

Linux Operating System:

1. Introduction to Linux

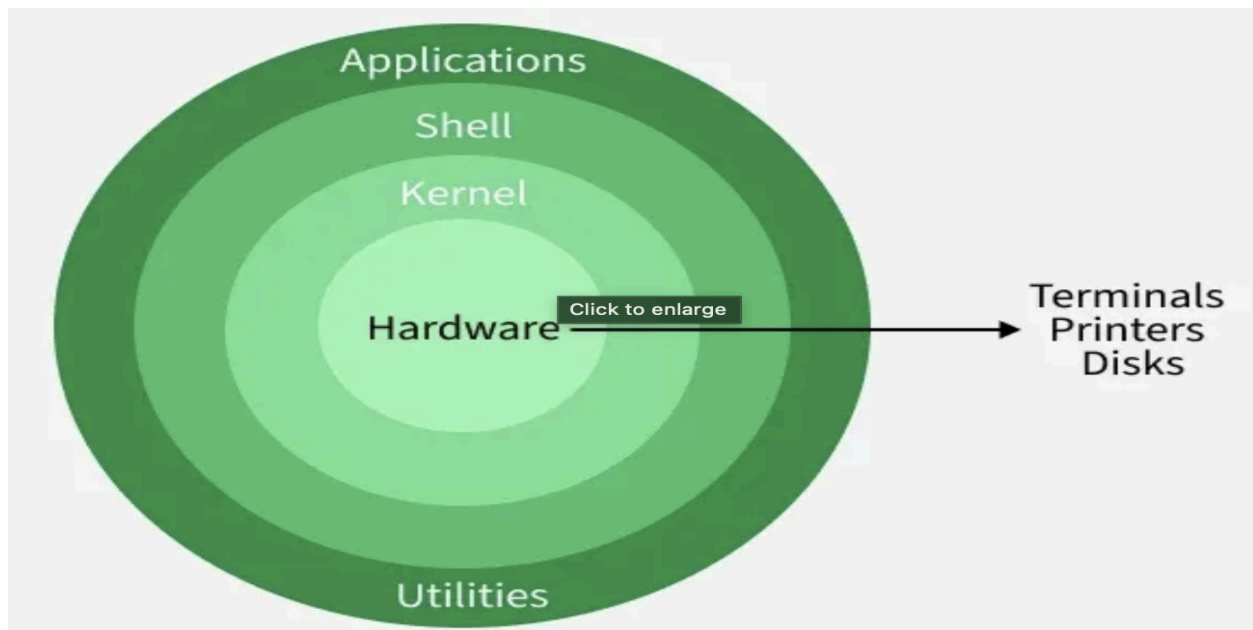
Linux is a free and open-source operating system based on **UNIX**, a powerful multitasking and multi-user system developed in the 1970s at AT&T Bell Labs.

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
Servers & Cloud	Powers the majority of the world's web servers and data centers.
Development	Offers a native environment for coding, debugging, and multiple languages.
Cybersecurity	The gold standard for ethical hacking and penetration testing (e.g., Kali Linux).
Embedded Systems	Used in IoT devices, routers, and smart appliances due to its efficiency.
Supercomputers	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**: 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 Promp

[ 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  ^_ Replace    ^U Paste      ^J Justify    ^_ Go To Line M-E Redo     M-6 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 Promp
t in Windows. These commands are case-sensitive and are commonly used for performing system and administrative tasks effic
iently.
```

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

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

- **rm**: Stands for **remove**. 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$
```

SYSTEM COMMANDS:

- **uname**: Displays the operating system name (e.g., Linux).

```
ubuntu:~$ uname  
Linux
```

- **uname -r**: Prints the **Kernel Release** version. This is critical when checking if a server is compatible with specific software like Docker.

```
ubuntu:~$ uname -r  
6.8.0-90-generic
```

- **uname -a**: The "All" flag. It provides a complete summary: OS name, hostname, kernel version,

```
ubuntu:~$ uname -a  
Linux ubuntu 6.8.0-90-generic #91-Ubuntu SMP PREEMPT_DYNAMIC Tue Nov 18 14:14:30 UTC 2025 x86_64 x86_64 x86_64 GNU/Linux
```

- **clear** (or **Ctrl + L**): Wipes the current terminal screen of previous text to give you a clean workspace.
- **who**: Lists all users currently logged into the system, including where they are logged in from and for how long.

