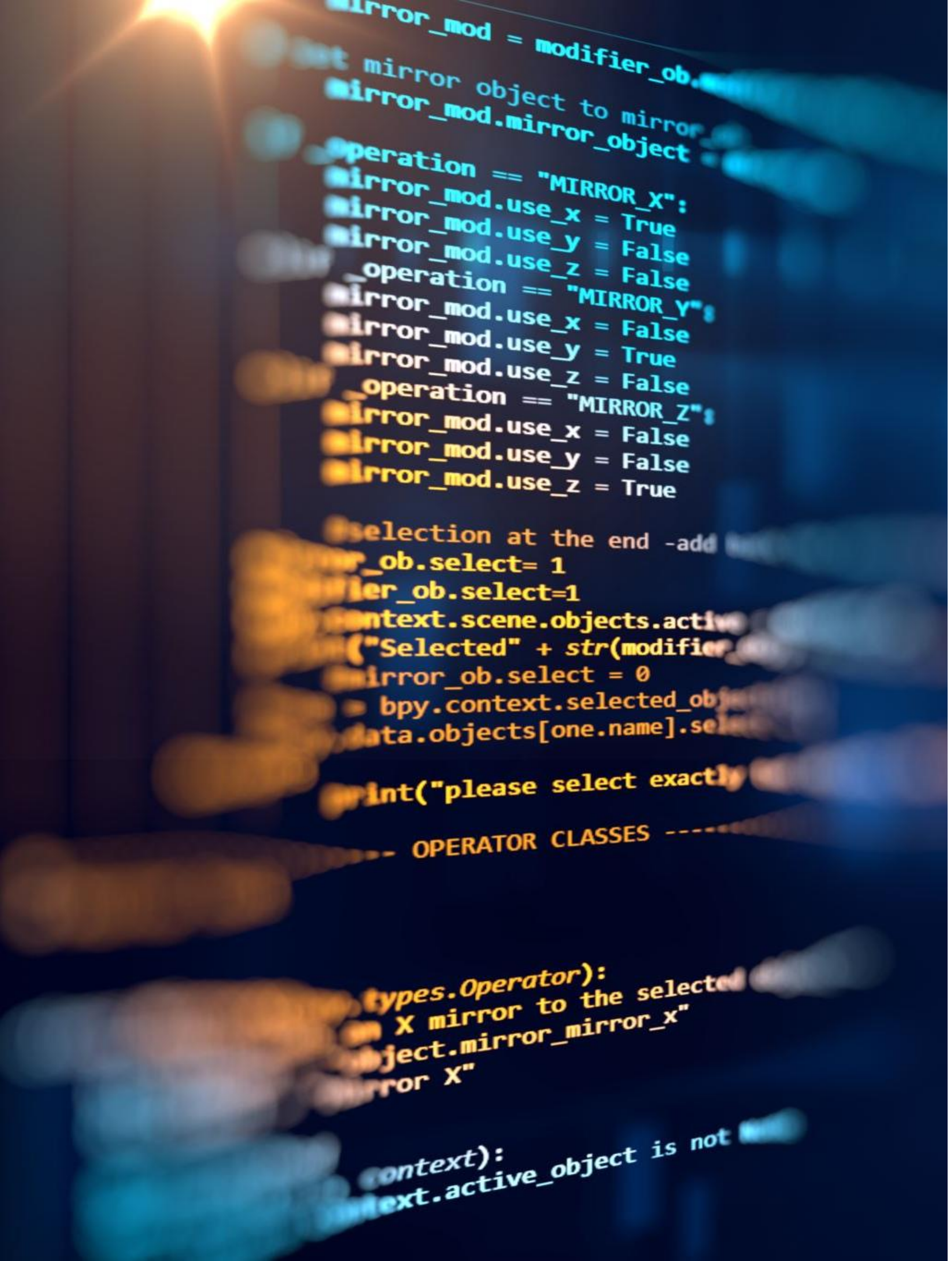
Windows Subsystem for Linux (WSL)

A Comprehensive Overview



Introduction to WSL

What is Windows Subsystem for Linux (WSL)?

