

# SHREE UTTAR GUJARAT BCA COLLEGE

## Unit 1: Introduction to Linux Operating System

### 1.1 Features of Linux OS

### 1.2 Components of Linux OS (Hardware, Kernel, Shell, GNU Utilities & Applications)

### 1.3 Shell in Linux (Bash, Zsh, Dash – Features and Differences)

### 1.4 Introduction to Files and File Types in Linux (text, binary, special files)

### 1.5 Linux Directory Structure and File System Hierarchy Standard (FHS)

## What is Linux?

Linux is based on the UNIX operating system. UNIX is a powerful, multi-user, multitasking operating system originally developed in the 1970s at AT&T Bell Labs. It laid the foundation for many modern operating systems, including Linux.

While UNIX is a licensed operating system (meaning you need to purchase a license to use it), Linux is free and open-source, making it accessible to everyone. Anyone can inspect and modify the source code, which enables global collaboration and innovation. Its efficient performance and strong security model make it suitable for a wide variety of devices and industries.

Since the beginning, Linux has grown into a dependable and safe OS that is used in an array of gadgets, including PCs, cell phones, and huge supercomputers. It is well-known for being cost-effective, which implies that employing it doesn't cost a lot, and efficient, which indicates it can complete a lot of jobs quickly.

## 1.1 Features of Linux OS

Linux is a free and open-source operating system that is widely used for computers, servers, and mobile devices. Here are some key features:

### 1. Open Source

- The source code of Linux is available freely.
- Anyone can view, modify, and distribute it.

### 2. Multiuser System

- Multiple users can use the system at the same time without affecting each other.

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## 3. Multitasking

- Linux can run multiple programs at the same time.

## 4. Portability

- Linux can run on different types of hardware like PCs, laptops, mobile devices, and servers.

## 5. Security

- Linux provides strong user security using passwords, file permissions, and encryption.

## 6. Stability and Reliability

- Linux rarely crashes and can run for years without rebooting.

## 7. Command Line Interface and GUI

- Linux provides both CLI (Command Line Interface) and GUI (Graphical User Interface).

## 1.2 Components of Linux OS

Linux is made up of several key components that work together:

### 1. Hardware

- The physical part of the computer (CPU, RAM, Hard Disk, etc.).
- Linux runs on the hardware.

### 2. Kernel

- The core part of the Linux OS.
- Manages hardware, memory, processes, and system calls.
- Acts as a bridge between hardware and software.

**Example functions:**

- Allocating memory
- Handling input/output
- Managing system processes

### 3. Shell

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- Interface between the user and the kernel.
- Accepts commands from the user and gives them to the kernel to execute.

## Types of Shells:

- Bourne Shell (sh)
- Bourne Again Shell (bash)
- C Shell (csh)
- Korn Shell (ksh)

## 4. GNU Utilities & Applications

- Collection of basic software tools for file management, text editing, programming, etc.
- Example tools: ls, cp, mv, grep, cat, echo, etc.

## 5. System Libraries

- Special functions or programs used by applications or the kernel.
- Help developers use OS features without writing code from scratch.

## 1.3: Shell in Linux

### What is a Shell?

A **Shell** is a **command-line interface (CLI)** that allows users to interact with the Linux operating system.

It reads user input (commands), interprets it, and passes it to the kernel for execution.

Think of it like a **translator** between the user and the system.

### Common Types of Shell in Linux

Here are the three popular shells used in Linux:

| Shell Name  | Full Form / Type     |
|-------------|----------------------|
| <b>Bash</b> | Bourne Again SHell   |
| <b>Zsh</b>  | Z Shell              |
| <b>Dash</b> | DebianAlmquist Shell |

## 1. Bash (Bourne Again Shell)

- Most commonly used shell in Linux systems.
- Default shell in many distributions (e.g., Ubuntu).
- Based on the original Bourne Shell (sh), but with more features.

### Features:

- Command history
- Tab completion (auto-completes file names or commands)
- Command aliasing
- Scripting support with variables, loops, conditionals
- Supports keyboard shortcuts (Ctrl+C to stop, etc.)

## 2. Zsh (Z Shell)

- Advanced shell built on top of Bash features.
- More customizable and user-friendly.

### Features:

- Everything in Bash + more
- **Auto-correction** (fixes typos in commands)
- **Theme and plugin support** (e.g., using Oh My Zsh)
- Advanced tab completion
- Better scripting support
- Used by developers and power users

## 3. Dash (Debian Almquist Shell)

- Lightweight and fast shell.
- Focused on **speed and POSIX compliance** (follows Linux standards strictly).
- Used mostly in **system scripts** and for booting Linux.