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

- **whoami**: Returns the username of the effective user you are currently operating as.

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

- **uptime**: Shows how long the system has been running, the number of users, and the **load average** (a vital stat for SREs to check if a server is overloaded).

```
ubuntu:~$ uptime
04:44:08 up 1:09, 0 user, load average: 0.01, 0.00, 0.00
```

- **uptime -p**: Displays the uptime in a "pretty" or simplified format (e.g., "up 2 hours, 30 minutes").

```
ubuntu:~$ uptime -p
up 1 hour, 9 minutes
```

- **date**: Displays the current system date, time, and timezone.

```
ubuntu:~$ date
Sat Jan 31 04:46:18 UTC 2026
```

- **timedatectl**: A modern tool to view and change the system clock, timezone, and network time synchronization (NTP) settings.

```
ubuntu:~$ timedatectl
          Local time: Sat 2026-01-31 04:46:28 UTC
        Universal time: Sat 2026-01-31 04:46:28 UTC
              RTC time: Sat 2026-01-31 04:46:28
            Time zone: Etc/UTC (UTC, +0000)
System clock synchronized: yes
              NTP service: active
          RTC in local TZ: no
```

- **timedatectl set-timezone [Zone]**: Permanently changes the system's timezone.

- *Example:* `timedatectl set-timezone Asia/Kolkata`

```
ubuntu:~$ timedatectl set-timezone Asia/Kolkata
```

```
ubuntu:~$ date  
Sat Jan 31 10:30:39 IST 2026
```

- **hostname**: Displays the system's network name.

```
ubuntu:~$ hostname  
ubuntu
```

- **hostname -i**: Displays the IP address(es) associated with the hostname.

```
ubuntu:~$ hostname -i  
127.0.0.1
```

- **hostnamectl set-hostname [Name]**: A persistent way to change the server's name. This updates the configuration files so the name stays changed even after a reboot.

```
ubuntu:~$ hostnamectl set-hostname "swiggy"  
ubuntu:~$ hostname  
swiggy
```

- **ip addr**: The modern replacement for `ifconfig`. It shows all network interfaces and their assigned IP addresses.

```
ubuntu:~$ ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host noprefixroute
        valid_lft forever preferred_lft forever
2: enp1s0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 2a:11:8e:9f:da:7f brd ff:ff:ff:ff:ff:ff
    inet 172.30.1.2/24 brd 172.30.1.255 scope global dynamic noprefixroute enp1s0
        valid_lft 86309374sec preferred_lft 75520174sec
    inet6 fe80::4511:769f:a2b7:c398/64 scope link
        valid_lft forever preferred_lft forever
3: docker0: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1454 qdisc noqueue state DOWN group default
    link/ether 56:75:bb:65:9d:29 brd ff:ff:ff:ff:ff:ff
    inet 172.17.0.1/16 brd 172.17.255.255 scope global docker0
        valid_lft forever preferred_lft forever
```

- **ip route**: Shows the **routing table**, telling you how traffic leaves the system and what the "Default Gateway" is.

```
ubuntu:~$ ip route
default via 172.30.1.1 dev enp1s0 proto dhcp src 172.30.1.2 metric 1002 mtu 1500
172.17.0.0/16 dev docker0 proto kernel scope link src 172.17.0.1 linkdown
172.30.1.0/24 dev enp1s0 proto dhcp scope link src 172.30.1.2 metric 1002 mtu 1500
```

- **ifconfig**: A legacy tool used to view or configure network interfaces. Note that many modern Linux distros require you to install **net-tools** to use this.

```
ubuntu:~$ ifconfig
docker0: flags=4099<UP,BROADCAST,MULTICAST> mtu 1454
    inet 172.17.0.1 netmask 255.255.0.0 broadcast 172.17.255.255
    ether 56:75:bb:65:9d:29 txqueuelen 0 (Ethernet)
    RX packets 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 0 bytes 0 (0.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

enp1s0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 172.30.1.2 netmask 255.255.255.0 broadcast 172.30.1.255
    inet6 fe80::4511:769f:a2b7:c398 prefixlen 64 scopeid 0x20<link>
    ether 2a:11:8e:9f:da:7f txqueuelen 1000 (Ethernet)
    RX packets 26559 bytes 33369468 (33.3 MB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 9834 bytes 14842159 (14.8 MB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 84 bytes 6264 (6.2 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 84 bytes 6264 (6.2 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

- **ps**: Stands for **Process Status**. By default, it shows processes running in the current terminal session.
 - *Industry Tip*: Use **ps -ef** or **ps aux** to see every process running on the entire system.