- A compatibility layer for running Linux binaries natively on Windows.
- Enables developers to use Linux tools without a virtual machine or dual boot.

History & Evolution

WSL 1 (2016)

- Uses a translation layer for Linux system calls.
- Slower file performance but lighter on system resources.

WSL 2 (2020)

- Uses a real Linux kernel via a lightweight VM.
- Improved performance and full system call compatibility.

Key Features of WSL

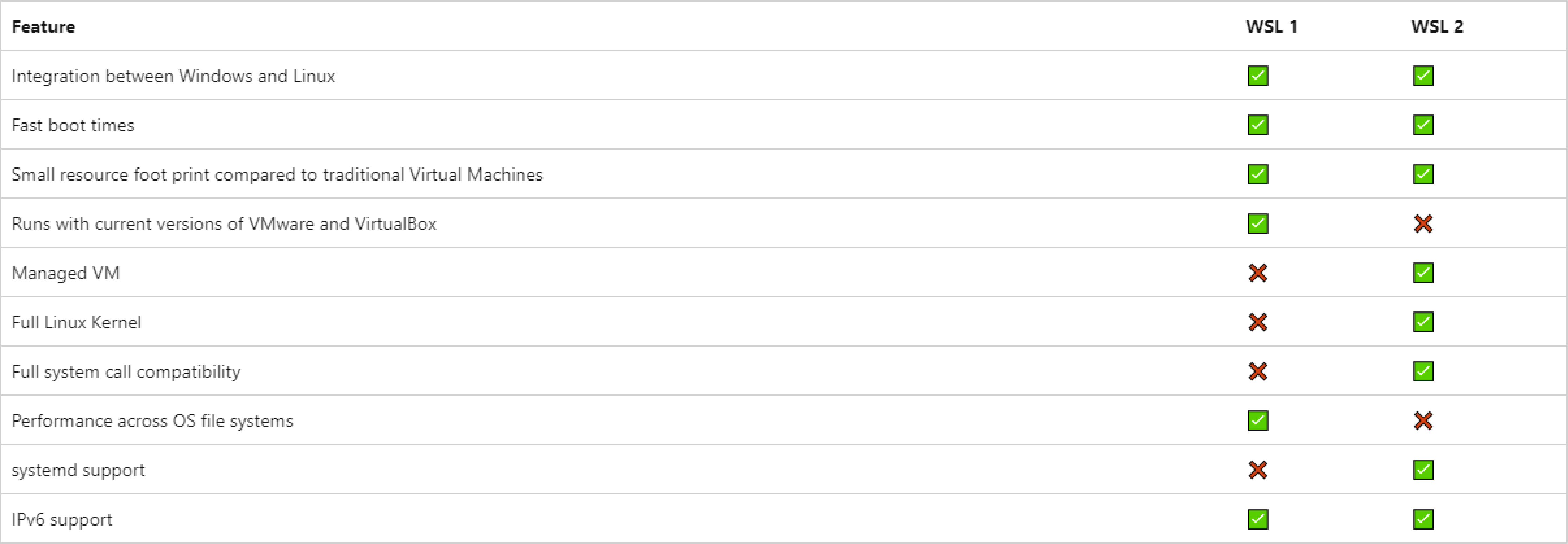
- Runs native Linux command-line tools.
- Supports multiple Linux distributions (Ubuntu, Debian, Kali, etc.).
- Full system call compatibility in WSL 2.
- Integration with Windows file system and applications.
- GPU compute support for AI/ML workloads.

WSL vs Virtual Machines (VM)

- WSL requires fewer resources (CPU, memory, and storage)
- Run Linux command-line tools and apps alongside Windows command-line, desktop and store apps.
- Enables Windows apps and Linux command-line tools on the same set of files.

