

Installing WSL on Windows 10 and 11

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In Stanford Math 289, we will use *coding agents*: AI tools that help us write and execute code. These agents tend to work better in Unix-like environments (e.g. Linux and macOS) than in Windows. We therefore prefer a Unix-like environment for the course. For Windows users, it is still possible to have a Linux environment while continuing to use Windows as usual. In this guide, we will help you set up *Ubuntu*, a widely used version of Linux that comes with a collection of useful programs. We will run Ubuntu through *Windows Subsystem for Linux* (WSL), a Windows feature that lets you use Linux without replacing Windows.

This guide works on Windows 10 and Windows 11. Most screenshots illustrate Windows 10; Windows 11 may look different, and the relevant menu differences are noted below.

Throughout this guide, **Windows+R** means hold down the key with the Windows logo, press **R**, then release both keys. This opens the *Run* dialog, a quick way to launch applications by typing their names and pressing **Enter**. For example, entering **winver** in the Run dialog (Figure 1) opens a window showing your Windows version.

Later, you will type *commands*: instructions executed inside PowerShell or the Ubuntu terminal. Each step specifies which application to use. Type or paste the command there and press **Enter**, then wait for it to finish before entering the next one.

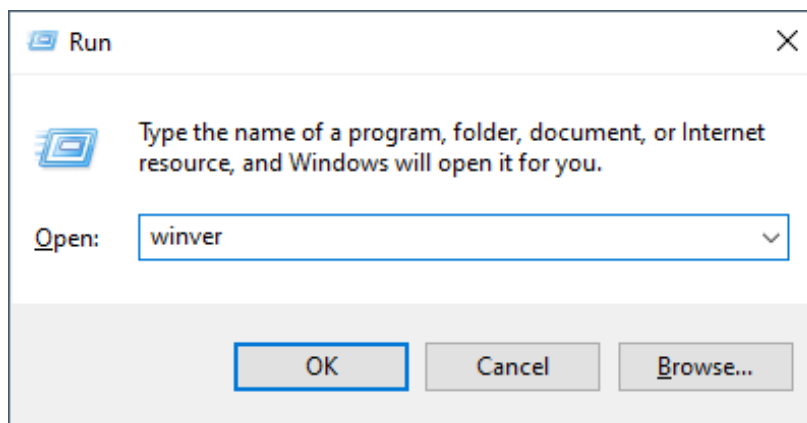


Figure 1: Run dialog with **winver** entered. Source: Southern Oregon University, <https://support.sou.edu/kb/articles/how-to-check-your-version-of-windows-10>.

Follow Section 1 through Section 6 in order: first check your computer and enable the Windows features, then learn how to use PowerShell, install Ubuntu, create your Linux account, and verify the installation. Section 7 covers everyday use and maintenance. If you run into problems, consult Section 8; Section 9 provides an alternative installation method if needed. Consulting AI models can also help you troubleshoot problems.

1 Check your computer

Save your work before starting: you will need to restart Windows. You also need an internet connection and a Windows account with administrator permission to install software.

1. Check the Windows version. Press **Windows+R**, type **winver**, and press **Enter**. In the window that opens, look for Version and OS Build (Figure 2). The main installation method works on Windows 11, or Windows 10 version 2004 or later with build 19041 or later (<https://learn.microsoft.com/en-us/windows/wsl/install>). Close the window after checking. If your Windows 10 version is older, check for updates under Settings > Update & Security > Windows Update, or use the optional manual instructions in Section 9.



Figure 2: Windows 10 Home 22H2 in **winver**. Source: Sun City Texas Computer Club, p. 9, <https://www.sctexas.org/Files/Library/27409/SUNCITYCOMPUTERWINDOWSSIG11082022.PDF>.

2. Check the system type. Open Start, then Settings > System > About. Under System

type, look for a 64-bit operating system with an x64-based or ARM-based processor (Figure 3).

