# 📁 Linux Filesystem Hierarchy – Detailed Documentation

## 🔰 Root Directory `/`

The root directory is the **starting point** of the entire Linux file system. Every file and directory stems from this root. It is denoted by a single forward slash `/`. Unlike Windows, Linux does not use drive letters like `C:` or `D:` – all file systems and storage devices are accessed as part of a single hierarchical tree under `/`.

---

## Overview of Directory Categories

| Category | Description |
|---|---|
| System Binaries | Contains essential executables used for basic system operations |
| Boot & Kernel-related | Files and configuration related to system startup and the Linux kernel |
| Configuration Files | System-wide configuration and settings |
| User-Related | User-specific directories and information |
| Shared Libraries | Libraries required by binaries and programs |
| Mount Points & Media | Used for mounting devices and media |
| System Info | Interfaces to kernel and hardware information |
| Multi-user Resources | Common data and resources accessible by users |
| Temporary Files | Storage for transient files |
| Operational Software | Optional or third-party software |

# 📘 Directory Structure with Detailed Purpose

## `/root` – Root User's Home Directory

- **Purpose**:
  This is the **personal directory for the root (administrator)** user. It is isolated from regular user directories (`/home`) to avoid accidental modifications by non-privileged users.
  Root uses this directory to store scripts, logs, and temporary files specific to system administration tasks.

---

## `/bin` – Essential User Binaries

- **Purpose**:
  Contains **fundamental command-line utilities** that are required by the system during **booting, single-user mode**, or for basic operations by all users. These commands are statically linked and are available even when other partitions are not yet mounted.

- **Common Tools**: `ls`, `cp`, `mv`, `rm`, `cat`, `chmod`, `echo`

---

## `/sbin` – System Binaries

- **Purpose**:
  Holds **critical system binaries** mainly intended for the **system administrator (root)**. These commands are used to manage file systems, shutdown, repair, configure devices, and more.

- **Examples**: `mount`, `fsck`, `shutdown`, `reboot`, `ifconfig`, `iptables`

---

## `/lib` – Shared Libraries

- **Purpose**:
  Stores **essential shared libraries** (similar to Windows DLL files) that are needed by programs in `/bin` and `/sbin` to execute. These include **low-level functions** for things

like file handling, process management, and mathematical operations.

---

## `/usr` – User System Resources

- **Purpose**:
  Contains **read-only user utilities and applications**, and is often the largest directory. It holds system-wide libraries, binaries, manuals, and header files for development.
    - `/usr/bin`: Non-essential binaries for all users
    - `/usr/sbin`: Non-essential system admin tools
    - `/usr/lib`: Libraries for `/usr/bin` and `/usr/sbin`
    - `/usr/share`: Architecture-independent data (man pages, icons, docs)

---

## `/boot` – Boot Loader Files

- **Purpose**:
  Holds all files needed for the **boot process**, including the **Linux kernel** and **bootloader configuration files**. This directory is often mounted on a **separate partition**.
    - `vmlinuz`: Compressed Linux kernel
    - `initrd`: Temporary root file system used during boot
    - `grub/grub.cfg`: Configuration file for the GRUB bootloader

---

## `/dev` – Device Files

- **Purpose**:
  This contains **special files that represent devices** attached to the system. These include **block devices** (disks, USBs) and **character devices** (terminals, serial ports).

The kernel and applications interact with devices via these files.

- `/dev/sda`: First hard drive
- `/dev/tty`: Terminal interface
- `/dev/null`, `/dev/zero`: Special-purpose files used in scripting

---

## `/etc` – System Configuration Files

- **Purpose**:
  A critical directory containing **configuration files** that control system behavior. All global settings are defined here – for users, services, networking, firewalls, etc.
  - `/etc/passwd`: User account info
  - `/etc/fstab`: Disk mount info
  - `/etc/hostname`: System hostname
  - `/etc/network/interfaces` or `/etc/netplan/`: Network settings

---

## `/home` – User Home Directories

- **Purpose**:
  Stores **personal data and settings** for regular users. Each user gets a dedicated subdirectory under `/home`, e.g., `/home/alice`, `/home/bob`. It includes documents, downloads, SSH keys, bash profiles, etc.

---

## `/media` – Removable Media Mount Point

- **Purpose**:
  Automatically created **mount points for removable devices**, such as USB drives, external hard disks, CDs, and DVDs.

Example: Plugging a USB drive may auto-mount as `/media/username/USB_DRIVE`

---

## `/mnt` – Temporary Mount Point

- **Purpose**:
  Reserved for **manual or temporary mount operations** by system administrators. For example, an external disk may be mounted here manually for troubleshooting or data recovery.

---

## `/proc` – Virtual Process Filesystem

- **Purpose**:
  Contains a **virtual filesystem** that provides **real-time information about system processes and kernel parameters**. It is not stored on disk but generated by the kernel in memory.
    - `/proc/cpuinfo`: CPU details
    - `/proc/meminfo`: RAM usage
    - `/proc/[PID]`: Info about a specific process

---

## `/sys` – System Files (sysfs)

- **Purpose**:
  Similar to `/proc`, `/sys` is a **virtual pseudo-filesystem** used to **expose hardware device information** and kernel modules. It provides a user-space interface to kernel subsystems and device tree structures.
    - Example: `/sys/class/net/` for network interfaces

---

## `/run` – Runtime Variable Data

- **Purpose**:
  Contains **volatile files used during system runtime**, such as **process IDs, sockets, and locks**. This directory is mounted early during boot and gets **cleared on each reboot**.

---

## `/srv` – Service Data

- **Purpose**:
  Holds **data served by system services**. For example, if you're running a web or FTP server, this directory may contain hosted files.
    - `/srv/www/`: Website files
    - `/srv/ftp/`: FTP content

---

## `/var` – Variable Files

- **Purpose**:
  Stores **dynamic content** that constantly changes as the system operates – such as logs, print spool data, and caches.
    - `/var/log`: System logs (auth, kernel, apache, etc.)
    - `/var/lib`: Persistent data for services and applications
    - `/var/spool`: Queued tasks like mail or print jobs

---

## `/tmp` – Temporary Files

- **Purpose**:
  Used for **temporary storage** by applications. Files here are not expected to be preserved across reboots. Often, this directory is cleaned at shutdown or startup

automatically.

---

### `/opt` – Optional/Third-party Software

- **Purpose**:
  Designed for **third-party or proprietary software installations** that are not managed by the system package manager. Applications here have their own subdirectories.
    - `/opt/google/chrome/`
    - `/opt/vmware/`

---

## ✅ Summary Table

| Directory | Purpose |
|---|---|
| `/` | Root of the filesystem |
| `/root` | Root user's personal directory |
| `/bin` | Essential command binaries |
| `/sbin` | Essential system binaries (admin only) |
| `/lib` | Shared libraries |
| `/usr` | User applications and resources |
| `/boot` | Bootloader and kernel files |
| `/dev` | Device interface files |
| `/etc` | System configuration files |
| `/home` | User home directories |
| `/media` | Auto-mounted removable media |

| | |
|---|---|
| `/mnt` | Temporary mount point |
| `/proc` | Kernel and process virtual filesystem |
| `/sys` | Kernel device info (pseudo-fs) |
| `/run` | Runtime process and socket files |
| `/srv` | Service data (e.g. web, FTP) |
| `/var` | Log and variable data |
| `/tmp` | Temporary application files |
| `/opt` | Optional third-party apps |