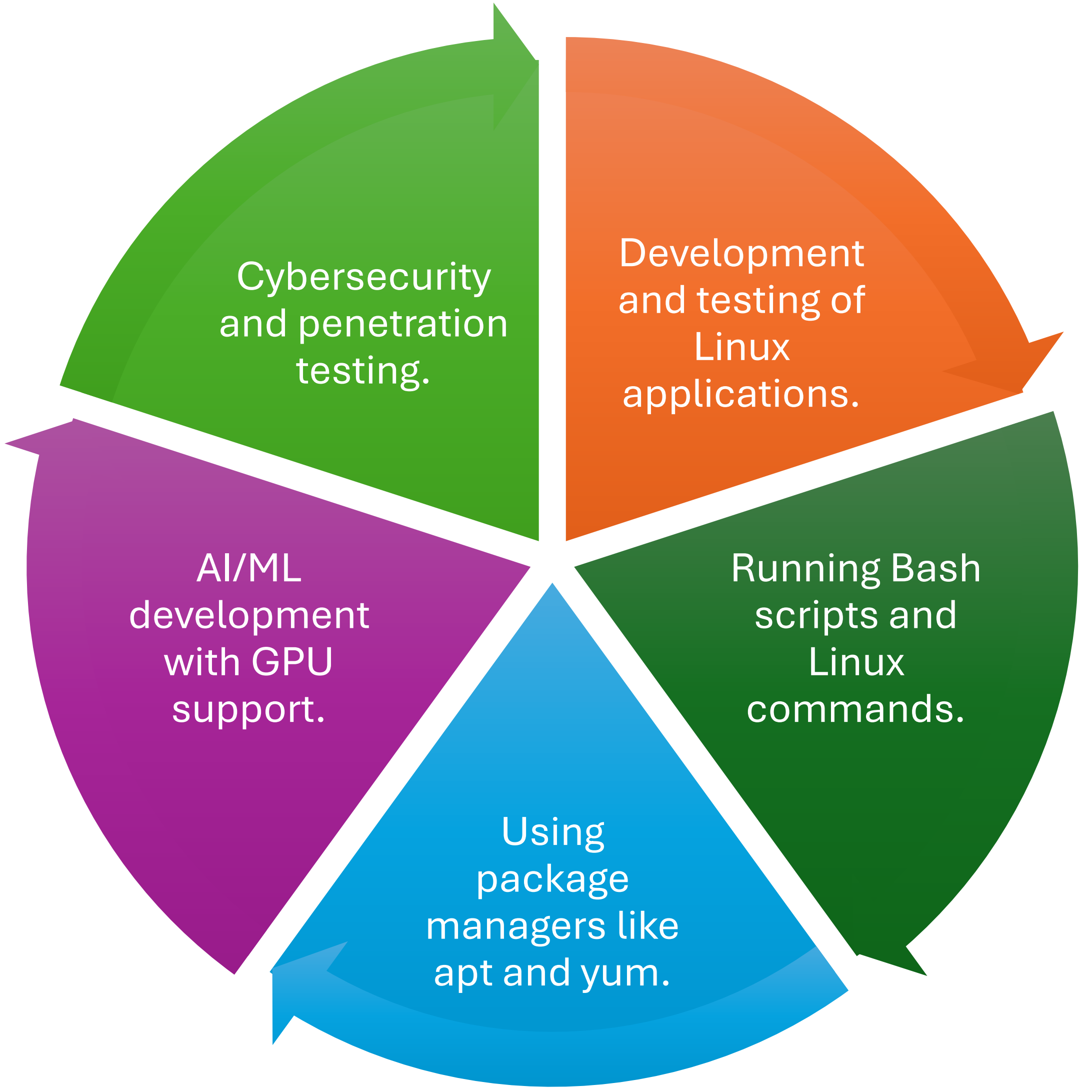
WSL 1 vs WSL 2

https://learn.microsoft.com/en-us/windows/wsl/compare-versions



Feature	WSL 1	WSL 2
Integration between Windows and Linux	✅	✅
Fast boot times	✅	✅
Small resource foot print compared to traditional Virtual Machines	✅	✅
Runs with current versions of VMware and VirtualBox	✅	❌
Managed VM	❌	✅
Full Linux Kernel	❌	✅
Full system call compatibility	❌	✅
Performance across OS file systems	✅	❌
systemd support	❌	✅
IPv6 support	✅	✅

Use Cases of WSL



Cybersecurity and penetration testing.