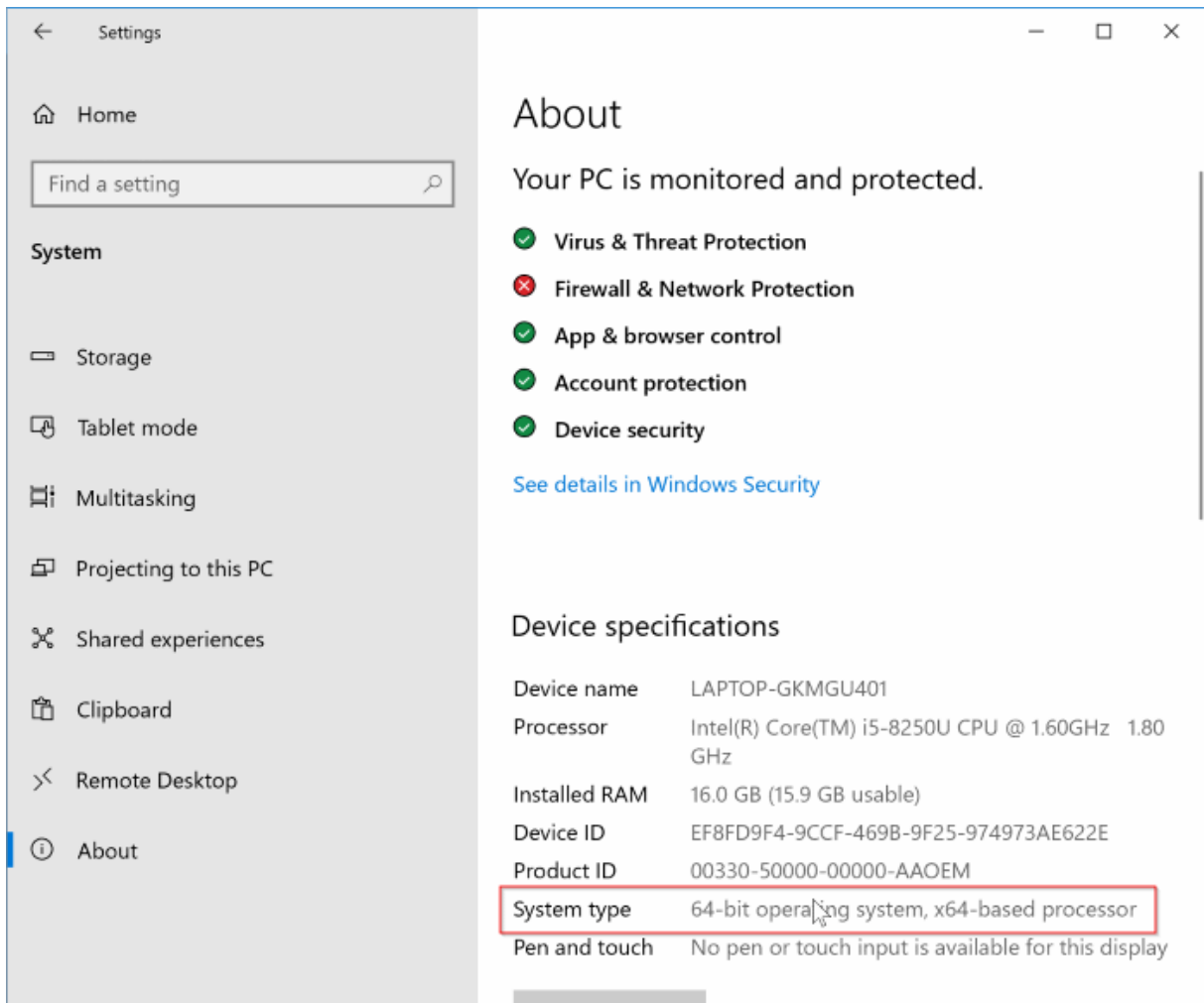


Figure 3: System type in Settings. Source: Into Windows, <https://www.intowindows.com/how-to-check-if-your-pc-is-running-32-bit-or-64-bit-windows-10/>.

3. Check virtualization. This is a computer feature needed by WSL 2. Press **Ctrl+Shift+Esc** to open Task Manager. Select More details if necessary, then Performance > CPU. Look for Virtualization: Enabled (Figure 4). If it says Disabled, follow your computer manufacturer's instructions for enabling virtualization in the BIOS/UEFI settings (the computer's startup settings) (<https://learn.microsoft.com/en-us/windows/wsl/troubleshooting>).

