

```
PS C:\Users\a_san\source\repos> Get-Module -ListAvailable | Where-Object {($_.Name -notlike "Microsoft*" -and $_.Name -notlike "Azure*") -and !$_.HelpInfoUri} | Select-Object -Property Name, HelpInfoUri


Name                           HelpInfoUri
----                           -----------
Pester
DeliveryOptimization
PersistentMemory
PSDiagnostics
StorageBusCache
SQLPS
Plaster
PowerShellEditorServices
PowerShellEditorServices.VSCode
PSScriptAnalyzer


PS C:\Users\a_san\source\repos>
```

Measure-Object

- Calculates a set of measures against property value(s) of objects
- Can be used to count objects (optionally against a specific property)
- Also, for numeric collections supports min, max, average, sum and standard deviation
- For text objects, supports measurement of lines, words and characters

Measure-Object

- By default, measure will return a list containing count only
- Using parameters of the command, you can enhance what's returned
- If you target a specific measure that is inconsistent with the type of data in the collection, you will receive an error
- Enables collection-level processing without using a loop

```
PS C:\Users\a_san\source\repos\pshell> Get-Command -Name Measure-Object -Syntax

Measure-Object [[-Property] <string[]>] [-InputObject <psobject>] [-Sum] [-Average] [-Maximum] [-Minimum] [<CommonParameters>]

Measure-Object [[-Property] <string[]>] [-InputObject <psobject>] [-Line] [-Word] [-Character] [-IgnoreWhiteSpace] [<CommonParameters>]

PS C:\Users\a_san\source\repos\pshell>
```

Measure-Object

```
PS C:\Users\a_san\source\repos\pshell> $array = 1.3, 3.45, -18.99, 22.01
PS C:\Users\a_san\source\repos\pshell> $array | Measure-Object


Count    : 4
Average  :
Sum      :
Maximum  :
Minimum  :
Property :
```

```
PS C:\Users\a_san\source\repos\pshell> $array | Measure-Object -Sum


Count    : 4
Average  :
Sum      : 7.77
Maximum  :
Minimum  :
Property :
```

```
PS C:\Users\a_san\source\repos\pshell> $array | Measure-Object -Sum -Average -Minimum


Count    : 4
Average  : 1.9425
Sum      : 7.77
Maximum  :
Minimum  : -18.99
Property :


PS C:\Users\a_san\source\repos\pshell>
```

Measure-Object

```
PS C:\Users\a_san\source\repos\pshell> 'The quick brown fox jumped over the lazy dog' | Measure-Object


Count    : 1
Average  :
Sum      :
Maximum  :
Minimum  :
Property :



PS C:\Users\a_san\source\repos\pshell> 'The quick brown fox jumped over the lazy dog' | Measure-Object -Word -Line -Character

Lines Words Characters Property
----- ----- ---------- --------
    1     9         44


PS C:\Users\a_san\source\repos\pshell>
```

Measure-Object

```
PS C:\Users\a_san\source\repos\pshell> 'The quick brown fox jumped over the lazy dog' | Measure-Object -Sum
Measure-Object : Input object "The quick brown fox jumped over the lazy dog" is not numeric.
At line:1 char:50
+ 'The quick brown fox jumped over the lazy dog' | Measure-Object -Sum
+                                                  ~~~~~~~~~~~~~~~~~~
    + CategoryInfo          : InvalidType: (The quick brown...er the lazy dog:String) [Measure-Object], PSInvalidOperationException
    + FullyQualifiedErrorId : NonNumericInputObject,Microsoft.PowerShell.Commands.MeasureObjectCommand



Count    : 1
Average  :
Sum      :
Maximum  :
Minimum  :
Property :


PS C:\Users\a_san\source\repos\pshell>
```

ForEach-Object

- Allows execution of either a ScriptBlock or other statement against each element of a piped collection
- Statement supports gather of property value without changing its type
- Statement can also include execution of a method defined on the element
- Arguments to the method are also supported via *ArgumentList* parameter

ForEach-Object

- For scripting logic to be run against each element, options include:
  - *Begin* – executed at the beginning of collection processing
  - *Process* – executed once for each element of the collection
  - *End* – executed at the end of collection processing
- *Process* supports an array of multiple ScriptBlocks to be executed in sequence

```
PS C:\Users\a_san\source\repos\pshell> Get-Command -Name ForEach-Object -Syntax

ForEach-Object [-Process] <scriptblock[]> [-InputObject <psobject>] [-Begin <scriptblock>] [-End <scriptblock>] [-RemainingScripts <scriptblock[]>] [-WhatIf] [-Confirm] [<CommonParameters>]

ForEach-Object [-MemberName] <string> [-InputObject <psobject>] [-ArgumentList <Object[]>] [-WhatIf] [-Confirm] [<CommonParameters>]

PS C:\Users\a_san\source\repos\pshell>
```

ForEach-Object

```
PS C:\Users\a_san\source\repos\pshell> $total = 0
PS C:\Users\a_san\source\repos\pshell> 1..100 | ForEach-Object -Begin {Write-Host 'Gathering sum'} -Process {$total += $_} -End {Write-Host 'Done with sum'}
Gathering sum
Done with sum
PS C:\Users\a_san\source\repos\pshell> $total
5050
PS C:\Users\a_san\source\repos\pshell>
```

```
PS C:\Users\a_san\source\repos\pshell> 13.34342, 19.234234 | ForEach-Object -MemberName ToString -ArgumentList 'C'
$13.34
$19.23
PS C:\Users\a_san\source\repos\pshell>
```

PS Providers & PS Drives

Develop Intelligence

PSProviders

Develop Intelligence

- .NET programs providing access to specialized data stores
- Intended to facilitate view and management of different types of data
- The data appears in a “drive” – provides virtual path for a data type

PSProviders

- Enables use of same commands used with files with other types of data
- Supports creation of your own or installation of those created by others
- *Get-PSProvider* lists available providers

```
PS C:\Users\a_san\source\repos\pshell> Get-PSProvider

Name                 Capabilities                                                    Drives
----                 ------------                                                    ------
Registry             ShouldProcess, Transactions                                     {HKLM, HKCU}
Alias                ShouldProcess                                                   {Alias}
Environment          ShouldProcess                                                   {Env}
FileSystem           Filter, ShouldProcess, Credentials                              {C, D}
Function             ShouldProcess                                                   {Function}
Variable             ShouldProcess                                                   {Variable}


PS C:\Users\a_san\source\repos\pshell>
```

PSDrives

- Data store location that can be accessed like a file system drive
- Commands exist for navigating the drive and its hierarchy (if applicable)
- Supports creation of custom drives for targeted access

PSDrives

- Reference to drive is via “<drivename>:” (like C: for files)
- *Get-PSDrive* can be used to list available drives

```
PS C:\Users\a_san\source\repos\pshell> Get-PSDrive

Name           Used (GB)     Free (GB) Provider      Root
----           ---------     --------- --------      ----
Alias                                  Alias
C                 188.27        749.44 FileSystem    C:\
Cert                                   Certificate   \
D                 373.76       1489.25 FileSystem    D:\
Env                                    Environment
Function                               Function
HKCU                                   Registry      HKEY_CURRENT_USER
HKLM                                   Registry      HKEY_LOCAL_MACHINE
Variable                               Variable
WSMan                                  WSMan


PS C:\Users\a_san\source\repos\pshell>
```

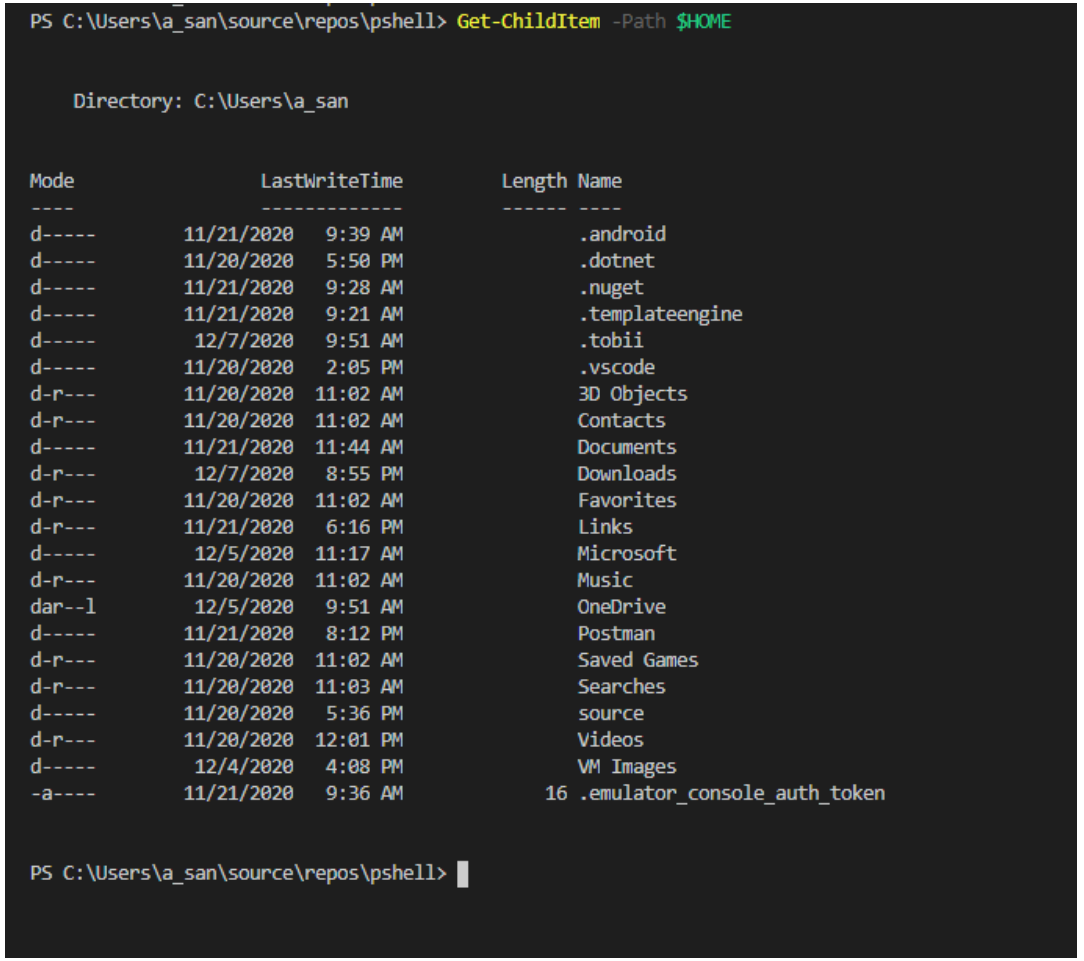
PSDrives

Drive Name	Brief Description
Alias	Provides access to available command aliases
C, D, etc.	Provides access to filesystem drives
Cert	Provides access to certificate store
Env	Provides access to environment variables
Function	Provides access to defined functions
HKCU, HKLM	Provides access to Registry keys
Variable	Provides access to defined variables
WSMan	Provides access to management configuration data (on local & remote systems)

PSDrives