Development and testing of Linux applications.

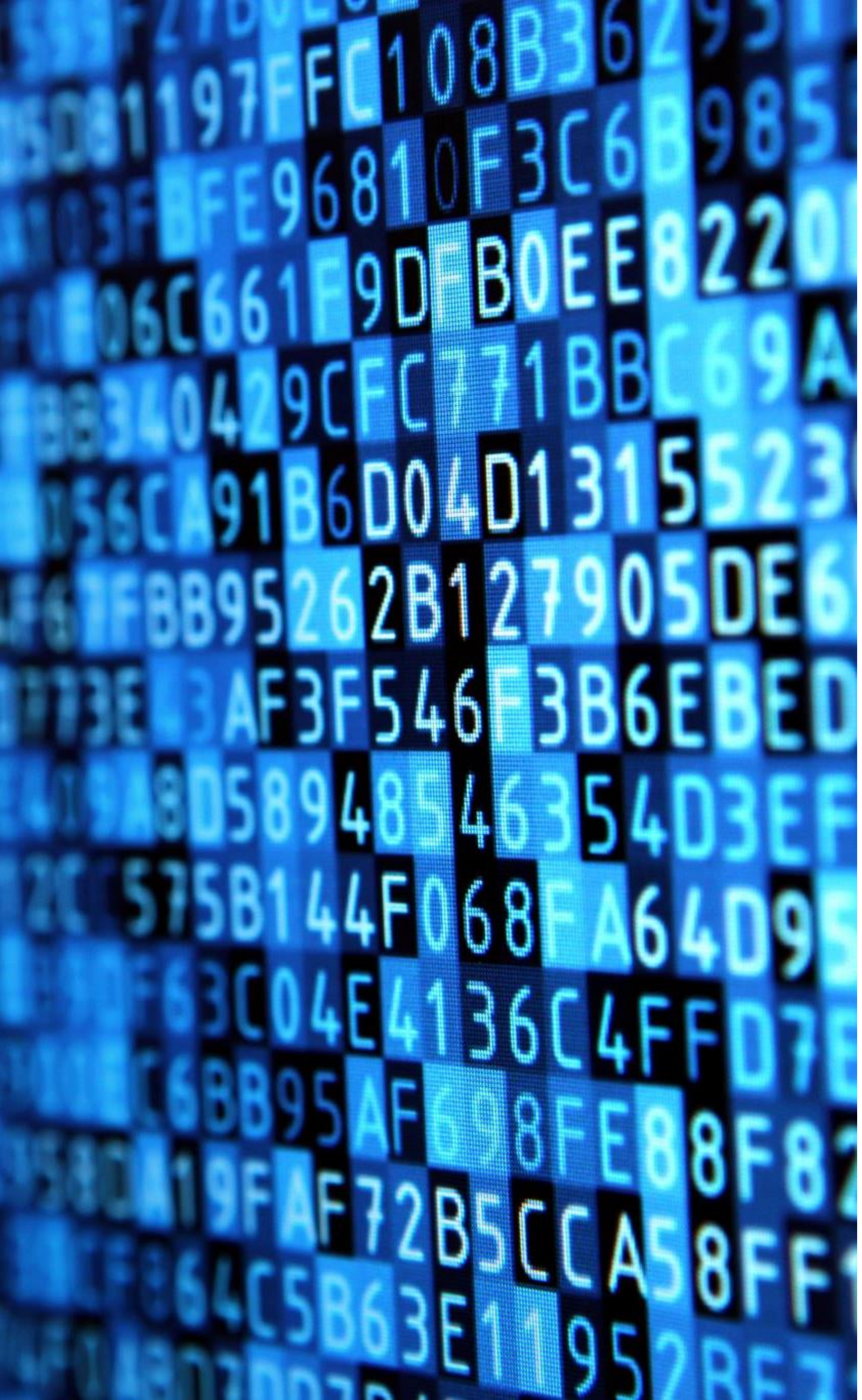
Running Bash scripts and Linux commands.

