

# Linux Operating System:

## 1. Introduction to Linux

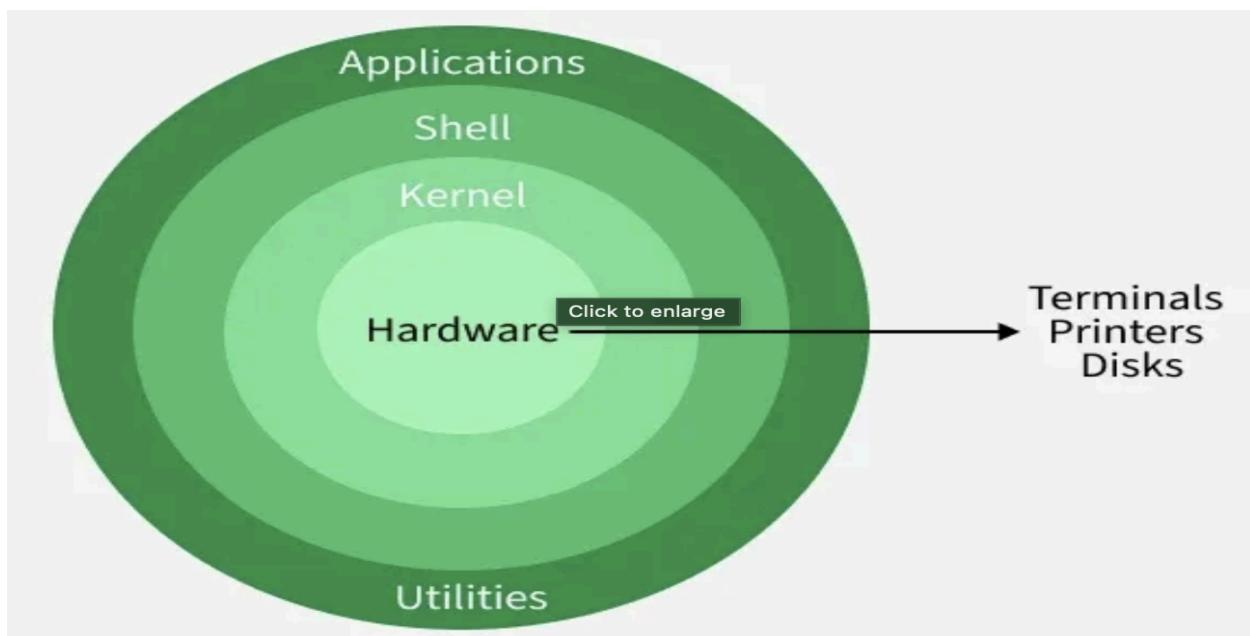
Linux is a free and open-source operating system based on **UNIX**, a powerful multitasking and multi-user system developed in the 1970s at AT&T Bell Labs.

### Key Characteristics

- **Open-Source:** The source code is accessible to everyone, promoting global innovation and collaboration.
- **Performance & Security:** Known for efficient resource management and robust security features.
- **Versatility:** Works across a vast range of devices, from embedded systems to supercomputers.
- **Completeness:** Combines the kernel with file systems, utilities, and applications to create a functional computing environment.

## 2. Linux Architecture

The architecture of Linux is a layered structure that defines how hardware and software components interact.



1. **Hardware Layer:** The physical components (CPU, RAM, Storage).
2. **Kernel:** The core of the OS. It manages hardware resources and acts as the communication bridge between hardware and software.
  - *Types:* Monolithic, Microkernel, Hybrid, Exokernel.
3. **System Libraries:** Pre-written code that allows applications to access kernel features without direct interaction.
4. **Shell:** The Command-Line Interface (CLI) that interprets user commands and sends them to the kernel.
5. **System Utilities & Applications:** Tools for management (installing software, user accounts) and end-user tasks (web browsers, office suites).

### 3. Understanding Distributions (Distros)

A **Linux Distribution** is a complete operating system built around the Linux kernel. With over 600+ distros available, users can choose based on stability, performance, or ease of use.

#### Popular Distributions

- **General Use:** Ubuntu, Linux Mint, Debian, Fedora.
- **Advanced/Custom:** Arch Linux, Gentoo.
- **Specialized:** Kali Linux (Security), MX Linux, openSUSE.