```
PS C:\Users\a_san\source\repos\pshell> $myVar = 42
PS C:\Users\a_san\source\repos\pshell> Get-ChildItem -Path Variable:

Name                           Value
----                           -----
$                              42
?                              True
^                              $myVar
args                           {}
ConfirmPreference              High
ConsoleFileName
DebugPreference                SilentlyContinue
Error                          {}
ErrorActionPreference          Continue
ErrorView                      NormalView
ExecutionContext               System.Management.Automation.EngineIntrinsics
false                          False
FormatEnumerationLimit         4
HOME                           C:\Users\a_san
Host                           System.Management.Automation.Internal.Host.InternalHost
InformationPreference          SilentlyContinue
input                          System.Collections.ArrayList+ArrayListEnumeratorSimple
MaximumAliasCount              4096
MaximumDriveCount              4096
MaximumErrorCount              256
MaximumFunctionCount           4096
MaximumHistoryCount            4096
MaximumVariableCount           4096
MyInvocation                   System.Management.Automation.InvocationInfo
myVar                          42
NestedPromptLevel              0
null
OutputEncoding                 System.Text.ASCIIEncoding
PID                            25216
PROFILE                        C:\Users\a_san\OneDrive\Documents\WindowsPowerShell\Microsoft.PowerShell_profile.ps1
ProgressPreference             Continue
```

PSDrives


PS C:\Users\a_san\source\repos\pshell> Get-ChildItem -Path $HOME
Directory: C:\Users\a_san
Mode LastWriteTime Length Name
---- ------------- ------ ----
d----- 11/21/2020 9:39 AM .android
d----- 11/20/2020 5:50 PM .dotnet
d----- 11/21/2020 9:28 AM .nuget
d----- 11/21/2020 9:21 AM .templateengine
d----- 12/7/2020 9:51 AM .tobii
d----- 11/20/2020 2:05 PM .vscode
d-r--- 11/20/2020 11:02 AM 3D Objects
d-r--- 11/20/2020 11:02 AM Contacts
d----- 11/21/2020 11:44 AM Documents
d-r--- 12/7/2020 8:55 PM Downloads
d-r--- 11/20/2020 11:02 AM Favorites
d-r--- 11/21/2020 6:16 PM Links
d----- 12/5/2020 11:17 AM Microsoft
d-r--- 11/20/2020 11:02 AM Music
dar--l 12/5/2020 9:51 AM OneDrive
d----- 11/21/2020 8:12 PM Postman
d-r--- 11/20/2020 11:02 AM Saved Games
d-r--- 11/20/2020 11:03 AM Searches
d----- 11/20/2020 5:36 PM source
d-r--- 11/20/2020 12:01 PM Videos
d----- 12/4/2020 4:08 PM VM Images
-a---- 11/21/2020 9:36 AM 16 .emulator_console_auth_token
PS C:\Users\a_san\source\repos\pshell>

PSDrives

```
PS C:\Users\a_san\source\repos\pshell> Get-ChildItem -Path HKCU:\SOFTWARE\Microsoft\Windows


    Hive: HKEY_CURRENT_USER\SOFTWARE\Microsoft\Windows


Name                           Property
----                           --------
AssignedAccessConfiguration
CurrentVersion
DWM                            Composition                : 1
                               ColorizationColor          : 3293334087
                               ColorizationColorBalance   : 89
                               ColorizationAfterglow      : 3293334087
                               ColorizationAfterglowBalance : 10
                               ColorizationBlurBalance    : 1
                               EnableWindowColorization   : 0
                               ColorizationGlassAttribute : 1
                               AccentColor                : 4282862156
                               ColorPrevalence            : 0
                               EnableAeroPeek             : 1
                               AlwaysHibernateThumbnails  : 0
Shell
ShellNoRoam
TabletPC
Windows Error Reporting        LastRateLimitedDumpGenerationTime : 132518422187833331
Winlogon


PS C:\Users\a_san\source\repos\pshell>
```

Adding New Drives

- Using *New-PSDrive*, you can create a new drive “mapping”
- At creation, you specify name, associated provider, and drive root
- Can use to create your own aliases for common paths
- As with other entities, drive exists in current session only (by default)

Adding New Drives

```
PS C:\Users\a_san\source\repos\pshell> New-PSDrive -Name git -PSProvider FileSystem -Root C:\Users\a_san\source\repos\

Name           Used (GB)     Free (GB) Provider      Root
----           ---------     --------- --------      ----
git                 0.00        749.44 FileSystem    C:\Users\a_san\source\repos\
```

```
PS C:\Users\a_san\source\repos\pshell> Get-PSDrive

Name           Used (GB)     Free (GB) Provider      Root
----           ---------     --------- --------      ----
Alias                                  Alias
C                 188.27        749.44 FileSystem    C:\
Cert                                   Certificate   \
D                 373.76       1489.25 FileSystem    D:\
Env                                    Environment
Function                               Function
git                 0.00        749.44 FileSystem    C:\Users\a_san\source\repos\
HKCU                                   Registry      HKEY_CURRENT_USER
HKLM                                   Registry      HKEY_LOCAL_MACHINE
Variable                               Variable
WSMan                                  WSMan
```

```
PS C:\Users\a_san\source\repos\pshell> Get-ChildItem -Path git:


    Directory: C:\Users\a_san\source\repos


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
d-----        12/7/2020   6:41 PM                pshell
d-----        12/6/2020   1:27 PM                pshell-core
d-----        12/7/2020   7:04 PM                pshell-core-public


PS C:\Users\a_san\source\repos\pshell>
```

Deleting Custom Drives

- Using *Remove-PSDrive*, you can delete a drive by name
- Cannot delete the drive while you are currently in the drive (i.e., Set-Location)

```
PS C:\Users\a_san\source\repos\pshell> Set-Location -Path git:
PS git:\> Remove-PSDrive -Name git
Remove-PSDrive : Cannot remove drive 'git' because it is in use.
At line:1 char:1
+ Remove-PSDrive -Name git
+ ~~~~~~~~~~~~~~~~~~~~~~~~~
    + CategoryInfo          : InvalidOperation: (:) [Remove-PSDrive], PSInvalidOperationException
    + FullyQualifiedErrorId : InvalidOperation,Microsoft.PowerShell.Commands.RemovePSDriveCommand

PS git:\>
```

Working with Files & Folders

Test-Path

- Used to check whether all elements in a path exist
- Returns true if so; false, otherwise
- Can be used to test before executing other file operations

```
PS C:\Users\a_san\source\repos\pshell> Test-Path -Path $HOME
True
PS C:\Users\a_san\source\repos\pshell> Test-Path -Path C:\I\Do\No\Exist\
False
PS C:\Users\a_san\source\repos\pshell>
```

New-Item

- Can be used to create a new directory or folder
- For a file, can also optionally be used to set its value at creation time
- *-Path*, *-Name*, and *–ItemType* parameters are used to describe
- When creating file, all parts of target path must exist (i.e. folders)

```
PS C:\Users\a_san\source\repos\pshell> Get-Command -Name New-Item -Syntax

New-Item [-Path] <string[]> [-ItemType <string>] [-Value <Object>] [-Force] [-Credential <pscredential>] [-WhatIf] [-Confirm] [-UseTransaction] [<CommonParameters>]

New-Item [[-Path] <string[]>] -Name <string> [-ItemType <string>] [-Value <Object>] [-Force] [-Credential <pscredential>] [-WhatIf] [-Confirm] [-UseTransaction] [<CommonParameters>]

PS C:\Users\a_san\source\repos\pshell>
```

New-Item

```
PS C:\Users\a_san\source\repos\pshell> New-Item -Path . -Name 'new-folder' -ItemType Directory


    Directory: C:\Users\a_san\source\repos\pshell


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
d-----         12/7/2020  11:25 PM                new-folder


PS C:\Users\a_san\source\repos\pshell> New-Item -Path .\new-folder\ -Name 'test.txt' -ItemType File


    Directory: C:\Users\a_san\source\repos\pshell\new-folder


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a----         12/7/2020  11:25 PM              0 test.txt


PS C:\Users\a_san\source\repos\pshell> New-Item -Path .\new-folder-2\ -Name 'test2.txt' -ItemType File
New-Item : Could not find a part of the path 'C:\Users\a_san\source\repos\pshell\new-folder-2\test2.txt'.
At line:1 char:1
+ New-Item -Path .\new-folder-2\ -Name 'test2.txt' -ItemType File
+ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
    + CategoryInfo          : WriteError: (C:\Users\a_san\...der-2\test2.txt:String) [New-Item], DirectoryNotFoundException
    + FullyQualifiedErrorId : NewItemIOError,Microsoft.PowerShell.Commands.NewItemCommand

PS C:\Users\a_san\source\repos\pshell>
```

Set-Location

- *Set-Location* can be used to change to a specific path (like *cd*)
- In that location, you can navigate its hierarchy using *cd* or *Set-Location*
- Alternatively, you can use –*Path* parameter of other commands

```
PS git:\> ls


    Directory: C:\Users\a_san\source\repos


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
d-----         12/7/2020   6:41 PM                pshell
d-----         12/6/2020   1:27 PM                pshell-core
d-----         12/7/2020   7:04 PM                pshell-core-public


PS git:\> cd .\pshell\
PS git:\pshell> cd ..
PS git:\> cd ..
PS git:\>
```