Using package managers like apt and yum.

AI/ML development with GPU support.

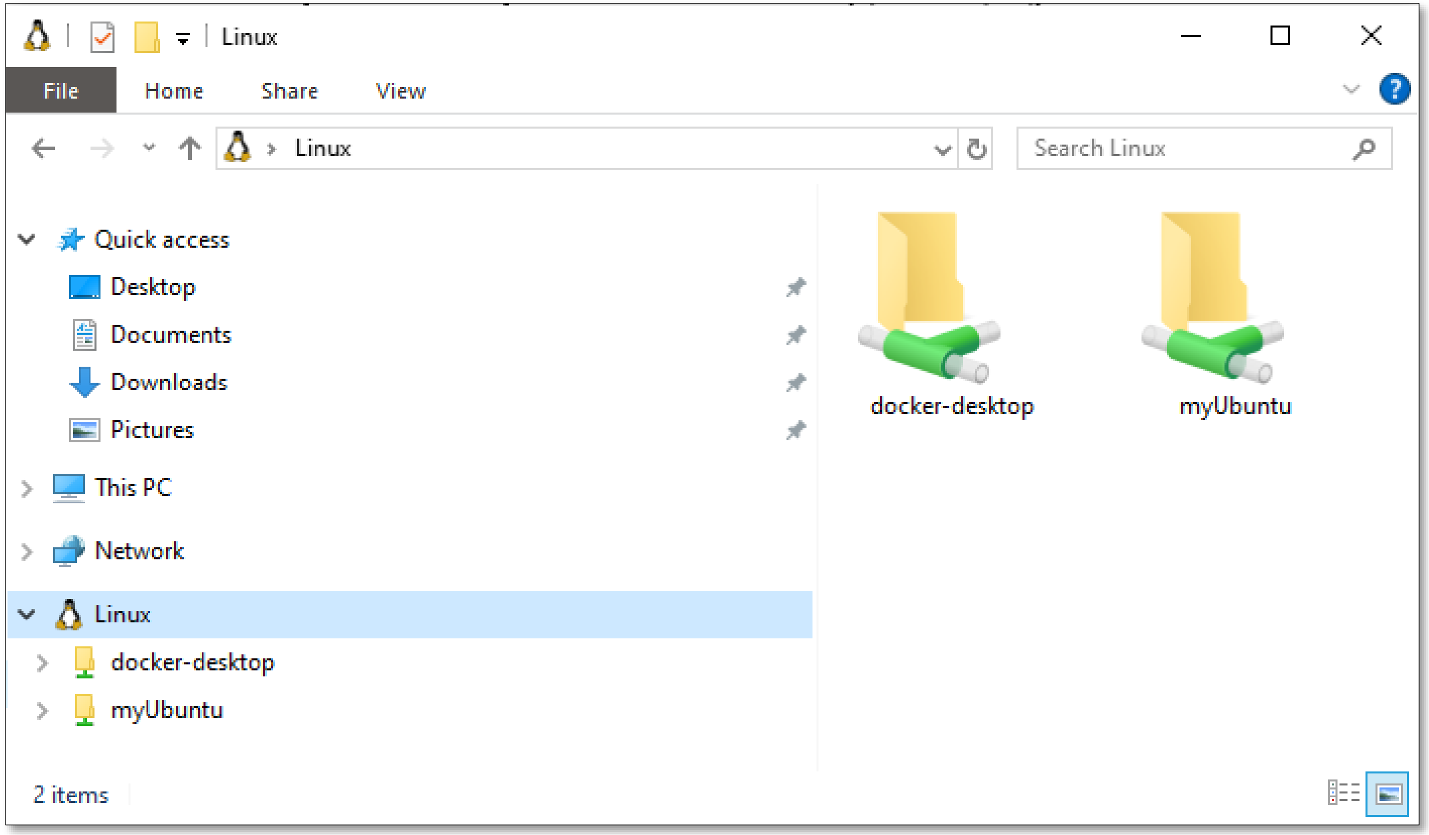
WSL GUI Support

- Windows Subsystem for Linux GUI (WSLg).
- Enables Linux GUI applications on Windows.
- Works with Wayland server and Weston compositor.
- Example: Running Gedit, GIMP, or Firefox from Linux on Windows.