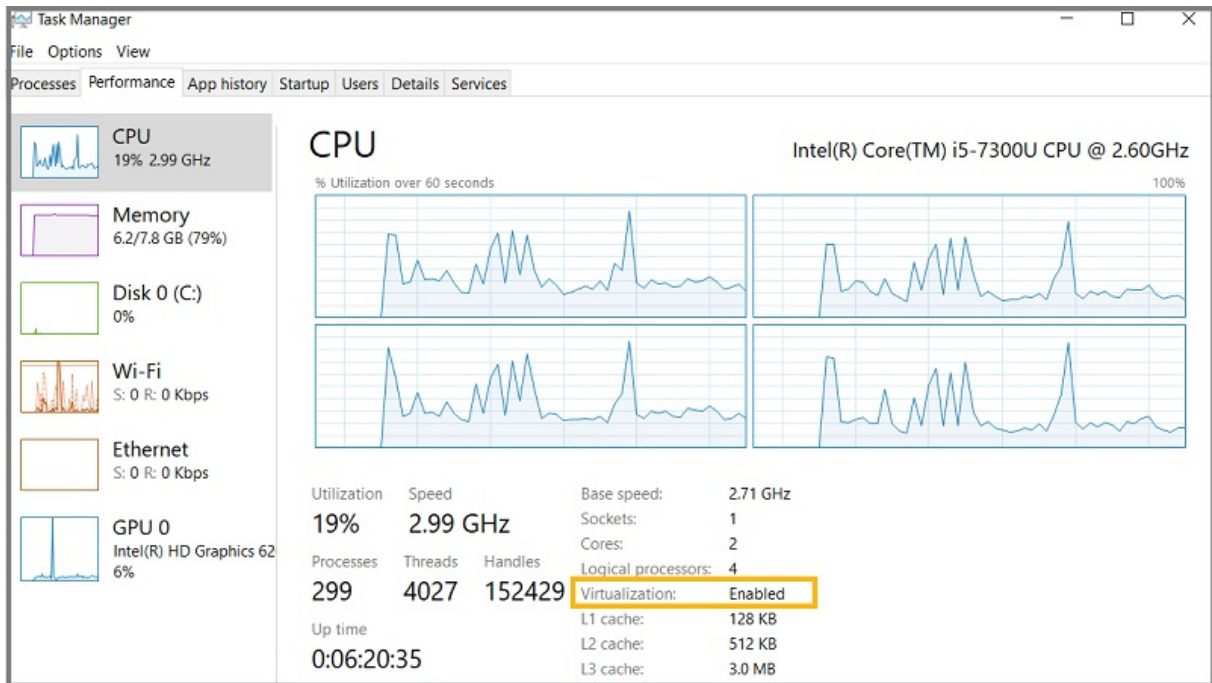


Figure 4: Virtualization status in Task Manager. Source: ASUS, <https://www.asus.com/us/support/faq/1043181/>.

2 Enable the Windows features

1. Press **Windows+R**, type **optionalfeatures**, and press **Enter**. A window called Windows Features opens.
2. Scroll down and check both Windows Subsystem for Linux and Virtual Machine Platform (Figure 5). If either box is already checked, leave it checked.
3. Click **OK**. If Windows asks for permission to make changes, approve it. Wait for Windows to finish.
4. If you checked either box in this step, **restart Windows** before continuing. Save any open documents first.