Get-ChildItem

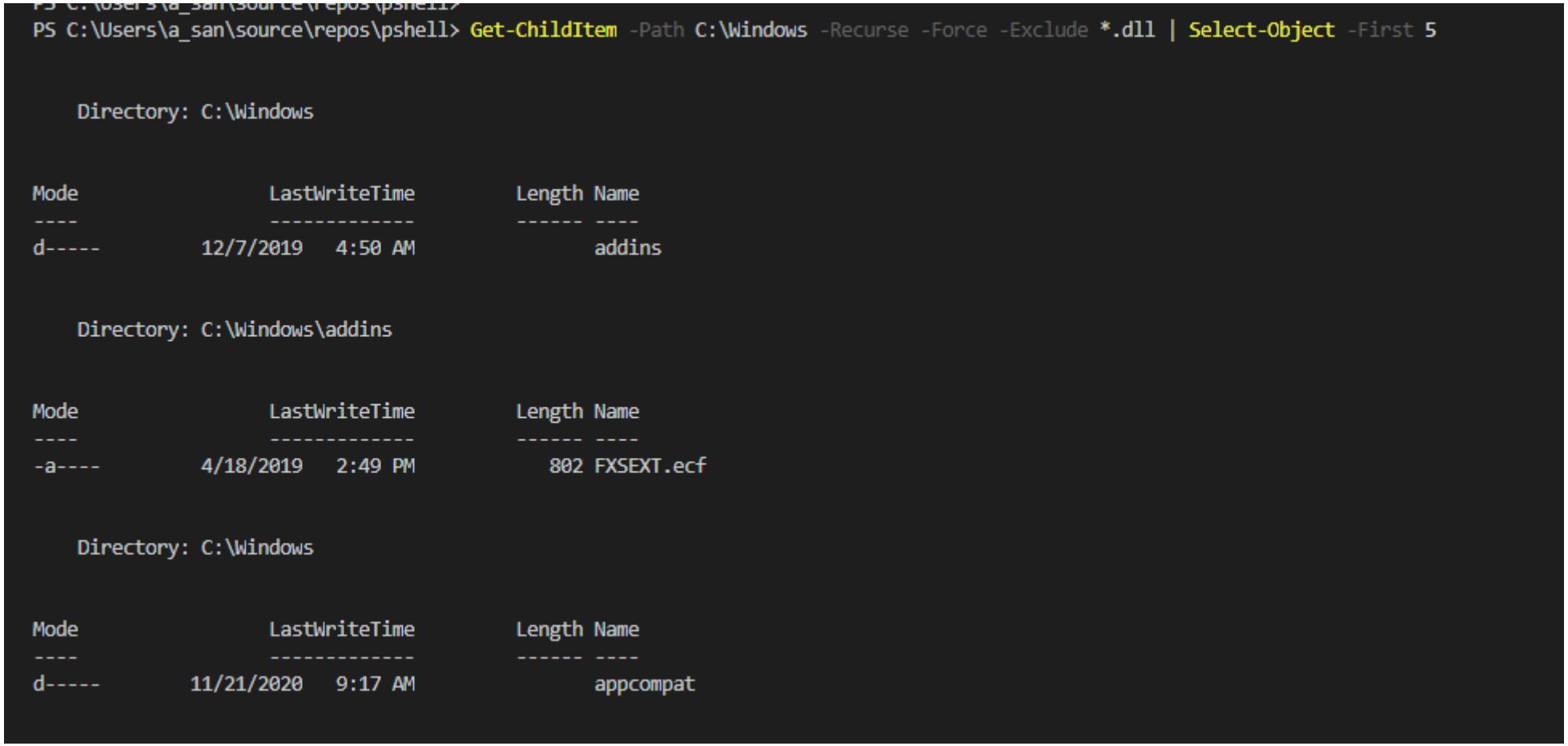
- *Get-ChildItem* can be used to list contents of a drive or path
- *ls* and *dir* are aliases for the command
- Provides a *–Recurse* parameter to include sub-locations

Get-ChildItem

- Provides a *–Force* parameter to list hidden items
- *-Exclude* can be used to exclude files by name
- *-Path* and *–Exclude* support wildcards

```
PS C:\Users\a_san\source\repos\pshell> Get-Command -Name Get-ChildItem -Syntax

Get-ChildItem [[-Path] <string[]>] [[-Filter] <string>] [-Include <string[]>] [-Exclude <string[]>] [-Recurse] [-Depth <uint32>] [-Force] [-Name] [-
UseTransaction] [-Attributes <FlagsExpression[FileAttributes]>] [-Directory] [-File] [-Hidden] [-ReadOnly] [-System] [<CommonParameters>]

Get-ChildItem [[-Filter] <string>] -LiteralPath <string[]> [-Include <string[]>] [-Exclude <string[]>] [-Recurse] [-Depth <uint32>] [-Force] [-Name]
 [-UseTransaction] [-Attributes <FlagsExpression[FileAttributes]>] [-Directory] [-File] [-Hidden] [-ReadOnly] [-System] [<CommonParameters>]

PS C:\Users\a_san\source\repos\pshell>
```

Get-ChildItem



Set-Content

- Used for writing objects to a file
- Writes new content or replaces existing content
- Supports use of –*Value* parameter or can pipe content to the command
- Will create file if does not exist

```
PS C:\Users\a_san\source\repos\pshell> Get-Command -Name Set-Content -Syntax

Set-Content [-Path] <string[]> [-Value] <Object[]> [-PassThru] [-Filter <string>] [-Include <string[]>] [-Exclude <string[]>] [-Force] [-Credential
<pscredential>] [-WhatIf] [-Confirm] [-UseTransaction] [-NoNewline] [-Encoding <FileSystemCmdletProviderEncoding>] [-Stream <string>] [<CommonParame
ters>]

Set-Content [-Value] <Object[]> -LiteralPath <string[]> [-PassThru] [-Filter <string>] [-Include <string[]>] [-Exclude <string[]>] [-Force] [-Creden
tial <pscredential>] [-WhatIf] [-Confirm] [-UseTransaction] [-NoNewline] [-Encoding <FileSystemCmdletProviderEncoding>] [-Stream <string>] [<CommonP
arameters>]

PS C:\Users\a_san\source\repos\pshell>
```

Add-Content

- Used for appending objects to a file
- Does not replace existing content
- Supports use of –*Value* parameter or can pipe content to the command
- Will create file if does not exist

```
PS C:\Users\a_san\source\repos\pshell> Get-Command -Name Add-Content -Syntax

Add-Content [-Path] <string[]> [-Value] <Object[]> [-PassThru] [-Filter <string>] [-Include <string[]>] [-Exclude <string[]>] [-Force] [-Credential
<pscredential>] [-WhatIf] [-Confirm] [-UseTransaction] [-NoNewline] [-Encoding <FileSystemCmdletProviderEncoding>] [-Stream <string>] [<CommonParame
ters>]

Add-Content [-Value] <Object[]> -LiteralPath <string[]> [-PassThru] [-Filter <string>] [-Include <string[]>] [-Exclude <string[]>] [-Force] [-Creden
tial <pscredential>] [-WhatIf] [-Confirm] [-UseTransaction] [-NoNewline] [-Encoding <FileSystemCmdletProviderEncoding>] [-Stream <string>] [<CommonP
arameters>]

PS C:\Users\a_san\source\repos\pshell>
```

Get-Content

- Used for retrieving contents of file
- Content will be returned as an array with each line representing an element
- *Get-Content* is often used to pipe a list of things from a file to other commands

```
PS C:\Users\a_san\source\repos\pshell> Get-Command -Name Get-Content -Syntax

Get-Content [-Path] <string[]> [-ReadCount <long>] [-TotalCount <long>] [-Tail <int>] [-Filter <string>] [-Include <string[]>] [-Exclude <string[]>]
 [-Force] [-Credential <pscredential>] [-UseTransaction] [-Delimiter <string>] [-Wait] [-Raw] [-Encoding <FileSystemCmdletProviderEncoding>] [-Strea
m <string>] [<CommonParameters>]

Get-Content -LiteralPath <string[]> [-ReadCount <long>] [-TotalCount <long>] [-Tail <int>] [-Filter <string>] [-Include <string[]>] [-Exclude <strin
g[]>] [-Force] [-Credential <pscredential>] [-UseTransaction] [-Delimiter <string>] [-Wait] [-Raw] [-Encoding <FileSystemCmdletProviderEncoding>] [-
Stream <string>] [<CommonParameters>]

PS C:\Users\a_san\source\repos\pshell>
```

Get-Content

services.txt

```
1   MSDTC
2   WSearch
3   WinRM
```

```
PS C:\Users\a_san\source\repos\pshell> $contents = Get-Content -Path .\services.txt
PS C:\Users\a_san\source\repos\pshell> $contents
MSDTC
WSearch
WinRM
PS C:\Users\a_san\source\repos\pshell> $contents.Length
3
PS C:\Users\a_san\source\repos\pshell> $contents[1]
WSearch
PS C:\Users\a_san\source\repos\pshell>
```

CSV, HTML, and JSON

Import-Csv

- Used for importing CSV file contents into memory
- Parses content into an array of PSCustomObjects
- Each header value is translated to a property on the object
- Row value for a given column header can be accessed using [ ] and . notation

Import-Csv

- “Records” can be piped to other commands for filter, projection on import
- *-Delimiter* parameter allows specification of a different delimiter
- *-Header* parameter allows change to header identifiers

```
PS C:\Users\a_san\source\repos\pshell>
PS C:\Users\a_san\source\repos\pshell> Get-Command -Name Import-Csv -Syntax

Import-Csv [[-Path] <string[]>] [[-Delimiter] <char>] [-LiteralPath <string[]>] [-Header <string[]>] [-Encoding <string>] [<CommonParameters>]

Import-Csv [[-Path] <string[]>] -UseCulture [-LiteralPath <string[]>] [-Header <string[]>] [-Encoding <string>] [<CommonParameters>]

PS C:\Users\a_san\source\repos\pshell>
```

Import-Csv

test.csv

```
"FirstName","LastName","Age"
"Joe","Smith",42
"Melissa","Testing",39
```

```
PS C:\Users\a_san\source\repos\pshell>
PS C:\Users\a_san\source\repos\pshell> $people = Import-Csv -Path .\test.csv -Header "fname", "lname", "age"
PS C:\Users\a_san\source\repos\pshell> $people

fname     lname    age
-----     -----    ---
FirstName LastName Age
Joe       Smith    42
Melissa   Testing  39


PS C:\Users\a_san\source\repos\pshell> $people[1].lname
Smith
PS C:\Users\a_san\source\repos\pshell>
```