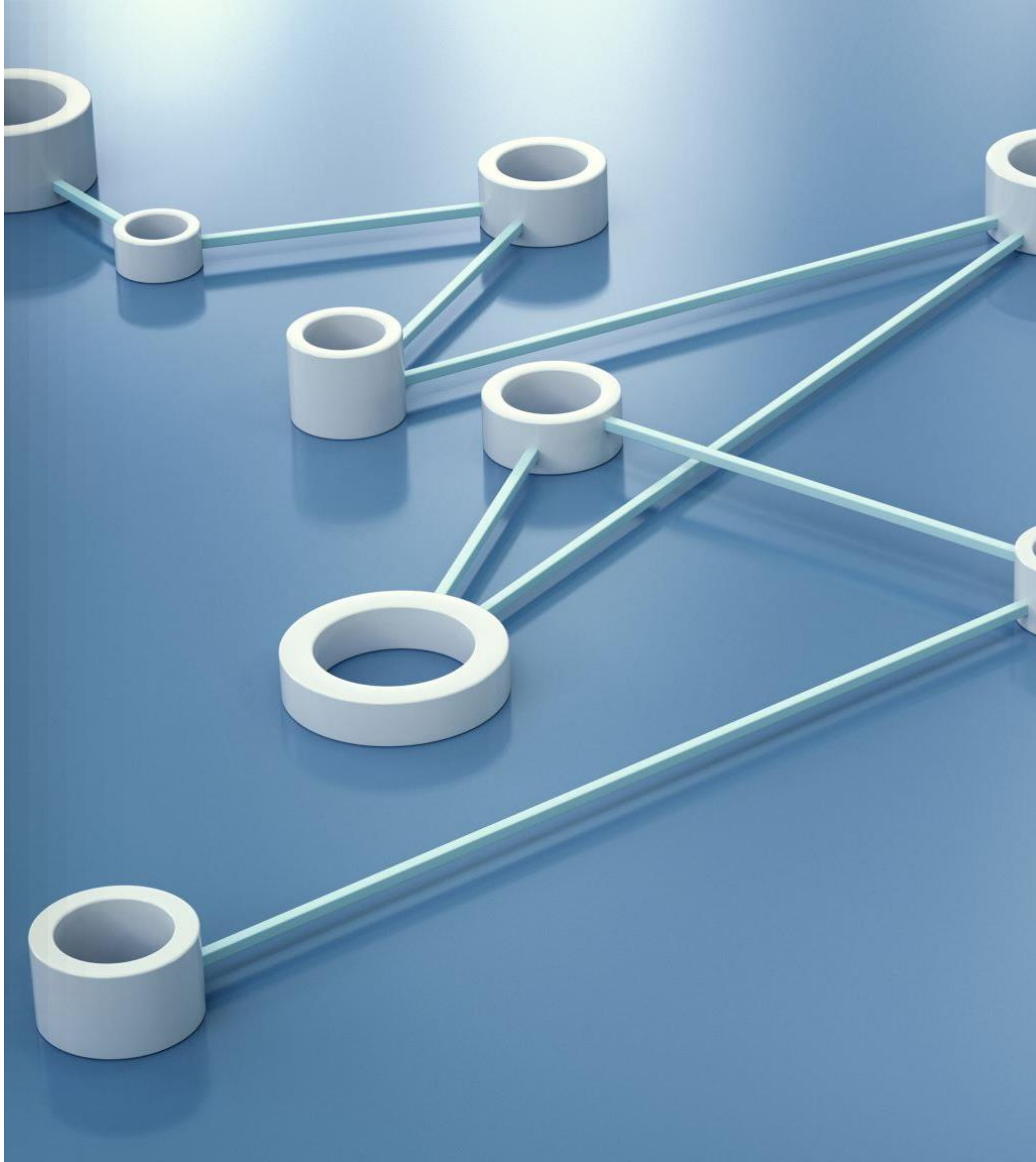
File System and Interoperability

- Access Windows files from WSL (/mnt/c/).
- Edit files across Windows and Linux environments.
- Run Windows executables from Linux and vice versa.