### 4. Applications of Linux

Linux is dominant across various industries due to its stability and open-source nature.

Domain	Key Use Case
<b>Servers &amp; Cloud</b>	Powers the majority of the world's web servers and data centers.
<b>Development</b>	Offers a native environment for coding, debugging, and multiple languages.
<b>Cybersecurity</b>	The gold standard for ethical hacking and penetration testing (e.g., Kali Linux).
<b>Embedded Systems</b>	Used in IoT devices, routers, and smart appliances due to its efficiency.
<b>Supercomputers</b>	Used almost exclusively for massive scientific calculations and simulations.

## 5. Selecting the Right Distribution

Choosing a distro depends entirely on your goals and experience level.

### Selection Guide

- **For Beginners:** **Ubuntu** (high support) or **Linux Mint** (Windows-like feel).
- **For Developers:** **Fedora** (latest tech) or **Debian** (rock-solid stability).
- **For Servers:** **Ubuntu Server** or **CentOS/RHEL** (enterprise stability).
- **For Security:** **Kali Linux** (pre-installed forensics and hacking tools).
- **For Older Hardware:** **Lubuntu** or **Puppy Linux** (extremely lightweight).

## 6. Importance of Linux

- **Cost-Effective:** Zero licensing fees for the core OS.
- **Customizable:** You can modify the system at every level to suit your needs.
- **Community Support:** Backed by a massive global community providing constant updates and troubleshooting.

# Linux Commands:

- **sudo su**: This command switches you to the **SuperUser** (root) account. **sudo** gives you administrative privileges, and **su** stands for "switch user." It is used when you need to perform multiple administrative tasks without typing **sudo** before every command.

```
ubuntu:~$ sudo su
ubuntu:~$ whoami
root
ubuntu:~$ pwd
/root
ubuntu:~$
```

- **whoami**: A simple but vital command that prints the **username** of the current user. It's helpful when you've switched between multiple accounts (like **root** and a standard user) and need to verify your current identity.

```
ubuntu:~$ whoami
root
```

- **touch**: Used to create a new, **empty file**. It is also used to update the access and modification timestamps of existing files.

```
ubuntu:~$ touch file1 file2
ubuntu:~$ ls
file1  file2  filesystem
```

- **ls** actually lists the **files and folders** in a directory

```
ubuntu:~$ ls
file1 file2 filesystem
ubuntu:~$
```

- **rm**: Stands for **remove**. It deletes files. By default, it does not delete directories unless specified.

```
ubuntu:~$ rm file1
ubuntu:~$ ls
file2 filesystem
ubuntu:~$
```

- **vi**: Open file if present else creates one. We can insert the data by clicking **i** then paste the data the **:wq** to save

```
ubuntu:~$ vi file1
ubuntu:~$ cat file1
Linux commands allow users to control and manage the system using the terminal, which works similarly to the Command Prompt in Windows. These commands are case-sensitive and are commonly used for performing system and administrative tasks efficiently.
ubuntu:~$
```

- **nano**: A simpler, more user-friendly terminal text editor compared to **vi**. It displays the keyboard shortcuts at the bottom of the screen, making it great for beginners.

```
ubuntu:~$ nano file1
```

```
GNU nano 7.2                               file1
Linux commands allow users to control and manage the system using the terminal, which works similarly to the Command Prompt in Windows. These commands are case-sensitive and are commonly used for performing system and administrative tasks efficiently.

[ Read 1 line ]
^G Help      ^O Write Out   ^W Where Is   ^K Cut        ^T Execute   ^C Location   M-U Undo   M-A Set Mark
^X Exit      ^R Read File   ^Y Replace    ^U Paste     ^J Justify   ^G Go To Line M-E Redo   M-G Copy
```

- **cat**: Stands for **concatenate**. While it can merge files, its most common use is to quickly **display the entire contents** of a file directly in the terminal window.

```
ubuntu:~$ cat file1
Linux commands allow users to control and manage the system using the terminal, which works similarly to the Command Prompt in Windows. These commands are case-sensitive and are commonly used for performing system and administrative tasks efficiently.
```

- **mkdir**: Stands for **make directory**. It creates a new folder.

```
ubuntu:~$ mkdir dir1
ubuntu:~$ ls
dir1  file1  filesystem
ubuntu:~$
```