Export-Csv

- Used for exporting data to a CSV file
- Can be used for storing projected results from another command
- Property names used as headers and property values become rows
- Useful for data reporting for available collections

```
PS C:\Users\a_san\source\repos\pshell>
PS C:\Users\a_san\source\repos\pshell> Get-Command -Name Export-Csv -Syntax

Export-Csv [[-Path] <string>] [[-Delimiter] <char>] -InputObject <psobject> [-LiteralPath <string>] [-Force] [-NoClobber] [-Encoding <string>] [-Append] [-NoTypeInformation] [-WhatIf] [-Confirm] [<CommonParameters>]

Export-Csv [[-Path] <string>] -InputObject <psobject> [-LiteralPath <string>] [-Force] [-NoClobber] [-Encoding <string>] [-Append] [-UseCulture] [-NoTypeInformation] [-WhatIf] [-Confirm] [<CommonParameters>]

PS C:\Users\a_san\source\repos\pshell>
```

Export-Csv

```
PS C:\Users\a_san\source\repos\pshell>
PS C:\Users\a_san\source\repos\pshell>
PS C:\Users\a_san\source\repos\pshell> Get-Process | Select-Object -Property Name,Company,Description |
>> Export-Csv -Path .\processes.csv -NoTypeInformation
PS C:\Users\a_san\source\repos\pshell>
```

processes.csv

```
"Name","Company","Description"
"AlienwareOn-ScreenDisplay","Alienware Corp.","Alienware On-Screen Display"
"Amazon Music Helper","Amazon.com Services LLC","Amazon Music Helper"
"ApplicationFrameHost","Microsoft Corporation","Application Frame Host"
"AppVShNotify","Microsoft Corporation","Microsoft Application Virtualization Client Shell Notifier"
"AppVShNotify","Microsoft Corporation","Microsoft Application Virtualization Client Shell Notifier"
"audiodg","Microsoft Corporation","Windows Audio Device Graph Isolation "
"AWCC","Dell Technologies","AWCC"
"AWCC.Background.Server","Dell Technologies","AWCC.Background.Server"
"AWCC.Service","Dell Technologies","AWCC.Service"
"Calculator","Microsoft Corporation","Calculator.exe"
"chrome","Google LLC","Google Chrome"
"chrome","Google LLC","Google Chrome"
"chrome","Google LLC","Google Chrome"
"chrome","Google LLC","Google Chrome"
"chrome","Google LLC","Google Chrome"
"chrome","Google LLC","Google Chrome"
"chrome","Google LLC","Google Chrome"
"chrome","Google LLC","Google Chrome"
"chrome","Google LLC","Google Chrome"
"chrome","Google LLC","Google Chrome"
"chrome","Google LLC","Google Chrome"
"chrome","Google LLC","Google Chrome"
"chrome","Google LLC","Google Chrome"
```

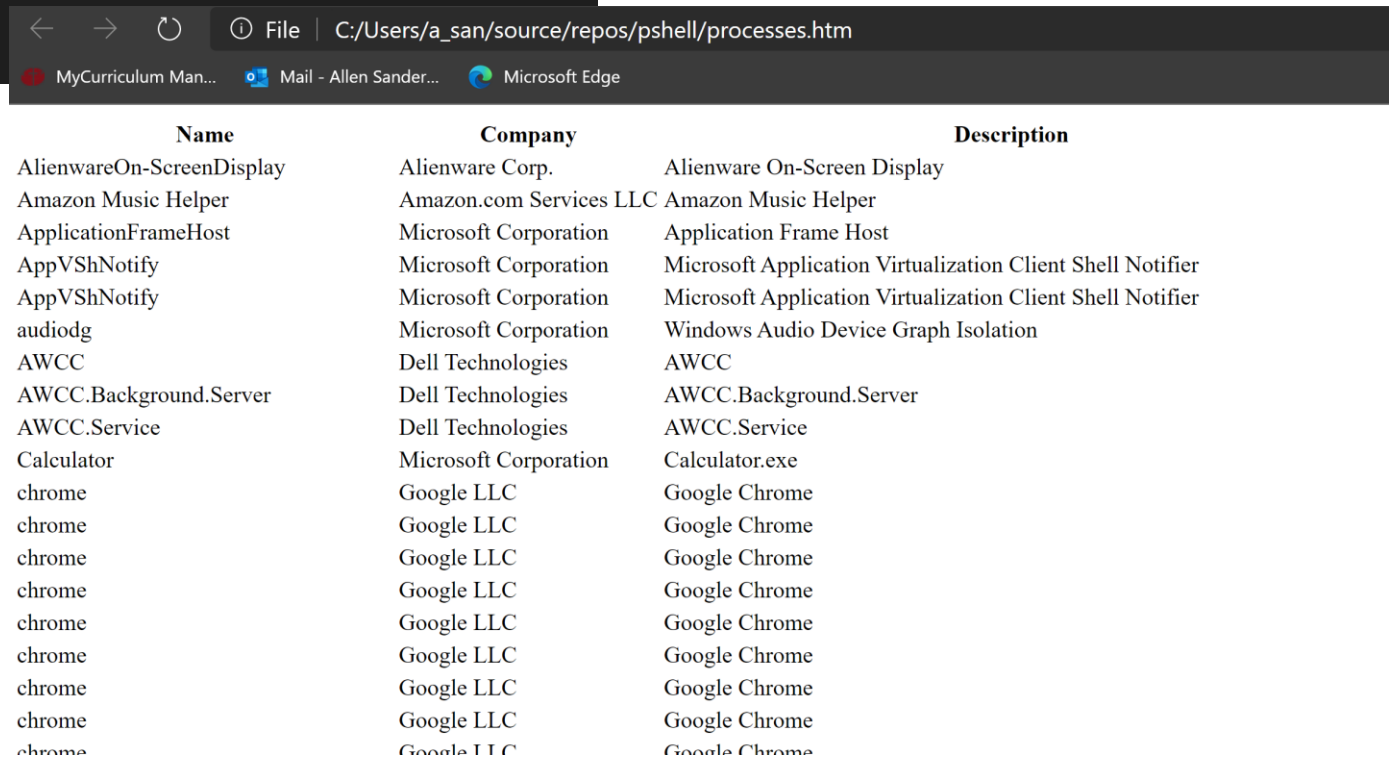
ConvertTo-Html

- Allows specification of fields to include on result (using *–Property*)
- Supports push to an output filename using > “<filepath>\<filename>.htm”
- Can be used to quickly provide results in a more visual appealing manner
- Can pipe output from another command for html display

```
PS C:\Users\a_san\source\repos\pshell>
PS C:\Users\a_san\source\repos\pshell> Get-Command -Name ConvertTo-Html -Syntax

ConvertTo-Html [[-Property] <Object[]>] [[-Head] <string[]>] [[-Title] <string>] [[-Body] <string[]>] [-InputObject <psobject>] [-As <string>] [-Css
Uri <uri>] [-PostContent <string[]>] [-PreContent <string[]>] [<CommonParameters>]

ConvertTo-Html [[-Property] <Object[]>] [-InputObject <psobject>] [-As <string>] [-Fragment] [-PostContent <string[]>] [-PreContent <string[]>] [<Co
mmonParameters>]

PS C:\Users\a_san\source\repos\pshell>
```

ConvertTo-Html

```
PS C:\Users\a_san\source\repos\pshell>
PS C:\Users\a_san\source\repos\pshell> Get-Process | Select-Object -Property Name,Company,Description |
>> ConvertTo-Html -Property Name,Company,Description > '.\processes.htm'
PS C:\Users\a_san\source\repos\pshell>
```



Name	Company	Description
AlienwareOn-ScreenDisplay	Alienware Corp.	Alienware On-Screen Display
Amazon Music Helper	Amazon.com Services LLC	Amazon Music Helper
ApplicationFrameHost	Microsoft Corporation	Application Frame Host
AppVShNotify	Microsoft Corporation	Microsoft Application Virtualization Client Shell Notifier
AppVShNotify	Microsoft Corporation	Microsoft Application Virtualization Client Shell Notifier
audiodg	Microsoft Corporation	Windows Audio Device Graph Isolation
AWCC	Dell Technologies	AWCC
AWCC.Background.Server	Dell Technologies	AWCC.Background.Server
AWCC.Service	Dell Technologies	AWCC.Service
Calculator	Microsoft Corporation	Calculator.exe
chrome	Google LLC	Google Chrome
chrome	Google LLC	Google Chrome
chrome	Google LLC	Google Chrome
chrome	Google LLC	Google Chrome
chrome	Google LLC	Google Chrome
chrome	Google LLC	Google Chrome
chrome	Google LLC	Google Chrome
chrome	Google LLC	Google Chrome
chrome	Google LLC	Google Chrome

ConvertFrom-Json

- Can be used to convert raw JSON as input into PowerShell objects
- Data will be converted to an array of custom objects
- Individual records and properties are available using [ ] and . notation

people.json

```
[
    {
        "FirstName": "Joe",
        "LastName": "Smith",
        "Age": 42
    },
    {
        "FirstName": "Melissa",
        "LastName": "Testing",
        "Age": 39
    }
]
```

```
PS C:\Users\a_san\source\repos\pshell> $jsonPeople = Get-Content -Path .\people.json -Raw | ConvertFrom-Json
PS C:\Users\a_san\source\repos\pshell> $jsonPeople

FirstName LastName Age
--------- -------- ---
Joe       Smith     42
Melissa   Testing   39


PS C:\Users\a_san\source\repos\pshell> $jsonPeople[1].Age
39
PS C:\Users\a_san\source\repos\pshell>
```

