LESSON NOTES

# Intro to Linux

## System Management

### 1.1.1 File System Hierarchy

## Lesson Overview:

**Students will:**

- Understand the base file systems of most Linux-based operating systems

**Guiding Question:** What is the standard filesystem hierarchy on a Linux operating system?

**Suggested Grade Levels:** 9 - 12

**Technology Needed:** None

## CompTIA Linux+ XK0-005 Objective:

1.1 - Summarize Linux fundamentals

- Filesystem Hierarchy Standard (FHS)
  - /boot
  - /proc
  - /sys
  - /var
  - /usr
  - /lib
  - /dev
  - /etc
  - /opt
  - /bin
  - /sbin
  - /home
  - /media
  - /mnt
  - /root
  - /tmp

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# File System Hierarchy

On a Linux system, there are standard file systems that have a similar layout among Linux distributions. This is because Linux was originally based on the Unix system. The standard file systems are maintained by the Linux Foundation, and they all start at the root ( / ) directory. This directory is important to the operating system, and it shares similar files amongst all the different distributions. Here are two examples of directories on a Kali Linux and an Ubuntu system:


*Filesystem on a Kali Linux Machine*


*Filesystem on an Ubuntu Linux Machine*

## What are the directories?

The **/boot** (read as root, boot) directory contains all the files required for the system's boot process. This includes the kernel of the system, RAM disk images, bootloader configuration files, etc. This directory is the core of the entire operating system and ultimately brings up the operating system when the system is booted.

The **/proc** directory does not actually contain files but rather information about processes, hardware configuration, and kernel parameters. If you know a process ID, you can go to **/proc/**[process ID] to find information about that running process. **/proc/info** provides information about the CPU of the system.

The **/sys** directory is similar to the /proc directory where it holds information about the kernel parameters as well as device attributes. It is important for monitoring hardware and the kernel configuration for the entire system. For example, the **/sys/gpio** file can be altered to manipulate the GPIO pins on embedded systems.

The **/var** directory stands for variable. This directory contains all the files that change while the system is being used. It's mainly used for storing variable data that is generated by services and applications. For example, the system's log files are stored in **/var/log** as well as cache data for applications in **/var/cache**.

The **/usr** directory contains data and resources about the users on the system. This is actually one of the largest directories on most systems. The **/usr/bin** directory contains commands and executables as well as common utilities and applications. The **/usr/share** directory contains files such as fonts, images, documentations, etc. that are shared across multiple applications.

The **/lib** directory contains several libraries that are essential for the system. They are typically needed for the early stages of the boot process. Sometimes, this directory is split into a **/lib32** and **/lib64** to hold both 32-bit and 64-bit libraries.

The **/dev** directory contains special device files that represent and provide access to hardware devices and pseudo-devices on the system. These device files are used for device communication. For example, **/dev/sda** might represent the first hard drive, while **/dev/ttyS0** might represent a serial port. The directories **/dev/null** and **/dev/zero** are special device files used for data input/output, with **/dev/null** acting as a black hole (data written to it is discarded), and **/dev/zero** providing an infinite stream of null bytes.

The **/etc** directory holds all of the configuration files and shell scripts for the system. It contains files for administrators to manage and configure such as the **/etc/passwd** file that contains all the user information for the system as well as **/etc/fstab**, the file system table.

The **/opt** directory holds all the optional or add-on software packages. These are not usually a part of the core of the system's files. This directory structure allows for easy management and organization of optional software packages, and it helps prevent conflicts with system files. For example, you might find software installed in **/opt/mysql** or **/opt/google/chrome** here.

The **/bin** directory stands for binary. This directory contains all the essential executable files and fundamental commands required for the system to function, including commands such as **ls**, **cp**, **mv**, etc.

The **/sbin** directory is essential system binaries that are mainly reserved for the system administrators. **/bin** is typically for all users on the system while **/sbin** is reserved for the admins. Some important commands include **fdisk**, **reboot**, or even **ifconfig** that are housed in the **/sbin** directory.

When a user is created the system automatically creates a **home** directory for them that is used for storing their personal files. All of the individual home directories are stored in the system **/root/home** folder. For example, if the user janedoe is added to a system, that home directory would be located at **/home/janedoe**.

Like the **/home** directory, the **/root** directory is the home directory for the superuser/root account on the system. This directory contains config files, scripts, or other files specific to the root user.

The **/media** directory is used as a mount point for removable media devices, such as USB drives, external hard disks, optical discs, and other storage media. When you insert a removable medium device into the system, the system typically automatically mounts it under a subdirectory within **/media** , often with a name that reflects the device's label or identifier. For example, if you insert a USB drive labeled "MyUSB," it might be mounted at **/media/MyUSB**. This directory provides access to the contents of the removable medium.

The **/mnt** directory is a general-purpose mount point used for temporarily mounting filesystems or devices. Unlike **/media**, which is primarily for removable media, **/mnt** can be used for any kind of mount operation. System administrators often use /mnt for mounting network shares, remote filesystems, or temporary storage devices. It provides a convenient location for manual mount operations.
The **/tmp** directory is a location for storing temporary files and directories that are needed by various processes and applications on the system. Unlike **/var/tmp**, which is meant for more persistent temporary data, files in **/tmp** are typically short-lived and may be deleted by the system during reboots or periodically to free up disk space. Many applications and system processes use **/tmp** to create and manipulate temporary files, caches, and other data that are not meant to persist across reboots. Users can also use **/tmp** for their own temporary files, but they should be aware that data stored here may be deleted by the system at any time.