Networking in WSL

- WSL 1: Shares host IP, easy access to Windows network.
- WSL 2: Runs in a VM, separate virtualized network.
- Port forwarding and localhost access.
- Integration with Docker for containerized development.



Advanced WSL Configurations

- Customizing WSL settings (.wslconfig, wsl.conf).
- Mounting additional drives in WSL.
- Running systemd in WSL 2 (recent feature).
- Using Docker with WSL.

Limitations and Challenges

- GUI support is still improving.
- Performance variations between WSL 1 and WSL 2.
- Limited support for certain kernel modules.
- Requires Windows 10/11 (not available on older versions).

Future of WSL

- Continued performance improvements.
- Enhanced compatibility with Linux applications.
- Stronger GPU and AI/ML support.
- Better networking and system integration.

wsl --help

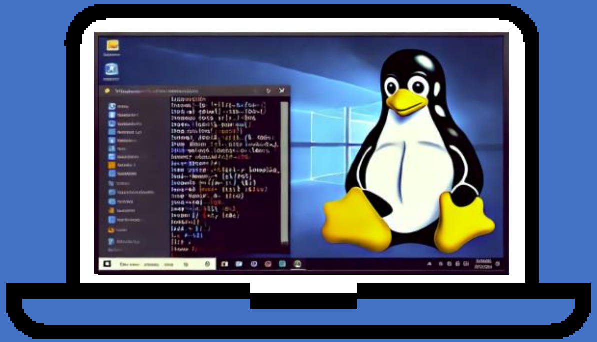
- wsl --version
- wsl --list
- wsl --list --verbose
- wsl --list –online
- wsl --shutdown
- wsl --terminate <DistributionName>
- wsl --unregister <DistributionName>
- wsl --set-default <DistributionName>

Demo

WSL

Rename WSL Distro

Demo



1. wsl --list --verbose
2. wsl --shutdown -d <DistributionName>
3. Open regedit
4. Navigate to

   HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Lxss

   Each subfolder under Lxss represents a different WSL distro.
5. Find and Edit the DistributionName
6. wsl --list
7. wsl -d <DistributionName>

Create Thumbnail

Assuming an Ubuntu Distribution

1. Install ImageMagick

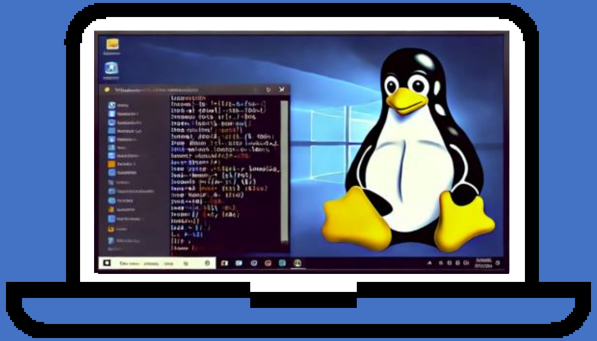
```
wsl sudo apt update
wsl sudo apt upgrade
wsl sudo apt-get install imagemagick
```