ConvertTo-Json

- Can be used to pipe output from other commands to JSON
- Enables translation of one format (e.g., CSV) to JSON
- Provides a –*Compress* parameter for minimizing resulting text

processes.csv

```
"Name","Company","Description"
"AlienwareOn-ScreenDisplay","Alienware Corp.","Alienware On-Screen Display"
"Amazon Music Helper","Amazon.com Services LLC","Amazon Music Helper"
"ApplicationFrameHost","Microsoft Corporation","Application Frame Host"
"AppVShNotify","Microsoft Corporation","Microsoft Application Virtualization Client Shell Notifier"
"AppVShNotify","Microsoft Corporation","Microsoft Application Virtualization Client Shell Notifier"
"audiodg","Microsoft Corporation","Windows Audio Device Graph Isolation "
"AWCC","Dell Technologies","AWCC"
"AWCC.Background.Server","Dell Technologies","AWCC.Background.Server"
"AWCC.Service","Dell Technologies","AWCC.Service"
"Calculator","Microsoft Corporation","Calculator.exe"
"chrome","Google LLC","Google Chrome"
"chrome","Google LLC","Google Chrome"
```

processes.json

```
[{"Name":"AlienwareOn-ScreenDisplay","Company":"Alienware Corp.","Description":"A
"Description":"Amazon Music Helper"},{"Name":"ApplicationFrameHost","Company":"Mi
Corporation","Description":"Microsoft Application Virtualization Client Shell Not
Virtualization Client Shell Notifier"},{"Name":"audiodg","Company":"Microsoft Cor
"Description":"AWCC"},{"Name":"AWCC.Background.Server","Company":"Dell Technologi
"Description":"AWCC.Service"},{"Name":"Calculator","Company":"Microsoft Corporati
{"Name":"chrome","Company":"Google LLC","Description":"Google Chrome"},{"Name":"c
"Description":"Google Chrome"},{"Name":"chrome","Company":"Google LLC","Descripti
"Company":"Google LLC","Description":"Google Chrome"},{"Name":"chrome","Company":
Chrome"},{"Name":"chrome","Company":"Google LLC","Description":"Google Chrome"},{
"Description":"Google Chrome"},{"Name":"chrome","Company":"Google LLC","Descripti
"Company":"Google LLC","Description":"Google Chrome"},{"Name":"Code","Company":"M
"Description":"Visual Studio Code"},{"Name":"Code","Company":"Microsoft Corporati
```

```
PS C:\Users\a_san\source\repos\pshell>
PS C:\Users\a_san\source\repos\pshell> Import-Csv -Path .\processes.csv | ConvertTo-Json -Compress | Set-Content -Path .\processes.json
PS C:\Users\a_san\source\repos\pshell>
```

Conditional Logic

Develop Intelligence

Comparison Operators

Operator	Description
-eq	Compares for equality
-ne	Compares for inequality
-gt	Checks for greater than
-ge	Checks for greater than or equal
-lt	Checks for less than
-le	Checks for less than or equal
-contains	Checks for contains

Case-sensitive versions also exist (prefixed with a “c”) – e.g. *–ceq*, *-cne*, etc.

Logical Operators

Operator	Description
-and	Logical AND – True when both are True
-or	Logical OR – True when either is True (or both)
-xor	Logic Exclusive OR – True when only one is True
-not	Logical NOT – negates the statement that follows
!	Same as –not

if Statement

- Allows us to check a condition (or combination or conditions)
- Multiple conditions can be combined as part of a single check using logical operators
- If evaluates to true, statement(s) defined in the corresponding branch execute

```
if (condition) {
        # code to run when True
}
```

else Statement

- Allows us to define code to execute when condition evaluates to False
- Alternate branch logic

```
if (condition) {
        # code to run when True
} else {
        # code to run when False
}
```

elseif Statement

- Allows definition of branches for checking additional conditions
- Best practice is to try and keep number of branches to a reasonable size

```
if (condition 1) {
        # code to run when condition 1 True
} else if (condition 2) {
        # code to run when condition 2 True
} else {
        # code to run when all False
}
```

switch Statement

- Potential substitute for if-elseif when testing a single value
- Checks for matching value in branches and executes branch if match found
- If none found, executes default branch (if defined)
- *break* is used to make the conditions mutually exclusive

```
switch (expression) {
        expressionvalue 1 {
                # Code
                break
        }
        expressionvalue 2 {
                # Code
                break
        }
        default {
                # Code for no match
        }
}
```

Looping

foreach Loop

- Performs an action for every object in a collection (usually an array)
- Useful when you need to iterate over the entire set
- Provides 3 different formats

foreach Statement

- Separate looping structure that can be used in our PowerShell code
- Uses a variable to hold a copy of the current item during iteration
- Logic defined in the loop has access to the variable for processing as part of current iteration

```
foreach ($var in $array) {
        # Logic to be executed on each iteration
        # Has read-only access to $var
}
```

ForEach-Object Cmdlet

- What we looked at earlier as part of the piping discussion

```
PS C:\Users\a_san\source\repos\pshell> Get-Command -Name ForEach-Object -Syntax

ForEach-Object [-Process] <scriptblock[]> [-InputObject <psobject>] [-Begin <scriptblock>] [-End <scriptblock>] [-RemainingScripts <scriptblock[]>] [-WhatIf] [-Confirm] [<CommonParameters>]

ForEach-Object [-MemberName] <string> [-InputObject <psobject>] [-ArgumentList <Object[]>] [-WhatIf] [-Confirm] [<CommonParameters>]

PS C:\Users\a_san\source\repos\pshell>
```

```
PS C:\Users\a_san\source\repos\pshell> $total = 0
PS C:\Users\a_san\source\repos\pshell> 1..100 | ForEach-Object -Begin {Write-Host 'Gathering sum'} -Process {$total += $_} -End {Write-Host 'Done with sum'}
Gathering sum
Done with sum
PS C:\Users\a_san\source\repos\pshell> $total
5050
PS C:\Users\a_san\source\repos\pshell>
```

```
PS C:\Users\a_san\source\repos\pshell> 13.34342, 19.234234 | ForEach-Object -MemberName ToString -ArgumentList 'C'
$13.34
$19.23
PS C:\Users\a_san\source\repos\pshell>
```

foreach( ) Method

- Exists on all arrays in PowerShell
- Provides same iterative functionality as other two
- Called as method on an array variable, executing the provided ScriptBlock parameter for each iteration
- Considerably faster than the other two

$array.forEach({ <script to be executed> })

for Loop

- Supports iteration for a predetermined number of occurrences
- Uses a numeric counter to track iterations against a target amount
- Requires an action to move the counter forward
- Also, helpful if access to current numeric position or access to more than one element is desired

```
for ($counter = 0; $counter –lt <#>; $counter++) {
        # Access to $counter possible here
        # Access to $array[$counter] or $array[$counter + 1], etc.
}
```

while Loop

- Executes a block of code while a condition is True
- Useful when the intended number of iterations is not known
- Requires a statement in the loop to move the loop to completion

```
$counter = 0
while ($counter –lt <#>) {
        # Access to $counter possible here
        $counter++  # For example
}
```

while Loop – Alternate Version

Develop Intelligence

```
$counter = 0
while ($true) {
        $counter++
        if ($counter –eq 10) {
                break
        }
}
```

do/while Loop

- Executes a block of code **while** a condition is True
- Difference between this and *while* loop is that associated code block will be executed at least once with *do/while*

```
do {
        # Code block
        # Requires statement to move to completion
} while (condition)
```

do/until Loop

- Executes a block of code **until** a condition is True
- Inverse to *do/while*

```
do {
        # Code block
        # Requires statement to move to completion
} until (condition) # Like while NOT true
```

PowerShell Security

Get-ExecutionPolicy

Develop Intelligence

- Execution policy is implemented in PowerShell to protect against malicious scripting
- *Get-ExecutionPolicy* shows currently applied execution policy (if executed without params)
- If executed with the –*List* param, will show applied execution policies across various scopes

Get-ExecutionPolicy

- Key options include:
  - *AllSigned* – All scripts (.ps1 files) must be signed by a trusted publisher (including scripts written on local computer); most stringent
  - *RemoteSigned* – All remotely downloaded scripts must be signed by a trusted publisher; scripts written on local computer can be executed without digital signature
  - *Restricted* – Prevents load of config files and script (.ps1 file) runs
  - *Unrestricted* – Loads config files and executes scripts; if unsigned downloaded from the Internet, will prompt for execution

Set-ExecutionPolicy

- Enables update of execution policy (as required) for running scripts on a machine
- Includes a couple of key parameters:
  - *-ExecutionPolicy* for specifying target value (AllSigned, RemoteSigned, etc.)
  - *-Scope* for specifying scope of policy application

Set-ExecutionPolicy

- Options include:
  - *MachinePolicy* – set by Group Policy for all users of the computer
  - *UserPolicy* – set by Group Policy for the current user of the computer
  - *Process* – affects only current PowerShell session
  - *CurrentUser* – affects only current user
  - *LocalMachine* – affects all users of the computer

Digitally-Signed Script

Develop Intelligence

- *Set-AuthenticodeSignature* used to sign the script using trusted cert

```
# SIG # Begin signature block
# MIIEMwYJKoZIhvcNAQcCoIIEJDCCBCACAQExCzAJBgUrDgMCGgUAMGkGCisGAQQB
# gjcCAQSgWzBZMDQGCisGAQQBgjcCAR4wJgIDAQAABBAfzDtgWUsITrck0sYpfvNR
# AgEAAgEAAgEAAgEAAgEAMCEwCQYFKw4DAhoFAAQU6vQAn5sf2qIxQqwWUDwTZnJj
...snip...
# m5ugggI9MIICOTCCAaagAwIBAgIQyLeyGZcGA4ZOGqK7VF45GDAJBgUrDgMCHQUA
# Dxoj+2keS9sRR6XPl/ASs68LeF8o9cM=
# SIG # End signature block
```

Get-Credential

- Many cmdlets allow specification of an alternate set of credentials at time of execution
- Useful if executing user or context is anonymous or not authorized to the target resources
- To use, look for a –Credential parameter on the command

```
PS C:\Users\a_san\source\repos\pshell> Get-Command -Name Get-Credential -Syntax

Get-Credential [-Credential] <pscredential> [<CommonParameters>]

Get-Credential [[-UserName] <string>] -Message <string> [<CommonParameters>]

PS C:\Users\a_san\source\repos\pshell>
```

Get-Credential

- There are mechanisms for building the credential in code as well

```
PS C:\Users\a_san\source\repos\pshell> New-PSSession -ComputerName WIN-KL9JE8KGF5I -Credential (Get-Credential)

cmdlet Get-Credential at command pipeline position 1
Supply values for the following parameters:
User: administrator
Password for user administrator: **********

 Id Name            ComputerName    ComputerType    State         ConfigurationName     Availability
 -- ----            ------------    ------------    -----         -----------------     ------------
  1 WinRM1          WIN-KL9JE8KGF5I RemoteMachine   Opened        Microsoft.PowerShell     Available


PS C:\Users\a_san\source\repos\pshell> Enter-PSSession -Id 1

[WIN-KL9JE8KGF5I]: PS C:\Users\Administrator\Documents>
```