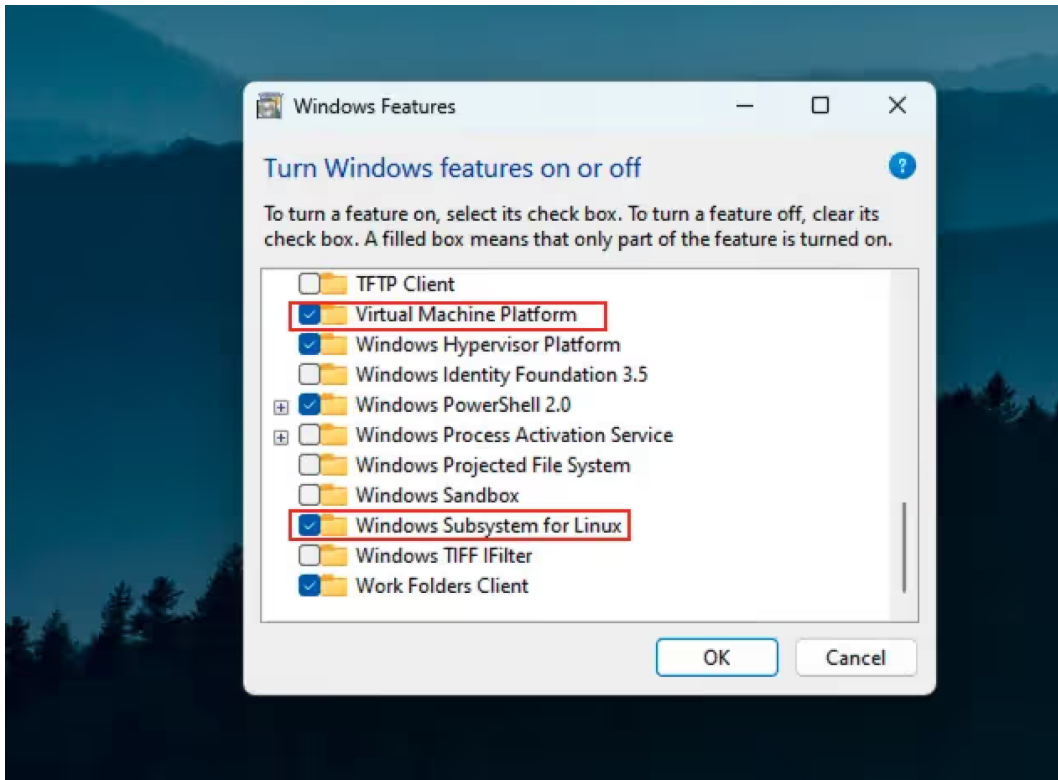


Figure 5: Windows Features on Windows 11, with both required items outlined. Source: Logic-Monitor, <https://www.logicmonitor.com/blog/install-pietrasanta-traceroute-on-windows-11>.

3 Using Windows PowerShell

Windows PowerShell is an application in which you type instructions for Windows. We will tell you exactly what to type and whether you need an administrator window, which has permission to change the computer's settings. Figure 6 shows the **Windows+X** menu used below.

- Administrator window: press **Windows+X**, select Windows PowerShell (Admin) on Windows 10 or Terminal (Admin) on Windows 11, and approve the administrator prompt. Use this for installing WSL or whenever a step requests administrator access.
- Ordinary window: press **Windows+X** and select Windows PowerShell on Windows 10 or Terminal on Windows 11. Use this for checking the installation or starting Ubuntu.

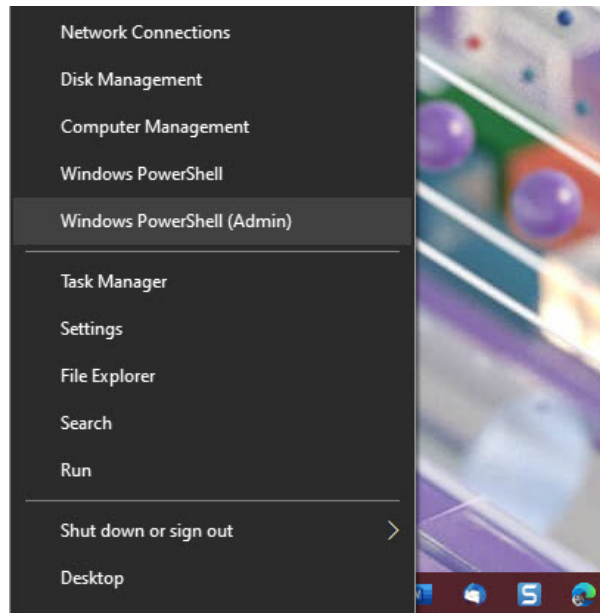


Figure 6: Windows+X menu. Source: WindowsLoop, <https://windowsloop.com/how-to-run-powershell-as-administrator/>.

