2. Explore directory structure of Linux File System. Understand and represent file system of LINUX with brief details.

The Linux file system is a hierarchical directory structure that starts with the **root directory** (`/`) and expands into subdirectories. Each directory serves a specific purpose and organizes files logically for efficient management.

Hierarchy and Root Directory

- The file system begins with the **root directory** (`/`), which is the top-level directory.
- All files and directories in Linux are part of this hierarchy.
- Devices, processes, configuration files, and user data are organized within this structure.

Key Directories in the Linux File System

Directory	Description
`/`	The **root directory**. The base of the Linux file system, containing all other directories.
`/bin`	**Binary files**: Contains essential user commands (e.g., `ls`, `cat`, `cp`, `mv`, etc.).
`/boot`	**Boot loader files**: Contains the Linux kernel, boot configuration files, and boot loader programs.
`/dev`	**Device files**: Contains device nodes for hardware devices (e.g., `/dev/sda` for a hard drive).
`/etc`	**Configuration files**: Stores system-wide configuration files (e.g., `/etc/passwd`, `/etc/fstab`).
`/home`	**User home directories**: Each user gets a subdirectory to store personal files (e.g., `/home/user`).
`/lib`	**Libraries**: Contains shared libraries needed by system programs and utilities.
`/media`	**Removable media**: Mount points for removable devices (e.g., USB drives, CDs).
`/mnt`	**Mount points**: Temporary mount points for filesystems (e.g., network shares or extra partitions).
`/opt`	**Optional software**: Used for third-party or additional software installations.
`/proc`	**Process information**: Virtual filesystem containing information about running processes.
`/root`	**Root user directory**: The home directory for the root (administrator) user.
`/run`	**Runtime files**: Contains runtime data like PID files and sockets for running processes.
`/sbin`	**System binaries**: Contains system administration commands (e.g., `ifconfig`, `shutdown`).
`/srv`	**Service data**: Contains data for services such as web servers (e.g., `/srv/www`).
`/sys`	**System information**: Virtual filesystem providing information about hardware

Directory	Description
	and devices.
`/tmp`	**Temporary files**: Used to store temporary data; files are often cleared on reboot.
`/usr`	**User programs and data**: Contains user-installed software, libraries, and documentation.
`/var`	**Variable data**: Stores log files, caches, and temporary files for running applications.

Representation of the Linux File System

Below is a basic representation of the Linux file system:

```
/
├── bin
├── boot
├── dev
├── etc
├── home
│   ├── user1
│   └── user2
├── lib
├── media
├── mnt
├── opt
├── proc
├── root
├── run
├── sbin
├── srv
├── sys
├── tmp
├── usr
│   ├── bin
│   ├── lib
│   └── share
└── var
    ├── log
    └── spool
```

1. Root Directory (`/`)

- The topmost directory in the Linux file system.
- Every file and directory starts here and branches out into a hierarchical structure.

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2. `/bin`

- **Purpose**: Contains essential **binary executable files** required for basic system functionality.
- **Examples**: Common commands like `ls`, `cat`, `cp`, `mv`, and `grep`.

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3. `/boot`

- **Purpose**: Contains **boot loader files** necessary for starting the system.
- **Examples**:
  - `vmlinuz`: Compressed Linux kernel file.
  - `grub/`: Directory for GRUB bootloader configuration.

---

4. `/dev`

- **Purpose**: Contains **device files** representing hardware devices (e.g., disks, terminals, USB drives).
- **Examples**:
  - `/dev/sda`: Represents the first hard disk.
  - `/dev/null`: A special device that discards all data written to it.

---

5. `/etc`

- **Purpose**: Stores **configuration files** and directories for system-wide settings.
- **Examples**:
  - `/etc/passwd`: User account information.
  - `/etc/fstab`: File system mount configuration.