PowerShell Modules

Develop Intelligence

Finding Modules

- *Get-Module –ListAvailable* returns the list of modules that are installed and can be imported
- Modules can be installed in multiple locations
- Modules are made up of a .psm1 file (module code) and .psd1 (for manifest)
- To be useful, a module needs to have functions (which should be related)

Finding Modules

- Possible installed module locations include:
  - System modules – C:\Windows\System32\WindowsPowerShell\1.0\Modules
  - All Users modules – C:\Program Files\WindowsPowerShell\Modules
  - Current User modules –C:\Users\<userid>\Documents\WindowsPowerShell\Modules

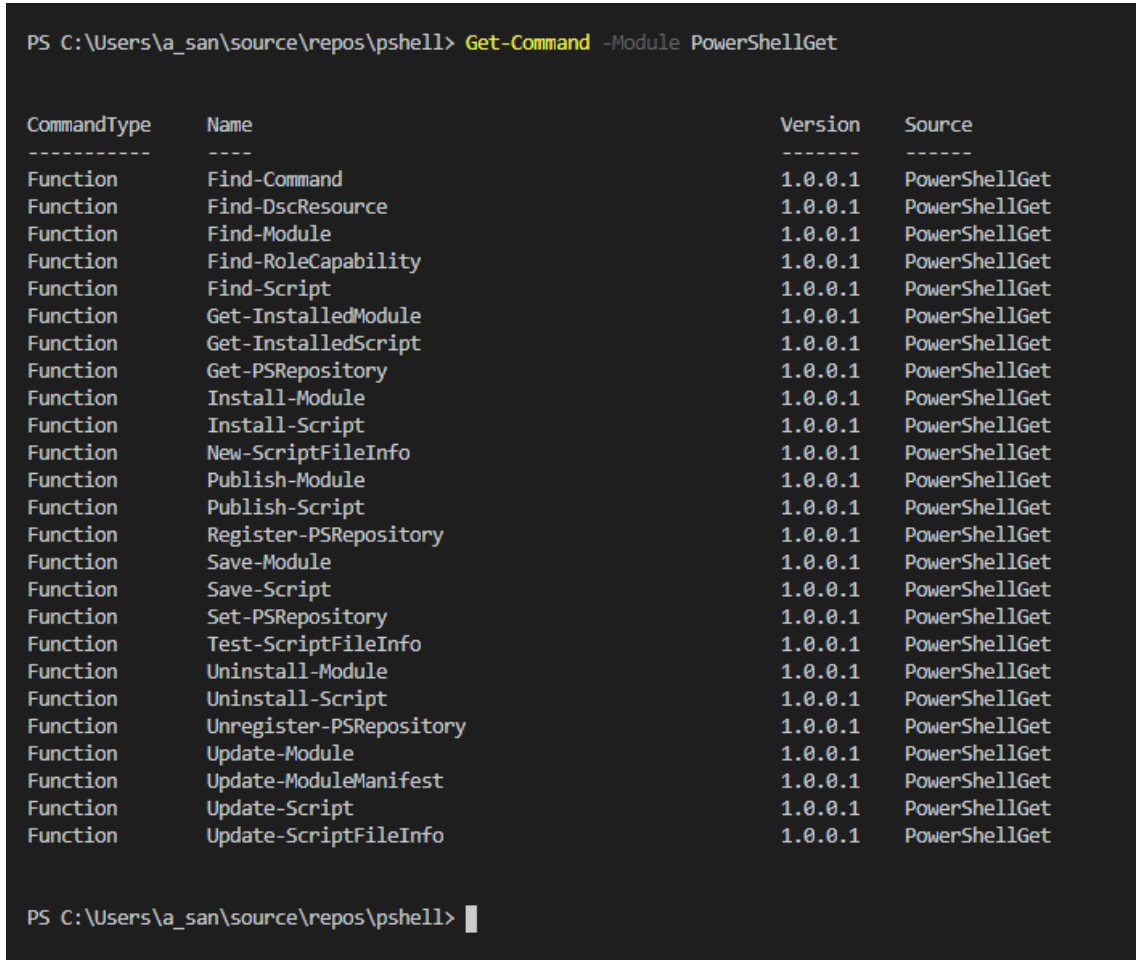
Importing Modules

- Installed modules must be imported to be used
- *Import-Module* can be used to import an installed module by name
- PowerShell supports auto-import – if module is installed and command in module is used, module will be automatically imported into session
- Can use –*Force* parameter with *Import-Module* to unload and reimport

Installing Modules

- The PowerShell Gallery (https://www.powershellgallery.com/) is a good source for modules
- The PowerShellGet module provides commands for integrating with the Gallery

Installing Modules



```
PS C:\Users\a_san\source\repos\pshell> Get-Command -Module PowerShellGet


CommandType     Name                                               Version    Source
-----------     ----                                               -------    ------
Function        Find-Command                                       1.0.0.1    PowerShellGet
Function        Find-DscResource                                   1.0.0.1    PowerShellGet
Function        Find-Module                                        1.0.0.1    PowerShellGet
Function        Find-RoleCapability                                1.0.0.1    PowerShellGet
Function        Find-Script                                        1.0.0.1    PowerShellGet
Function        Get-InstalledModule                                1.0.0.1    PowerShellGet
Function        Get-InstalledScript                                1.0.0.1    PowerShellGet
Function        Get-PSRepository                                   1.0.0.1    PowerShellGet
Function        Install-Module                                     1.0.0.1    PowerShellGet
Function        Install-Script                                     1.0.0.1    PowerShellGet
Function        New-ScriptFileInfo                                 1.0.0.1    PowerShellGet
Function        Publish-Module                                     1.0.0.1    PowerShellGet
Function        Publish-Script                                     1.0.0.1    PowerShellGet
Function        Register-PSRepository                              1.0.0.1    PowerShellGet
Function        Save-Module                                        1.0.0.1    PowerShellGet
Function        Save-Script                                        1.0.0.1    PowerShellGet
Function        Set-PSRepository                                   1.0.0.1    PowerShellGet
Function        Test-ScriptFileInfo                                1.0.0.1    PowerShellGet
Function        Uninstall-Module                                   1.0.0.1    PowerShellGet
Function        Uninstall-Script                                   1.0.0.1    PowerShellGet
Function        Unregister-PSRepository                            1.0.0.1    PowerShellGet
Function        Update-Module                                      1.0.0.1    PowerShellGet
Function        Update-ModuleManifest                              1.0.0.1    PowerShellGet
Function        Update-Script                                      1.0.0.1    PowerShellGet
Function        Update-ScriptFileInfo                              1.0.0.1    PowerShellGet


PS C:\Users\a_san\source\repos\pshell>
```

Installing Modules

- To install a module from the Gallery, you can use *Find-Module* to search by name
- Results of *Find-Module* can be piped to *Install-Module* to install
- *-AllowClobber* can be used to override existing commands with same nam

```
PS C:\Users\a_san\source\repos\pshell> Find-Module -Name VMWare.PowerCLI | Install-Module

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 yo
ellgallery.com/api/v2'?
[Y] Yes [A] Yes to All [N] No [L] No to All [S] Suspend [?] Help (default is "No"): a
PackageManagement\Install-Package : The following commands are already available on this system:'Export-VM,Get-VM,Get-VMHost,Move-VM,New-VM,Remove-VM,Restart-VM,Set-VM,Set-VMHost,Sta
'VMware.VimAutomation.Core' may override the existing commands. If you still want to install this module 'VMware.VimAutomation.Core', use -AllowClobber parameter.
At C:\Program Files\WindowsPowerShell\Modules\PowerShellGet\1.0.0.1\PSModule.psm1:1912 char:34
+ ...          $null = PackageManagement\Install-Package @PSBoundParameters
+                      ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
    + CategoryInfo          : InvalidOperation: (Microsoft.Power....InstallPackage:InstallPackage) [Install-Package], Exception
    + FullyQualifiedErrorId : CommandAlreadyAvailable,Validate-ModuleCommandAlreadyAvailable,Microsoft.PowerShell.PackageManagement.Cmdlets.InstallPackage

PS C:\Users\a_san\source\repos\pshell>
```

Uninstalling Modules

- Uninstall-Module can be used to remove a module from disk by name

```
PS C:\Users\a_san\source\repos\pshell> Uninstall-Module -Name VMWare.PowerCLI
```

Custom Modules

Develop Intelligence

- PowerShell supports creation of your own modules
- Can be shared within organization or to the Gallery for public use
- Requires three pieces – a folder, a .psm1 file (module code) and a .psd1 file (module manifest)

Custom Modules

Develop Intelligence

- Files must be stored in folder with same name as module
- If placed in one of the common locations (System, All Users or Current User), PowerShell will import automatically
- Manifest file has a specific format

Custom Modules

- *New-ModuleManifest* provides parameters for things like path, author, etc. and builds file in correct format
- To make functions defined in module available, need to set he *FunctionsToExport* key in manifest

Functions

What are Functions?

Develop Intelligence

- Functions are a named piece or reusable code that performs a specific task
- Can accept parameters with validation (if required)
- Provide options for enabling pipeline support
- More advanced versions support parameter configuration to make the function look more like a cmdlet (-*WhatIf, -Confirm*, etc.)