- **rmdir**: Stands for **remove directory**. This command only works if the directory is **empty**. If there are files inside, you must use **rm -r**.

```
ubuntu:~/dir1$ rmdir dir1.1/  
rmdir: failed to remove 'dir1.1/': Directory not empty  
ubuntu:~/dir1$ cd ..  
ubuntu:~$ rmdir dir2  
ubuntu:~$ ls  
dir1  dir3  filesystem  
ubuntu:~$
```

- **rm -rf**: The "nuclear" option.
  - **-r** (recursive) deletes a directory and everything inside it.
  - **-f** (force) ignores non-existent files and never prompts for confirmation.
  - **Caution:** In the industry, using this on a production server without checking your path first is a major risk.

```
dir1  dir3  filesystem  
ubuntu:~$ rm -rf dir1  
ubuntu:~$ ls  
dir3  filesystem  
ubuntu:~$
```

- **mv**: Stands for **move**. It is used to move files or directories from one location to another. It is also the standard way to **rename** a file in Linux.

```
ubuntu:~$ mv file1 file  
ubuntu:~$ ls  
dir3  file  filesystem
```

```
ubuntu:~$ mv file dir3
ubuntu:~$ ls
dir3  filesystem
ubuntu:~$ cd dir3/
ubuntu:~/dir3$ ls
file
ubuntu:~/dir3$
```

- **cp**: Stands for **copy**. It creates a duplicate of a file or directory. To copy a directory, you usually need the `-r` flag.

```
ubuntu:~$ cp filee dir2
ubuntu:~$ ls
dir1  dir2  dir3  filee  filesystem
ubuntu:~$ cd dir2/
ubuntu:~/dir2$ ls
filee
ubuntu:~/dir2$
```

- **cd**: Stands for **change directory**. It is how you navigate through the file system (e.g., `cd /var/log`).

```
ubuntu:~/dir2$ pwd  
/root/dir2  
ubuntu:~/dir2$ cd ..  
ubuntu:~$ cd dir2/  
ubuntu:~/dir2$ pwd  
/root/dir2  
ubuntu:~/dir2$ █
```

- **pwd**: Stands for **print working directory**. It displays the full absolute path of the directory you are currently in.

```
ubuntu:~/dir2$ pwd  
/root/dir2
```

- **wget**: A command-line utility for **downloading files** from the internet via protocols like HTTP, HTTPS, and FTP.
  - *Example:* wget https://example.com/file.zip

```
ubuntu:~/dir2$ wget www.google.com  
--2026-01-30 06:24:31-- http://www.google.com/  
Resolving www.google.com (www.google.com)... 172.217.20.36, 2a00:1450:4007:80f::2004  
Connecting to www.google.com (www.google.com)|172.217.20.36|:80... connected.  
HTTP request sent, awaiting response... 200 OK  
Length: unspecified [text/html]  
Saving to: 'index.html'  
  
index.html [=>] 19.74K --.-KB/s in 0.01s  
2026-01-30 06:24:31 (1.56 MB/s) - 'index.html' saved [20212]  
  
ubuntu:~/dir2$ ls  
filee index.html  
ubuntu:~/dir2$ █
```

- **ping**: Used to test the **reachability** of a host (like a server or website) on an IP network. It sends small packets of data and measures how long it takes for them to return.

```
ubuntu:~/dir2$ ping www.google.com
PING www.google.com (172.217.20.36) 56(84) bytes of data.
64 bytes from arn11s01-in-f4.1e100.net (172.217.20.36): icmp_seq=1 ttl=115 time=13.2 ms
64 bytes from arn11s01-in-f4.1e100.net (172.217.20.36): icmp_seq=2 ttl=115 time=12.8 ms
64 bytes from arn11s01-in-f4.1e100.net (172.217.20.36): icmp_seq=3 ttl=115 time=15.1 ms
64 bytes from arn11s01-in-f4.1e100.net (172.217.20.36): icmp_seq=4 ttl=115 time=12.7 ms
64 bytes from arn11s01-in-f4.1e100.net (172.217.20.36): icmp_seq=5 ttl=115 time=13.0 ms
^C
--- www.google.com ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4006ms
rtt min/avg/max/mdev = 12.704/13.353/15.060/0.867 ms
ubuntu:~/dir2$
```