Linux Directory Structure

🧱 / — Root Directory

- The **base** of the filesystem. Every single file and directory starts from here.
- This is **not** the same as /root (which is the home directory for the root user).
- Accessing:

cd /

📁 /bin — Essential User Binaries

- Holds essential **command-line tools** used in single-user mode or by all users.
- Available even when no other mount is available (e.g., during system rescue).
- **Examples of binaries:**
  - ls – list directory contents
  - cp – copy files
  - mv – move/rename
  - bash – Bourne Again Shell
- **Why it matters:**
  - /bin ensures that even if /usr is not mounted, basic shell functionality is available.
- 📦 Path:

ls /bin

📁 /sbin — System Binaries

- Contains **essential system programs** used by **root or system administrators**.
- Not typically in a regular user's PATH.
- **Examples:**
  - shutdown, reboot – power control
  - fdisk – partitioning
  - iptables – firewall

- 🔐 These are not for everyday users.

ls /sbin

📁 /boot — Boot Files

- Critical for booting the OS.
- Contains:
  - **Linux kernel** – /boot/vmlinuz-*
  - **Initial RAM disk** – /boot/initrd.img-*
  - **GRUB config** – /boot/grub/grub.cfg
- Messing with this directory can make your system unbootable.
- 🛠️ Use case:
  - When upgrading the kernel
  - Troubleshooting boot issues

ls /boot

📁 /dev — Device Files

- Everything in Linux is a file—even hardware devices.
- /dev contains **special files** that represent hardware devices and virtual devices.
- **Examples:**
  - /dev/sda – first hard disk
  - /dev/tty – terminal
  - /dev/null – discard output
- 📌 You can use mount /dev/sdb1 /mnt to mount a USB stick.
- 🔄 Devices are dynamically managed by udev.

ls /dev

ls -l /dev/null

📁 /etc — Configuration Files

- This is the **brain of your system's configuration**.

- Contains system-wide config files and directories.
- **Examples:**
  - /etc/hostname – name of your machine
  - /etc/passwd – user account data
  - /etc/fstab – auto-mount filesystem info
  - /etc/ssh/sshd_config – SSH server config
- 🛠️ Modified during system setup, service config, networking, and security.

cat /etc/os-release

cat /etc/hostname

📁 /home — User Home Directories

- Each regular user gets a subdirectory here:
  - /home/aditya
  - /home/devops_student
- Stores user files, configs (dotfiles like .bashrc, .gitconfig), and personal projects.
- Safe space for users to work.

cd /home

ls

📁 /lib, /lib64 — Shared Libraries

- Contains **shared libraries** needed by programs in /bin and /sbin.
- Like DLLs on Windows.
- **Examples:**
  - /lib/x86_64-linux-gnu/libc.so.6
- You can view dependencies using:

ldd /bin/ls

📁 /media — Mount Point for Removable Media

- When you insert a **USB drive or CD/DVD**, it's automatically mounted here by GUI systems.
    - e.g., /media/aditya/USB_DRIVE
- Managed by desktop environments or udisks.

ls /media

📁 /mnt — Mount Point for Temporary Mounting

- Used by **system administrators** to manually mount filesystems.
- For example:

mount /dev/sdb1 /mnt

- Unlike /media, it’s not automatic.

📁 /opt — Optional Software

- "Optional" third-party software or **custom apps** are installed here.
- Example: /opt/google, /opt/vscode, /opt/tomcat
- Keeps it separate from system packages.

📁 /proc — Process Information (Virtual Filesystem)

- Virtual filesystem exposing runtime system information.
- Dynamic files that represent system and process information.
- Examples:
    - /proc/cpuinfo – CPU info
    - /proc/meminfo – memory info
    - /proc/[PID]/ – details of specific processes
- Not real files on disk — virtual and constantly updating.

cat /proc/cpuinfo

ls /proc/$(pidof bash)

📁 /root — Root User's Home Directory

- Home directory for the **root user** (not /home/root!).
- Only accessible to root.

sudo ls /root

📁 /run — Temporary Runtime Files

- Contains **runtime data** since boot (e.g., PIDs, sockets).
- Replaces older /var/run and is mounted as a tmpfs (in-memory).
- Example: /run/nginx.pid, /run/lock

📁 /srv — Service Data

- "Service" directory that holds data for services **provided by the system**.
- Example: Web server files
  - /srv/www or /srv/http
  - /srv/ftp for FTP files

📁 /sys — System Information

- Like /proc, a **virtual filesystem**.
- Exposes system and kernel information.
- Example: /sys/class/net/ for network interfaces

📁 /tmp — Temporary Files

- For temporary files created by programs.
- Gets cleared on reboot (in most systems).
- Example: temporary downloads, socket files.

touch /tmp/test.txt

📁 /usr — User Utilities and Applications

- Contains **secondary hierarchy** of files and programs **not essential for boot**.

- Subdirectories:
    - /usr/bin – non-essential user commands
    - /usr/sbin – non-essential admin commands
    - /usr/lib – libraries
    - /usr/local – locally compiled apps

📁 /var — Variable Data

- Contains files that **grow over time**.
- Logs, spool files, databases, caches.
- Common subdirectories:
    - /var/log/ – system logs (syslog, auth.log, dmesg)
    - /var/mail/
    - /var/lib/
    - /var/cache/

cat /var/log/syslog

🔄 Linux Directory Tree Summary Table

Directory	Description	Example
/bin	Essential commands	ls, cp, bash
/sbin	Admin commands	fsck, iptables
/boot	Boot files	vmlinuz, grub.cfg
/dev	Device files	/dev/sda, /dev/null
/etc	System config	fstab, passwd
/home	User directories	/home/aditya
/lib, /lib64	Shared libraries	libc.so.6
/media	Auto-mounted devices	USB drives
/mnt	Manual mount point	Mounted NFS

Directory	Description	Example
/opt	Optional software	/opt/tomcat
/proc	Process/system info	cpuinfo, meminfo
/root	Root user home	~ for root
/run	Runtime info	PID files
/srv	Service data	Web/FTP files
/sys	Kernel info	/sys/class/net
/tmp	Temp files	socket files
/usr	User utilities	/usr/bin/git
/var	Variable data	logs, mail, cache