```
ubuntu:~$ ps
  PID TTY          TIME CMD
 1865 pts/0        00:00:00 bash
 2196 pts/0        00:00:00 ps
```

- **kill -9 [PID]**: Sends a "SIGKILL" signal to a process ID. The **-9** flag is the "force" option, used to immediately stop a process that is frozen or won't close normally.

```
ubuntu:~$ kill -9 PID
bash: kill: PID: arguments must be process or job IDs
ubuntu:~$ ps
  PID TTY          TIME CMD
 1865 pts/0        00:00:00 bash
 2196 pts/0        00:00:00 ps
```

Using the **+** sign allows you to extract specific parts of the timestamp, which is incredibly useful for **shell scripting** (like naming a backup file with today's date).

Command	Output Description	Example
date +"%d"	Day of the month	31
date +"%m"	Month number	01
date +"%y"	Last two digits of year	26

date +"%H"	Hour (24-hour format)	10
date +"%M"	Minute	07
date +"%S"	Seconds	46
date +"%D"	Date as MM/DD/YY	01/31/26
date +"%F"	Full date (YYYY-MM-DD)	2026-01-31
date +"%A"	Full name of the weekday	Saturday
date +"%B"	Full name of the month	January

```
ubuntu:~$ date
Sat Jan 31 10:18:13 IST 2026
ubuntudate +"%d" "%d"
"31"
ubuntudate +"%m" "%m"
"01"
ubuntudate +"%y" "%y"
"26"
ubuntudate +"%H" "%H"
"10"
ubuntudate +"%M" "%M"
"18"
ubuntudate +"%S" "%S"
"04"
ubuntu:~$ date +"%D"
01/31/26
ubuntudate +"%F" "%F"
"2026-01-31"
ubuntudate +"%A" "%A"
"Saturday"
ubuntudate +"%B" "%B"
"January"
ubuntu:~$ date
Sat Jan 31 10:30:39 IST 2026
```


HARDWARE COMMANDS:

- **lscpu**: This is the most user-friendly way to view CPU details. It gathers information from the system architecture and displays the number of CPUs, cores, threads, and the CPU model name in a clean, structured list.

```
ubuntu:~$ lscpu
Architecture:          x86_64
CPU op-mode(s):        32-bit, 64-bit
Address sizes:          39 bits physical, 48 bits virtual
Byte Order:             Little Endian
CPU(s):                 1
On-line CPU(s) list:    0
Vendor ID:              GenuineIntel
BIOS Vendor ID:         Red Hat
Model name:             Intel Xeon E312xx (Sandy Bridge, IBRS update)
BIOS Model name:        RHEL-9.6.0 PC (Q35 + ICH9, 2009) CPU @ 2.0GHz
BIOS CPU family:        1
CPU family:             6
Model:                  42
Thread(s) per core:     1
Core(s) per socket:     1
Socket(s):              1
Stepping:               1
BogoMIPS:               7008.00
Flags:                  fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov pat pse36 clflush mmx fxsr sse sse
                        2 syscall nx rdtscp lm constant_tsc rep_good nopl xtopology cpuid tsc_known_freq pni pclmulqdq s
                        sse3 cx16 pcid sse4_1 sse4_2 x2apic popcnt tsc_deadline_timer aes xsave avx hypervisor lahf_lm c
                        puid_fault pti ssbd ibrs ibpb stibp tsc_adjust xsaveopt arat md_clear

Virtualization features:
Hypervisor vendor:      KVM
Virtualization type:    full
Caches (sum of all):
L1d:                    32 KiB (1 instance)
L1i:                    32 KiB (1 instance)
L2:                     4 MiB (1 instance)
L3:                     16 MiB (1 instance)
NUMA:
NUMA node(s):           1
NUMA node0 CPU(s):      0
Vulnerabilities:
Gather data sampling:    Not affected
Itlb multihit:           KVM: Mitigation: VMX unsupported
L1tf:                   Mitigation; PTE Inversion
Mds:                     Mitigation; Clear CPU buffers; SMT Host state unknown
```

- **cat /proc/cpuinfo**: This command reads directly from the virtual file system. It provides a highly detailed, technical breakdown for *every single logical core* in the system. If you have 16 cores, it will print 16 long blocks of text.
 - **Industry Use:** Use **lscpu** for a quick summary and **/proc/cpuinfo** if you need to find specific hardware flags or cache sizes.