---

6. `/home`

- **Purpose**: Contains **user directories** where individual users store their personal files and settings.
- **Examples**:
  - `/home/user1`: Files and data for `user1`.
  - `/home/user2`: Files and data for `user2`.

---

7. `/lib`

- **Purpose**: Stores **shared libraries** and kernel modules needed by programs in `/bin` and `/sbin`.
- **Examples**:

- `.so` files (shared objects), which are the equivalent of DLLs in Windows.

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8. `/media`

- **Purpose**: Contains **mount points** for removable media (e.g., USB drives, CDs).
- **Examples**:
  - `/media/usb`: Mount point for a USB drive.
  - `/media/cdrom`: Mount point for a CD-ROM.

---

9. `/mnt`

- **Purpose**: Temporarily **mount file systems** (e.g., external storage or network drives).
- **Examples**:
  - Mount a remote file system using commands like `mount /mnt/remote`.

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10. `/opt`

- **Purpose**: Contains **optional software** or third-party applications installed on the system.
- **Examples**:
  - A third-party application like a database or proprietary software might reside here.

---

11. `/proc`

- **Purpose**: A **virtual file system** that contains runtime system information, such as processes and kernel data.
- **Examples**:
  - `/proc/cpuinfo`: Information about the CPU.
  - `/proc/meminfo`: Information about system memory usage.

---

12. `/root`

- **Purpose**: The **home directory for the root user** (system administrator).
- **Examples**:
  - Configuration files and scripts specific to the root user are stored here.

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13. `/run`

- **Purpose**: Stores **runtime data** for processes since the last system boot.
- **Examples**:
  - PID files (`/run/foo.pid`), sockets, and temporary system files.

---

14. `/sbin`

- **Purpose**: Contains **system binaries** for administrative tasks.
- **Examples**:
  - `ifconfig`: Configure network interfaces.
  - `reboot`: Restart the system.

---

15. `/srv`

- **Purpose**: Stores **data for services** offered by the system, such as web servers or file servers.
- **Examples**:
  - `/srv/www`: Web server data.
  - `/srv/ftp`: FTP server data.

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16. `/sys`

- **Purpose**: Another **virtual file system** that provides system information, especially about hardware.
- **Examples**:
  - `/sys/class/net`: Contains information about network interfaces.

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17. `/tmp`

- **Purpose**: Stores **temporary files** created by applications or the system.
  -
  - Files in `/tmp` are often cleared on system reboot.

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18. `/usr`

- **Purpose**: Contains **user utilities and applications**.
- **Structure**:
  - **`/usr/bin`**: User-installed binaries and programs (e.g., `gcc`, `python`).

- **`/usr/lib`**: Libraries for `/usr/bin` programs.
- **`/usr/share`**: Architecture-independent files (e.g., documentation, icons).

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19. `/var`

- **Purpose**: Contains **variable data** that changes frequently, like logs, caches, and spool files.
- **Structure**:
  - **`/var/log`**: System log files (e.g., `/var/log/syslog`, `/var/log/auth.log`).
  - **`/var/spool`**: Spool files for tasks like print jobs or mail queues.

Brief Explanation of the Linux File System

1. **Root Directory (`/`)**:
   - The single starting point of the file system tree.
2. **User Directories**:
   - Files and configurations related to individual users are stored in `/home`.
3. **System Files**:
   - System-critical files reside in `/etc`, `/bin`, `/sbin`, and `/lib`.
4. **Dynamic Information**:
   - Directories like `/proc` and `/sys` provide a dynamic view of system processes and hardware.
5. **Temporary Data**:
   - `/tmp` is used for temporary storage, while `/var` stores logs and frequently changing files.
6. **Mount Points**:
   - External devices and filesystems are mounted under `/mnt` or `/media`.

Conclusion

The Linux file system is structured for flexibility, efficiency, and modularity. By understanding its directory hierarchy and purpose, users can effectively navigate, manage files, and troubleshoot issues in a Linux environment.