2. Create thumbnail of image

```
wsl convert myImage.jpg –thumbnail 400 t-myImage.jpg
```

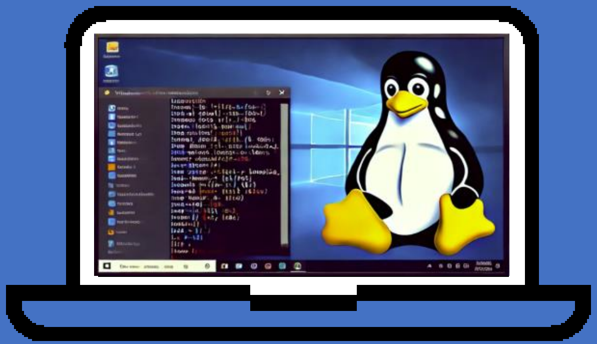
https://github.com/ImageMagick/ImageMagick

Demo



Export\Import distributions

Demo



Assuming an Ubuntu Distribution

1. Export

```
wsl --terminate Ubuntu
wsl --export Ubuntu myUbuntu.tar
```

2. Import

```
mkdir c:\wslDistroStorage
wsl --import myUbuntu C:\wslDistroStorage .\myUbuntu.tar
```

https://learn.microsoft.com/en-us/windows/wsl/use-custom-distro

File Count/Directory Size

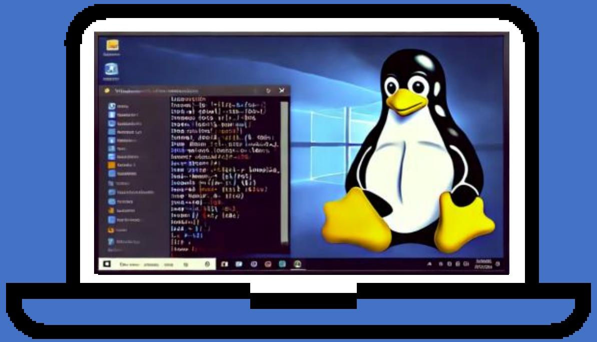
- File Count

```
wsl ls | wsl wc -l
```

- Directory Size

```
wsl du –sh myDirectory
```

Demo



grep vs findstr

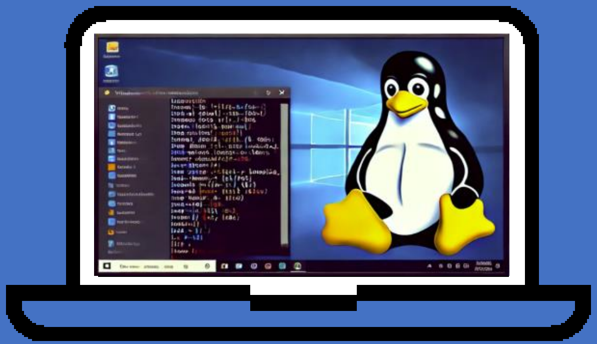
- grep

```
wsl grep --color=always –nr searchString myDirectory
```

- findstr

```
Findstr /a:5 /n searchString .\myDirectory\*
```

Demo



Running a Bash Script

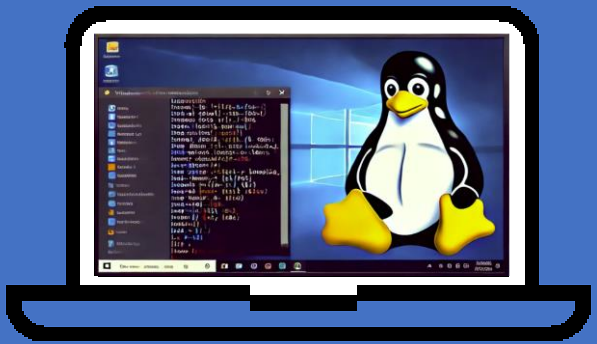
1. Create helloWorld.sh File

```
#!/bin/sh
Echo “Hello World”
```

2. Run Script

```
wsl sh helloWorld.sh
```

Demo



Summary

- WSL is a powerful tool for running Linux on Windows.
- Offers high performance with minimal resource use.
- Ideal for developers, sysadmins, and researchers.
- Continued development by Microsoft ensures future enhancements.

References

- Windows Subsystem for Linux Documentation
  https://learn.microsoft.com/en-us/windows/wsl/
- Slides
  https://github.com/danielecolon/WSL