On Windows 11, Terminal may be labeled Windows Terminal. It opens a window with tabs; use a PowerShell tab. Figure 7 shows PowerShell in both a classic window and Windows Terminal. If one is not already open, select Windows PowerShell from the arrow menu beside the + button.

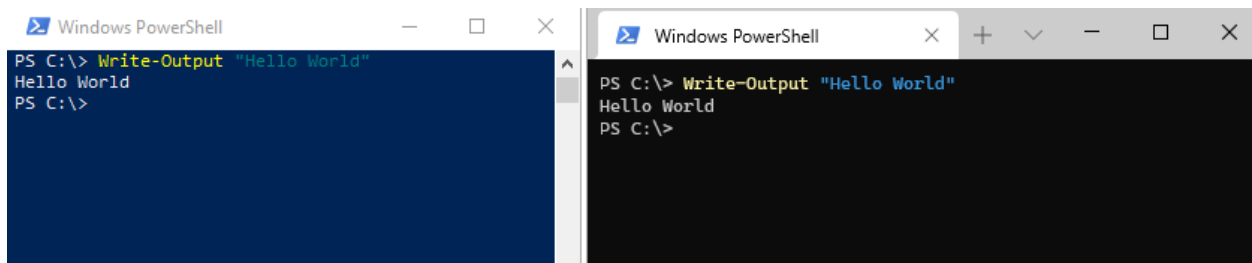


Figure 7: PowerShell in a classic window (left) and Windows Terminal (right). Source: Packt, p. 1, https://static.packt-cdn.com/downloads/9781800207561_ColorImages.pdf.

If these options are missing, search for Windows PowerShell in Start. Click the app for an ordinary window, or right-click it and select Run as administrator for an administrator window.

A *prompt* is the text the computer displays when it is ready for you to type a command. A PowerShell prompt usually begins with PS, followed by the current Windows folder. For example:

```
PS C:\Users\alice>
```

Type commands after the prompt; do not copy the prompt itself. In an administrator window, the title normally includes Administrator.

4 Install WSL and Ubuntu

Use an administrator PowerShell window as described in Section 3. Type the following line exactly, including the spaces and hyphens, and press **Enter**:

```
wsl --install -d Ubuntu
```

Windows will download and install the necessary software. Wait until it finishes, then restart Windows. After signing in again, click Start, type Ubuntu, and click the Ubuntu app if it has not opened automatically. Its first startup may take a few minutes. This method installs WSL 2, the version used in this guide (<https://learn.microsoft.com/en-us/windows/wsl/install>).

For another illustrated walkthrough, see Microsoft's WSL tutorial (<https://code.visualstudio.com/docs/remote/wsl-tutorial>). It also covers optional Visual Studio Code setup; use Section 9 here for the full manual WSL 2 installation sequence.

5 Getting started with Ubuntu

Use the Ubuntu window for this section. This window is called the *Ubuntu terminal*: it lets you type commands for Linux. You can open it by selecting Ubuntu from Start (Figure 8 for Windows 10 or Figure 9 for Windows 11).

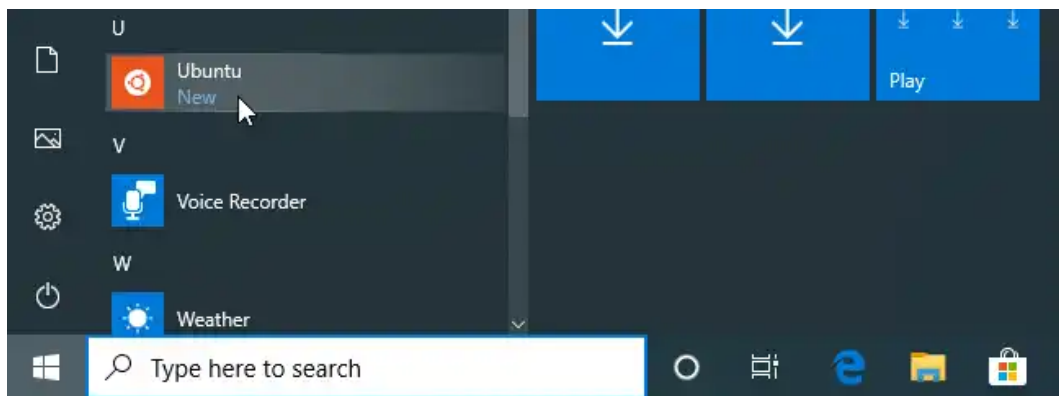


Figure 8: Ubuntu in the Windows 10 Start menu. Source: Config Server Firewall, <https://www.configserverfirewall.com/ubuntu-linux/install-ubuntu-on-windows-10/>.