### Features:

- Faster than Bash and Zsh
- Uses less memory
- No interactive features like auto-complete or history
- Not user-friendly for regular terminal usage

## Comparison Table

| Feature                 | Bash   | Zsh          | Dash                    |
|-------------------------|--------|--------------|-------------------------|
| Default in many distros | ✓      | ✗ (optional) | ✓ (Ubuntu system shell) |
| User-friendly           | ✓      | ✓✓✓          | ✗                       |
| Auto-completion         | ✓      | ✓✓✓          | ✗                       |
| Command correction      | ✗      | ✓✓           | ✗                       |
| Script compatibility    | ✓      | ✓            | ✓✓✓                     |
| Speed                   | Medium | Medium       | ✓✓✓✓                    |
| Suitable for scripting  | ✓✓     | ✓✓           | ✓✓✓✓                    |

## 1.4: Introduction to Files and File Types in Linux

**In Linux, everything is a file – even devices and directories!**

Linux organizes and accesses data through a **file system**. Files can be of different types depending on their content and purpose.

### Types of Files in Linux

#### 1. Text Files

- Contain readable characters.
- Examples: .txt, .conf, .sh, .log
- Can be opened and edited with text editors like nano, vi, or gedit.

#### 2. Binary Files

- Contain machine-readable (compiled) code.
- Cannot be read directly as text.
- Examples: executable files (ls, cp), compiled programs.
- Command: file <filename> can help identify file type.

#### 3. Special Files

Linux has special file types to manage system-level devices and functions:

##### 1. Device Files

- Found in /dev directory.

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- Represent hardware devices like hard disks, USBs, etc.
- Two types:
  - **Character Devices** (data flows in characters – keyboard)
  - **Block Devices** (data flows in blocks – hard drives)

## 2. Named Pipes (FIFO)

- Used for inter-process communication.
- Data flows in one direction.

## 3. Sockets

- Allow two-way communication between processes or systems.
- Used in networking.

## 4. Symbolic Links (Symlinks)

- Like a shortcut to another file.
- Created using: `ln -s source target`

## 1.5: Linux Directory Structure and File System Hierarchy Standard (FHS)

### What is the Linux Directory Structure?

Linux uses a **hierarchical directory structure** that starts with the **root directory** /. Every file and folder is located under this root.

The **File System Hierarchy Standard (FHS)** defines the names, purposes, and locations of important directories and files in Linux. This structure helps organize files logically and consistently.

### Key Directories in the Linux File System

| Directory | Purpose / Description                                                                             |
|-----------|---------------------------------------------------------------------------------------------------|
| /         | <b>Root directory:</b> The top-most directory. All other directories are under this.              |
| /bin      | <b>Essential command binaries:</b> Common Linux commands like ls, cp, mv. Available to all users. |
| /sbin     | <b>System binaries:</b> Commands for system administration, like reboot, shutdown. Used by root.  |

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| Directory | Purpose / Description                                                                 |
|-----------|---------------------------------------------------------------------------------------|
| /etc      | <b>Configuration files:</b> Contains settings for system and programs.                |
| /home     | <b>User home directories:</b> Each user gets a folder here, e.g., /home/khushbu.      |
| /root     | <b>Home directory for root user</b> (administrator). Not to be confused with /.       |
| /dev      | <b>Device files:</b> Represents hardware devices like USB, hard disk (/dev/sda), etc. |
| /proc     | <b>Virtual filesystem:</b> Provides system and process information.                   |
| /var      | <b>Variable files:</b> Like system logs, print spool files, mail, etc.                |
| /tmp      | <b>Temporary files:</b> Used by programs. Files here are usually deleted on reboot.   |
| /usr      | <b>User programs and data:</b> Contains applications, libraries, and documentation.   |
| /lib      | <b>Essential shared libraries:</b> Needed by binaries in /bin and /sbin.              |
| /boot     | <b>Boot files:</b> Kernel and bootloader files for starting the system.               |
| /media    | <b>Mount point for removable devices:</b> Like USB drives and CDs.                    |
| /mnt      | <b>Mount point for manual mounting:</b> Used by administrators to attach filesystems. |
| /opt      | <b>Optional software packages:</b> Third-party applications may install here.         |
| /srv      | <b>Service data:</b> Contains files for web servers, FTP servers, etc.                |

## Linux Directory Structure

/

- |— bin → Essential commands
- |— boot → Boot files (kernel, grub)
- |— dev → Device files
- |— etc → Configuration files

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|           |                        |
|-----------|------------------------|
| — home    | → User directories     |
| — khushbu |                        |
| — lib     | → Libraries            |
| — media   | → Mounted USB/DVD      |
| — mnt     | → Temporary mounts     |
| — opt     | → Optional software    |
| — proc    | → System/process info  |
| — root    | → Admin user's home    |
| — sbin    | → Admin commands       |
| — srv     | → Service data         |
| — tmp     | → Temporary files      |
| — usr     | → User programs/data   |
| — var     | → Variable data (logs) |

- Linux uses a **tree-like directory structure** starting from / (root).
- The **FHS standard** defines the layout of the Linux file system.