Functions vs. Cmdlets

- Sounds like cmdlets
- Difference lies in how created
- Cmdlets are written in another language, compiled and made available in PS
- Functions are written in PowerShell directly

Defining Functions

Develop Intelligence

- Simplest form includes key word *function*, a name and ScriptBlock
- Can be defined inline in the shell or (more likely) in a .ps1 script or module
- Once defined can be executed using its name

Function Naming Convention

- By convention, PowerShell function names should follow the *Verb-Noun* format
- You can use *Get-Verb* to see the list of recommended verbs
- Noun typically matches the entity/context in which defined
- The following will group verbs by specific categories for view

```
> Get-Verb | Format-Table Verb, Group -GroupBy Group -AutoSize
```

Function Parameters

- Adding parameters to functions allows variability
- Instead of doing the same thing every time called, parameters allow us to change based on runtime conditions
- Parameters are added to our functions using param( )
- Supports multiple properties for defining/constraining the parameter's value

Function Parameters

- Simple example

```
function Get-Area {
        [CmdletBinding( )]
        param(
                [Parameter( )]
                [decimal] $radius
        )

        $area = [Math]::PI * $radius * $radius
        Write-Host “$radius has area $area”
}
```

Making Parameters Mandatory

- Add *Mandatory* keyword to parameter definition
- Attempts to call with out parameter will prompt user

```
function Get-Area {
        [CmdletBinding( )]
        param(
                [Parameter(Mandatory)]
                [decimal] $radius
        )

        $area = [Math]::PI * $radius * $radius
        Write-Host "$radius has area $area"
}
```

Setting Parameter Defaults

- Accomplished by assigning value at parameter declaration
- Alternative to using *Mandatory*
- Still allows call with a specific value

```
function Get-Area {
        [CmdletBinding( )]
        param(
                [Parameter( )]
                [decimal] $radius = 1.5
        )

        $area = [Math]::PI * $radius * $radius
        Write-Host “$radius has area $area”
}
```

Adding Parameter Validation

- Various validation attributes exist to validate parameter values
- If value provided on call violates, an error is thrown
- See https://docs.microsoft.com/en-us/powershell/scripting/developer/cmdlet/validating-parameter-input

```
function Get-Area {
    [CmdletBinding( )]
    param(
        [Parameter( )]
        [ValidateRange(0.0, 5.0)]
        [decimal] $radius = 1.5
    )

    $area = [Math]::PI * $radius * $radius
    Write-Host "$radius has area $area"
}
```

Adding Pipeline Support

Develop Intelligence

- Adding *ValueFromPipeline* or *ValueFromPipelineByPropertyName* to parameter adds pipeline support
- *ValueFromPipeline* will match pipeline input by type
- *ValueFromPipelineByPropertyName* will match pipeline input by name
- Probably most useful for functions exported from a module

Begin, End and Process

Develop Intelligence

- As written so far, our function will only run once – even if multiple values are piped to it
- Logic to be executed once for each input object, should be wrapped in a *process* block
- A *begin* block can be used to execute logic before any piped elements are run
- An *end* block can be used to execute logic after all piped elements are run

DEMO – Making available in module

Running Scripts Remotely

Enabling Remoting

- Requires that a WinRM service is running with appropriate firewall ports open and access rights configured
- As of Server 2012, should be enabled by default
- You can run *Test-WSMan* to check setup

```
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
```

- If not setup, *Enable-PSRemoting* can be executed from an elevated console session to configure
- Once enabled, *Invoke-Command* can be used to execute remote commands

Invoke-Command

- Enables connection to a remote system and execution of a ScriptBlock or script file

  Invoke-Command –ScriptBlock { <script> } –ComputerName <computer name>
  Invoke-Command –FilePath <scriptfile> -ComputerName <computer name>

- For script file, script contents (not the script itself) executed on remote system and results returned to local
- *-ArgumentList* can be used to pass local values to remote system – referenced in script using $args automatic variable (array)

Invoke-Command

- *Invoke-Command* is used this way with ad hoc commands
- Connects, runs command and disconnects
- Behind-the-scenes, something called a session is used for the connection
- However, with ad hoc, the session is created, command executed, and session gets torn down

Sessions

- PowerShell remoting leverages a session
- We can create a session remotely which opens a local session on the remote system
- We then connect to that session for routing remote commands

Sessions

- Instead of ad hoc, you can create sessions, and then connect/disconnect
- Session maintains state until removed
- More efficient than ad hoc when multiple statements or scripts to be run

New-PSSession

- Used to create a semi-permanent session on remote computer
- Uses name of machine for connection
- Requires local admin or member of Remote Management Users group on remote machine
- Also, requires that local and remote systems be in same AD domain

New-PSSession

- If not in same AD domain, can add remote system to TrustedHosts collection
- Use Get-Item WSMan:\localhost\Client\TrustedHosts to check
- Use Set-Item WSMan:\localhost\Client\TrustedHosts –Value <hostname> to add

New-PSSession

- Can use the –*Credential* parameter and *Get-Credential* cmdlet (or build credential in code) for access
- Adds session to set of available sessions configured on local system
- Can be referenced instead of –*ComputerName* to connect and execute

Invoke-Command - Redux

Develop Intelligence

- Enables connection to a remote system and execution of a ScriptBlock or script file

Invoke-Command –ScriptBlock { <script> } ***–Session <session ref>***
Invoke-Command –FilePath <scriptfile> ***-Session <session ref>***

- Runs faster than ad hoc – no need to create and tear down for every command
- Also access to additional functionality (e.g., variables set in remote session persist)

Interactive Sessions

- Enter-PSSession can be used to connect to a remote session interactively
- Command-line changes to reflect remote session
- Can be a good alternative to Remote Desktop Protocol (RDP)

Disconnect & Reconnect – Session

Develop Intelligence

- *Disconnect-PSSession* can be used to disconnect from a remote session (for potential reconnection later)
- *Connect-PSSession* can be used to reconnect
- NOTE: Disconnected sessions only work if local and remote machine have same PowerShell version
- Can use *$PSVersionTable* on both systems to check

Removing Sessions

- *Remove-PSSession* can be used to delete a session
- Tears down session at remote computer, and, if exists, removes local references

Remote Management

Develop Intelligence

DEMO

Scheduled Jobs

Develop Intelligence

What Are They?

- PowerShell scripts that can be triggered on a schedule on in response to events
- Run asynchronously in the background
- Used for regularly repeated tasks – maintenance, configuration, etc.

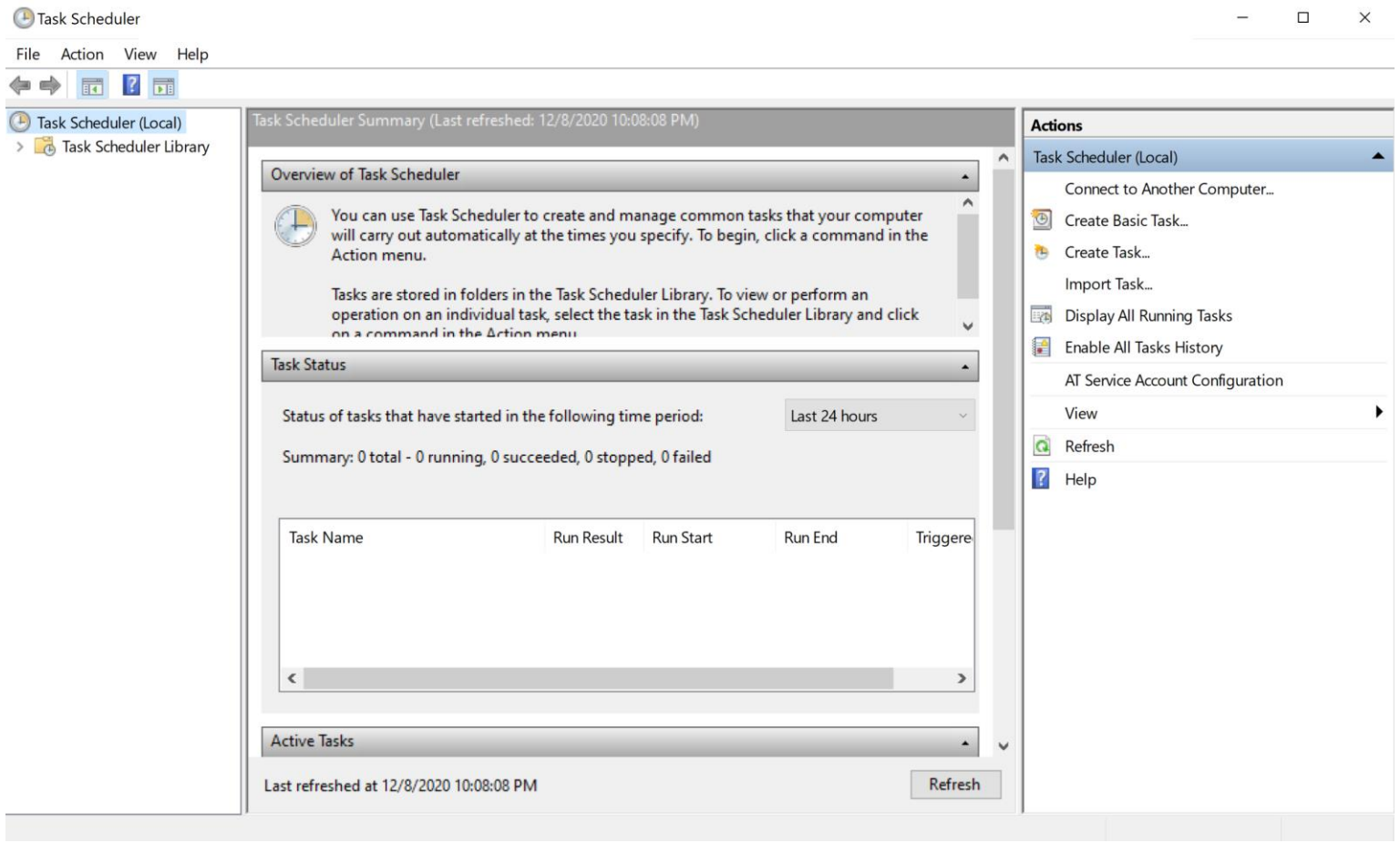
What Are They?