```

ubuntu:~$ cat /proc/cpuinfo
processor       : 0
vendor_id      : GenuineIntel
cpu family     : 6
model          : 42
model name     : Intel Xeon E312xx (Sandy Bridge, IBRS update)
stepping       : 1
microcode      : 0x1
cpu MHz        : 3504.000
cache size     : 16384 KB
physical id    : 0
siblings       : 1
core id        : 0
cpu cores      : 1
apicid         : 0
initial apicid : 0
fpu            : yes
fpu_exception  : yes
cpuid level    : 13
wp             : yes
flags          : fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov pat pse36 clflush mmx fxsr sse sse2 syscall
l nx rdtscp lm constant_tsc rep_good nopl xtopology cpuid tsc_known_freq pni pclmulqdq ssse3 cx16 pcid sse4_1 sse4_2 x2api
c popcnt tsc_deadline_timer aes xsave avx hypervisor lahf_lm cpuid_fault pti ssbd ibrs ibpb stibp tsc_adjust xsaveopt arat
md_clear
bugs           : cpu_meltdown spectre_v1 spectre_v2 spec_store_bypass l1tf mds swapgs itlb_multihit mmio_unknown bhi
bogomips       : 7008.00
clflush size   : 64
cache_alignment : 64
address sizes   : 39 bits physical, 48 bits virtual
power management:

ubuntu:~$ lsblk -a
NAME        MAJ:MIN RM   SIZE RO TYPE MOUNTPOINTS
loop0        7:0      0     0B  0 loop
loop1        7:1      0     0B  0 loop
loop2        7:2      0     0B  0 loop
loop3        7:3      0     0B  0 loop
loop4        7:4      0     0B  0 loop
loop5        7:5      0     0B  0 loop

```

- **lsblk -a**: Lists all "Block Devices" (hard drives, SSDs, partitions, and even RAM disks). The **-a** flag ensures it shows empty devices as well.
 - **Key Insight**: It shows a "tree" structure, making it easy to see which partition belongs to which physical disk.
 - **Industry Use**: Essential when you are adding a new volume to a cloud instance (like an AWS EBS volume) to verify the system "sees" the new hardware.

```

ubuntu:~$ lsblk -a
NAME        MAJ:MIN RM   SIZE RO TYPE MOUNTPOINTS
loop0        7:0      0     0B  0 loop
loop1        7:1      0     0B  0 loop
loop2        7:2      0     0B  0 loop
loop3        7:3      0     0B  0 loop
loop4        7:4      0     0B  0 loop
loop5        7:5      0     0B  0 loop
loop6        7:6      0     0B  0 loop
loop7        7:7      0     0B  0 loop
vda          253:0     0    20G  0 disk
|-vda1       253:1     0    19G  0 part /
|-vda14      253:14    0     4M  0 part
|-vda15      253:15    0   106M  0 part /boot/efi
`-vda16      259:0     0   913M  0 part /boot

```

- **free**: Displays the total amount of free and used physical memory (RAM) and swap memory in the system. By default, it displays values in **Kilobytes (KB)**, which can be hard for humans to read quickly.

```
ubuntu:~$ free
```

	total	used	free	shared	buff/cache	available
Mem:	1948940	483732	501892	1064	1160980	1465208
Swap:	1048572	0	1048572			

- **cat /proc/meminfo**: Like the CPU version, this reads directly from the kernel's data. it provides a massive list of memory statistics, including "Dirty" memory, "Cached" memory, and "Buffers."