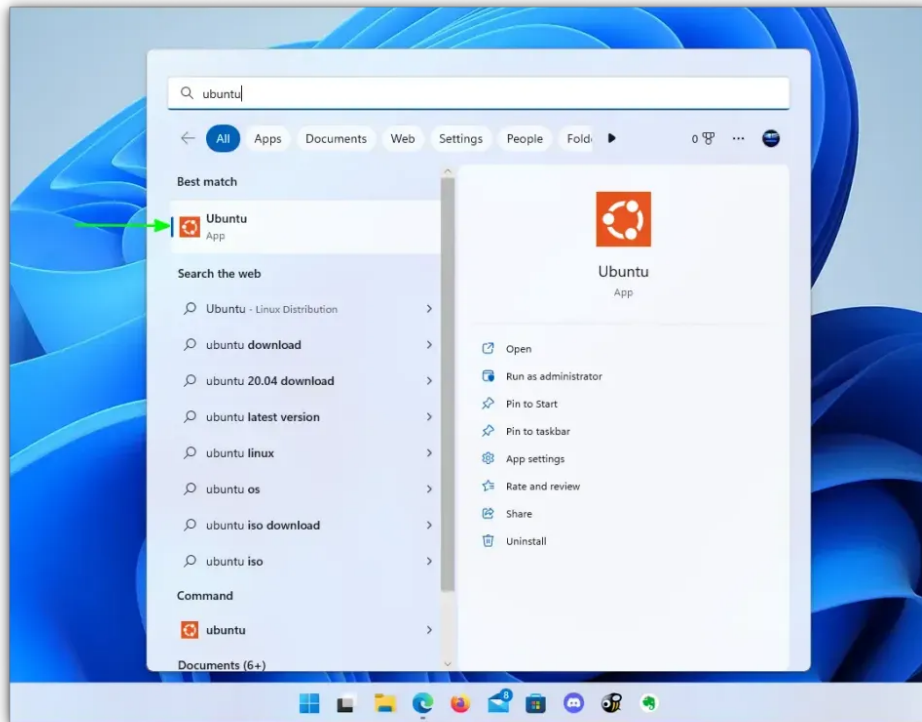


Figure 9: Ubuntu in Start search on Windows 11. Source: It's FOSS, <https://itsfoss.com/run-linux-apps-windows-wsl/>.

On its first launch, Ubuntu will ask you to choose a username and password. Use a simple username with lowercase letters and no spaces, such as `alice`. This account is separate from your Windows account. Remember the password: you will need it when installing or updating Linux software.

Remark 1. Nothing appears while you type a password, not even dots or asterisks. This is normal. You can use **Backspace** to delete the last character you typed. Type the password and press **Enter**, then type it again when asked to confirm it.

For example, the account setup may display the following prompts. Choose your own username in place of `alice`; password entry remains invisible.

```
Enter new UNIX username: alice
New password:
Retype new password:
```

After account setup, the terminal displays a *prompt* when Ubuntu is ready for a command (Figure 10). For example:

```
alice@DESKTOP:~$
```

Here, `alice` is your Linux username, `DESKTOP` is your computer's name, and `~` means your home folder. Your names may differ. Type commands after the `$`; do not copy the prompt itself. After a command finishes, the prompt returns so you can enter another.

```
chrisdias@CHRISDIAS5020: ~  
Installing, this may take a few minutes...  
Please create a default UNIX user account. The username does not need to match your Windows username.  
For more information visit: https://aka.ms/wslusers  
Enter new UNIX username: chrisdias  
Enter new UNIX password:  
Retype new UNIX password:  
passwd: password updated successfully  
Installation successful!  
To run a command as administrator (user "root"), use "sudo <command>".  
See "man sudo_root" for details.  
  
chrisdias@CHRISDIAS5020:~$ uname  
Linux  
chrisdias@CHRISDIAS5020:~$ _
```

Figure 10: Ubuntu terminal after account setup. Source: Microsoft, <https://code.visualstudio.com/docs/remote/wsl-tutorial>.