Develop Intelligence

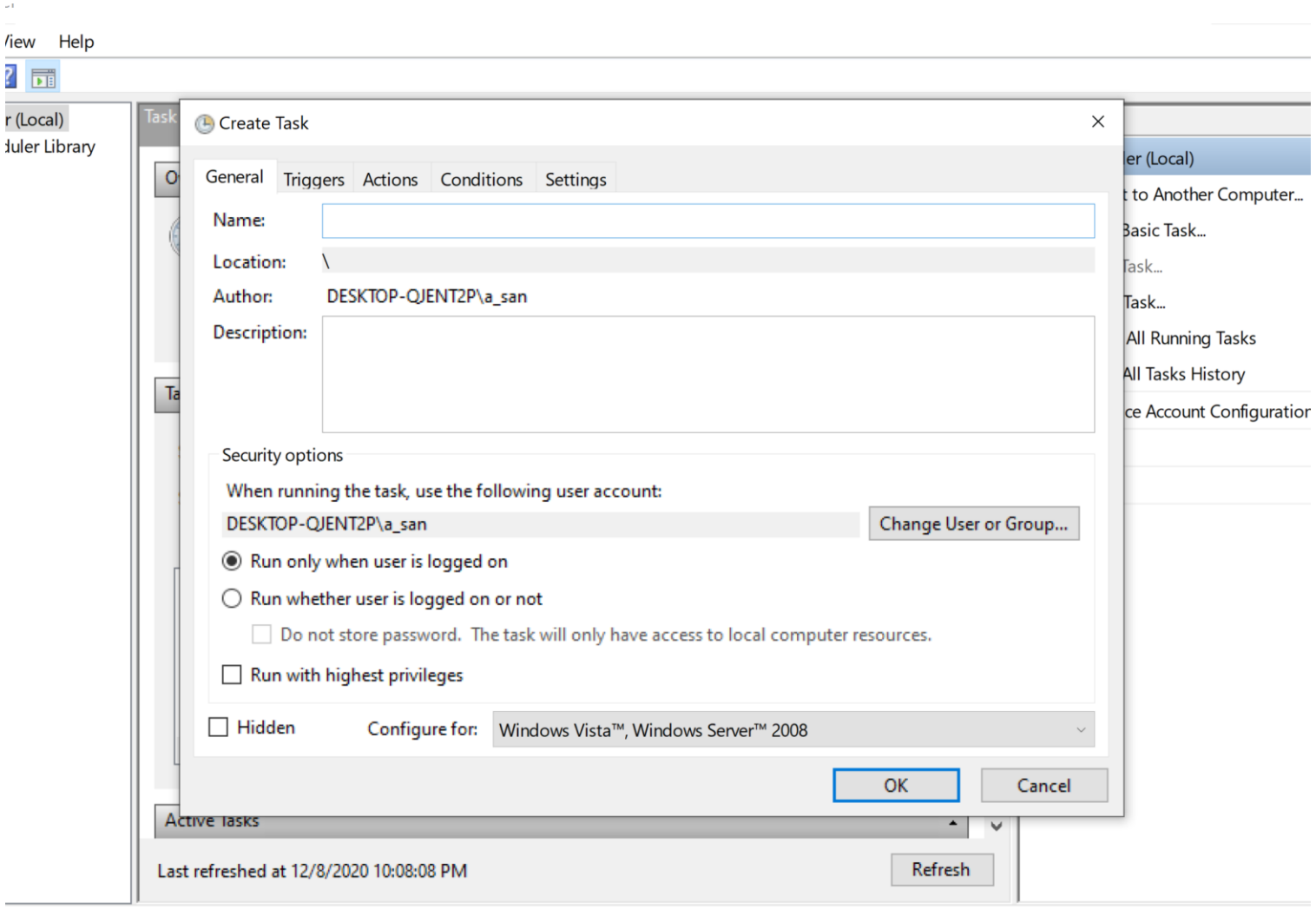
- Can be viewed and managed in Task Scheduler
- Jobs are saved to disk – can be enabled, disabled, executed
- Results of instance runs are saved to disk as well, including a log of job output

Mirrors Task Scheduler

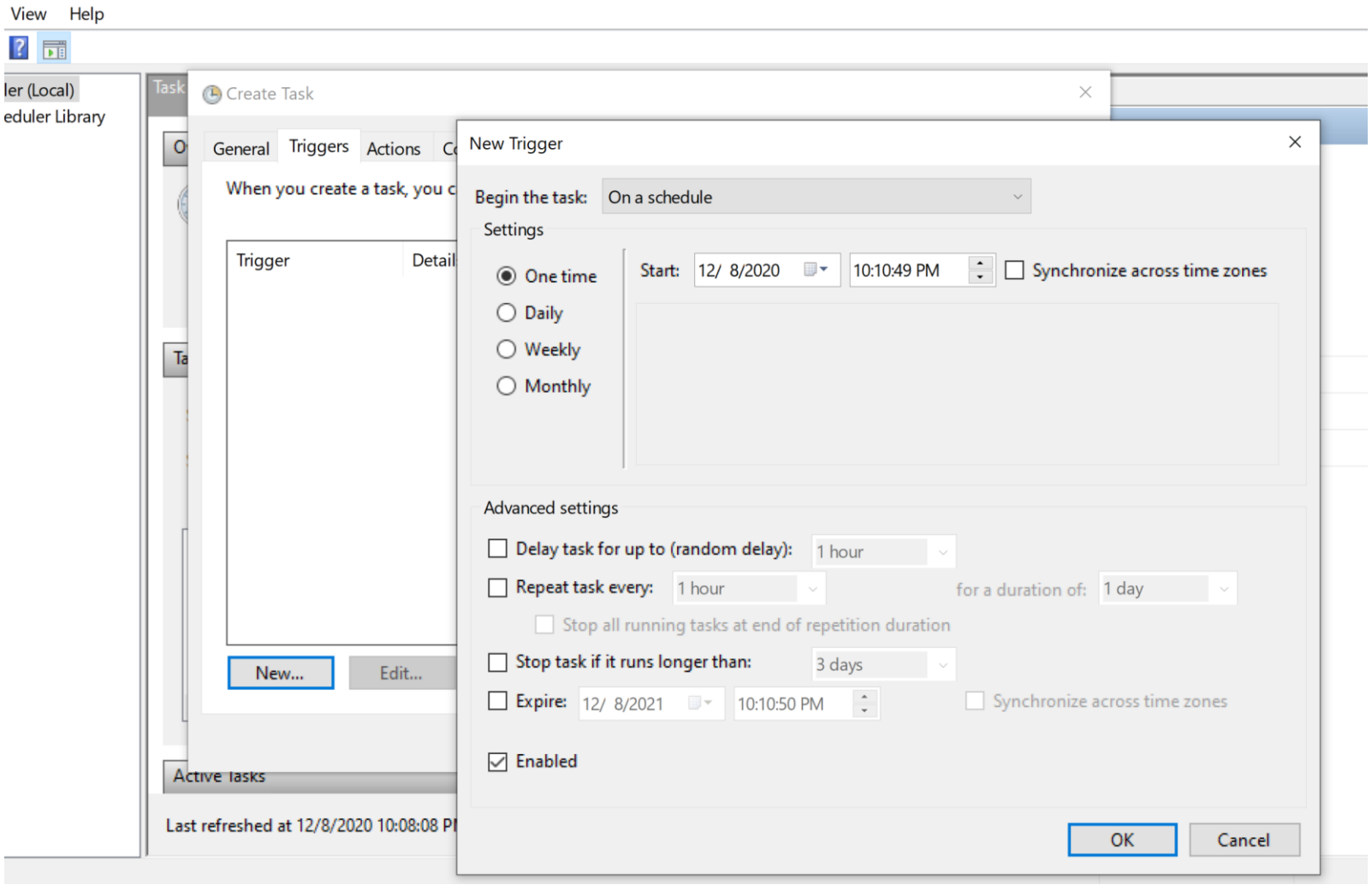
- But defined in PowerShell



Mirrors Task Scheduler



Mirrors Task Scheduler



Getting Info About Scheduled Jobs

- *Get-ScheduledJob* retrieves list of scheduled jobs on system
- *Get-JobTrigger* retrieves info about defined trigger for a job
- *Get-Job* retrieves info on all instances of scheduled job that have previously run

Getting Info About Scheduled Jobs

- *Receive-Job* gets the results of the most recent run instance
- *Receive-Job* includes a *–Keep* parameter to leave in place as most recent
- Even without *–Keep*, job results are saved on disk until you delete or maximum # exceeded

Creating New Scheduled Jobs

- *Register-ScheduledJob* used to define and register job for execution
- *-Trigger* parameter used to set job trigger
- *-ScheduledJobOption* used to define job options
- Job can be defined using *–ScriptBlock* or *–FilePath* (for script file)

```
PS C:\Users\a_san\source\repos\pshell> Get-Command -Name Register-ScheduledJob -Syntax

Register-ScheduledJob [-Name] <string> [-ScriptBlock] <scriptblock> [-Trigger <ScheduledJobT
rigger[]>] [-InitializationScript <scriptblock>] [-RunAs32] [-Credential <pscredential>] [-A
uthentication <AuthenticationMechanism>] [-ScheduledJobOption <ScheduledJobOptions>] [-Argum
entList <Object[]>] [-MaxResultCount <int>] [-RunNow] [-RunEvery <timespan>] [-WhatIf] [-Confirm] [<Common
Parameters>]

Register-ScheduledJob [-Name] <string> [-FilePath] <string> [-Trigger <ScheduledJobTrigger[]>] [-Initializ
ationScript <scriptblock>] [-RunAs32] [-Credential <pscredential>] [-Authentication <AuthenticationMechani
sm>] [-ScheduledJobOption <ScheduledJobOptions>] [-ArgumentList <Object[]>] [-MaxResultCount <int>] [-RunN
ow] [-RunEvery <timespan>] [-WhatIf] [-Confirm] [<CommonParameters>]
```

Defining Trigger

- *New-JobTrigger* used to define trigger
- Multiple versions available to support different types of schedules
- Versions also available for trigger on startup or logon

```
PS C:\Users\a_san\source\repos\pshell> Get-Command -Name New-JobTrigger -Syntax

New-JobTrigger -Once -At <datetime> [-RandomDelay <timespan>] [-RepetitionInterval <timespan>] [-Repetitio
nDuration <timespan>] [-RepeatIndefinitely] [<CommonParameters>]

New-JobTrigger -Daily -At <datetime> [-DaysInterval <int>] [-RandomDelay <timespan>] [<CommonParameters>]

New-JobTrigger -Weekly -At <datetime> -DaysOfWeek <DayOfWeek[]> [-WeeksInterval <int>] [-RandomDelay <time
span>] [<CommonParameters>]

New-JobTrigger -AtStartup [-RandomDelay <timespan>] [<CommonParameters>]

New-JobTrigger -AtLogOn [-RandomDelay <timespan>] [-User <string>] [<CommonParameters>]

PS C:\Users\a_san\source\repos\pshell>
```

THANK YOU

Develop
Intelligence