```
ubuntu:~$ cat /proc/meminfo
```

MemTotal:	1948940	KB
MemFree:	501892	KB
MemAvailable:	1465244	KB
Buffers:	125904	KB
Cached:	784380	KB
SwapCached:	0	KB
Active:	456956	KB
Inactive:	604204	KB
Active(anon):	160692	KB
Inactive(anon):	0	KB
Active(file):	296264	KB
Inactive(file):	604204	KB
Unevictable:	27284	KB
Mlocked:	27284	KB
SwapTotal:	1048572	KB
SwapFree:	1048572	KB
Zswap:	0	KB
Zswapped:	0	KB
Dirty:	12	KB
Writeback:	0	KB
AnonPages:	178208	KB
Mapped:	170732	KB
Shmem:	1064	KB
KReclaimable:	250732	KB
Slab:	308716	KB
SReclaimable:	250732	KB
SUnreclaim:	57984	KB
KernelStack:	3004	KB
PageTables:	6840	KB
SecPageTables:	0	KB
NFS_Unstable:	0	KB
Bounce:	0	KB
WritebackTmp:	0	KB
CommitLimit:	2023040	KB
Committed_AS:	877704	KB
VmallocTotal:	34359738367	KB
VmallocUsed:	16228	KB
VmallocChunk:	0	KB

- **free -m**: The same as **free**, but it converts all values into **Megabytes (MB)**.
 - **Industry Use**: In 2026, most engineers prefer **free -h** (human-readable), which automatically switches between MB, GB, and TB so you don't have to do the math in your head.

```
ubuntu:~$ free -m
```

	total	used	free	shared	buff/cache	available
Mem:	1903	472	490	1	1133	1430
Swap:	1023	0	1023			

- **df -h**: Stands for "disk free." It reports how much space is used and available on all mounted file systems.
 - **The -h flag**: "Human-readable" format (shows 50G instead of 52428800).
 - **Industry Use**: This is a "must-know" command. If your **MySQL** database stops working, the first thing you check with **df -h** is if the disk is 100% full.

```
ubuntu:~$ df -h
```

Filesystem	Size	Used	Avail	Use%	Mounted on
tmpfs	191M	980K	190M	1%	/run
/dev/vda1	19G	5.2G	14G	29%	/
tmpfs	952M	84K	952M	1%	/dev/shm
tmpfs	5.0M	0	5.0M	0%	/run/lock
/dev/vda16	881M	117M	703M	15%	/boot
/dev/vda15	105M	6.2M	99M	6%	/boot/efi

```
ubuntu:~$
```

GREP (Global Regular Expression Print):

```
ubuntu:~$ ls
filesystem
ubuntu:~$ vi file
ubuntu:~$ cat
^C
ubuntu:~$ cat file
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:~$
```

- **grep "word" filename**: The basic search. It scans the file and prints every line that contains a match for "word."

```
ubuntu:~$ grep "Linux" file
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.
```

- **grep -n "word" filename**: Adds the **line number** from the file to each matching line.
- **Industry Use**: Very helpful when you find an error in a long configuration file and need to know exactly where to go to fix it.

```
ubuntu:~$ grep -n "Linux" file
1: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.
```

- **grep -c "word" filename**: Instead of showing the lines, it gives you a **count** of how many lines contained the match.

```
ubuntu:~$ grep -c "Linux" file
1
```

- **grep -i "word" filename**: Performs a **case-insensitive** search. It will match "Word", "WORD", or "wOrD".

```
ubuntu:~$ grep -i "linux" file
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.
```

- **cat /etc/passwd**: Displays the raw system file containing user account information. Each line represents a user and includes their UID, GID, home directory, and default shell.
- **getent passwd**: A more robust command that "gets entries" from the password database. While it often shows the same as **/etc/passwd**, it is preferred in professional environments because it can also pull users from external sources like LDAP or Active Directory.
- **useradd [username]**: Creates a new user account.
 - **The "Home" Note**: By default, it creates a personal directory at **/home/[username]**. This is where the user stores their personal files and configurations.
 - **The "Group" Note**: Most modern Linux distributions use **User Private Groups (UPG)**. This means for every user added, a group with the exact same name is created, and the user is made the only member of that group.
- **useradd -M [username]**: The **-M** flag stands for "No Home Directory."
 - **Industry Use**: This is commonly used for **System Users** (like a **mysql** or **nginx** user). Since these "users" are just used to run background services and won't be logging in to type commands, they don't need a **/home** folder.
- **userdel [username]**: Deletes the user account from the system and removes their name from the **/etc/group** file.
 - **The "Safety" Note**: It leaves the **/home** folder untouched as a safety measure so that important data isn't accidentally deleted.
- **userdel -r [username]**: The **-r** flag stands for "**Recursive**." It deletes the user account AND their home directory and mail spool simultaneously.
- **passwd [username]**: Assigns or changes a password for a user. Without a username, it changes the password for the account you are currently using.

- **su - [username]**: Stands for "**Switch User.**"