The three commands below display your username, your Ubuntu release, and the Linux kernel version (the version of the core part of Linux). The following sample session uses `alice` on a computer named `DESKTOP`. Type only the commands after the `$` prompt; the other lines are example output. Your username, computer name, Ubuntu release, and kernel version may differ. The `/etc/os-release` output is abbreviated.

```
alice@DESKTOP:~$ whoami  
alice  
alice@DESKTOP:~$ cat /etc/os-release  
PRETTY_NAME="Ubuntu 24.04.1 LTS"  
NAME="Ubuntu"  
VERSION_ID="24.04"  
VERSION="24.04.1 LTS (Noble Numbat)"  
ID=ubuntu  
...  
alice@DESKTOP:~$ uname -r  
5.15.167.4-microsoft-standard-WSL2
```

Enter the following commands one at a time to update Ubuntu's software. Wait for the first to finish before entering the second:

```
sudo apt update  
sudo apt upgrade
```

The word `sudo` asks Ubuntu for permission to change installed software. Enter the Linux password you just created if asked. The first command checks for available updates; the second installs them. If asked `Do you want to continue? [Y/n]`, type `y` and press `Enter`. Wait until the prompt returns.

Remark 2. Windows Update does not update the software inside Ubuntu.

Microsoft's illustrated setup guide covers accounts, updates, and Linux files (<https://learn.microsoft.com/en-us/windows/wsl/setup/environment>).

6 Verify your installation

Open an ordinary PowerShell window as described in Section 3. Run:

```
wsl --list --verbose
```

Look for Ubuntu with 2 in the VERSION column. For example:

NAME	STATE	VERSION
* Ubuntu	Running	2

Remark 3. Stopped is also normal: it means Ubuntu is not currently open. The VERSION column should show 2; this is the WSL version, not the Ubuntu release number. You can ignore the asterisk. If the column shows 1, see Section 8 (<https://learn.microsoft.com/en-us/windows/wsl/basic-commands>).

Installation is complete when `wsl -list -verbose` lists Ubuntu with WSL version 2 and the example commands in Section 5 work in Ubuntu. You can now close the PowerShell window. For future work, simply open Ubuntu from Start; you do not need to repeat the installation.

7 Everyday use and maintenance

In a PowerShell window, run `wsl -d Ubuntu` to enter Linux. Inside Ubuntu, run `exit` to return. You can also launch Ubuntu directly from Start.

For work with Linux software, keep files in your Linux *home folder*, the personal folder belonging to your Ubuntu account. The symbol `~` means this folder. In Ubuntu, the commands below create a folder named `projects`, switch to it, and open it in Windows File Explorer:

```
mkdir -p ~/projects
cd ~/projects
explorer.exe .
```

Remark 4. Keep the final dot in `explorer.exe .`: it means “the current folder.” Windows drive C: is accessible from Linux at `/mnt/c`. See file storage guidance (<https://learn.microsoft.com/en-us/windows/wsl/setup/environment>).

Routine maintenance

PowerShell: update WSL itself with:

```
wsl --update
```

Continue to run `sudo apt update` and `sudo apt upgrade` inside Ubuntu for Linux packages. To restart WSL, save your work first, then run these commands in a PowerShell

window:

```
wsl --shutdown  
wsl -d Ubuntu
```

Shutdown stops *all* running WSL distributions. On older WSL installations, some newer options may be absent; `wsl -help` lists the options your installation supports. See maintenance commands (<https://learn.microsoft.com/en-us/windows/wsl/basic-commands>).

8 Troubleshooting

If something goes wrong, copy the complete error message or take a photograph of it before closing the window. The following suggestions cover common problems.

Ubuntu is listed with VERSION 1.

In an ordinary PowerShell window, run the following. If this Ubuntu installation already contains work, save a backup copy of that work first. Replace `Ubuntu` if the `NAME` column shows a different name.

```
wsl --set-version Ubuntu 2
```

Wait for it to finish, then repeat `wsl -list -verbose`.

Installer prints help, or Ubuntu is missing.

In a PowerShell window, run `wsl -list -online`, then `wsl -install -d Ubuntu`. Launch Ubuntu once to finish initialization. Use the same Windows account in which you installed it.

Download remains at 0.0%.

Try `wsl -install -web-download -d Ubuntu` in an administrator PowerShell window. If that option is unavailable, consult `wsl -help` and use the manual fallback. See installer troubleshooting (<https://learn.microsoft.com/en-us/windows/wsl/install>).

Error 0x80370102: virtual machine cannot start.

Repeat the virtualization check in Section 1 and the checkbox check in Section 2, then restart Windows. If the error persists, look up the exact error in Microsoft's troubleshooting guide (<https://learn.microsoft.com/en-us/windows/wsl/troubleshooting>).

Error 0x8007019e: WSL component disabled.

Return to the Windows Features check in Section 2, enable Windows Subsystem for Linux, and restart Windows.

WSL 2 reports a missing or outdated kernel.

Try `wsl -update` in a PowerShell window. For the legacy manual installation, install the matching kernel update package from Section 9.

For more help, see Microsoft's troubleshooting guide (<https://learn.microsoft.com/en>

`-us/windows/wsl/troubleshooting).`

9 Alternative installation (optional)

Skip this section if Ubuntu is already working. These older installation steps may be useful when the command in Section 4 is unavailable. Microsoft's manual guide lists the Windows versions supported by this method and provides the downloads (<https://learn.microsoft.com/en-us/windows/wsl/install-manual>).

Complete the Windows Features check and any required restart in Section 2 before proceeding.

1. Download and run the x64 or ARM64 WSL 2 Linux kernel update package linked in step 4 of Microsoft's manual guide. Choose x64 for an x64-based processor or ARM64 for an ARM-based processor, using the System type you checked in Section 1. Download the file, then double-click it to run the installer.
2. PowerShell: run `wsl -set-default-version 2`.
3. Install Ubuntu from the Microsoft Store (Figure 11) and launch it. If the Store is unavailable, use the direct distribution downloads and package instructions in the manual guide.

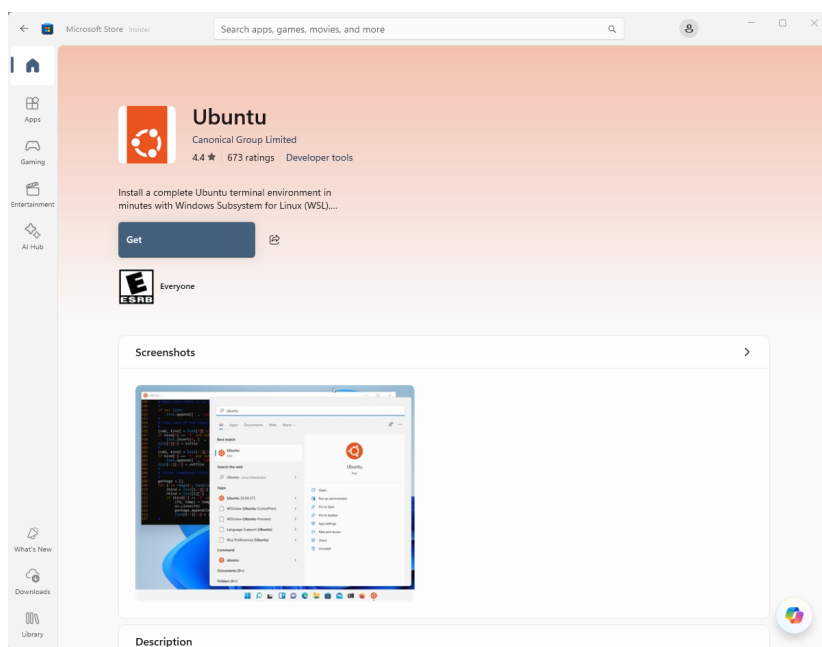


Figure 11: Ubuntu in the Microsoft Store (appearance may vary). Source: manual installation guide (<https://learn.microsoft.com/en-us/windows/wsl/install-manual>).

4. Complete the account setup and verification in Section 5 and Section 6.