

# Managing Linux Systems

- 2nd Course in Linux Foundations Specialization

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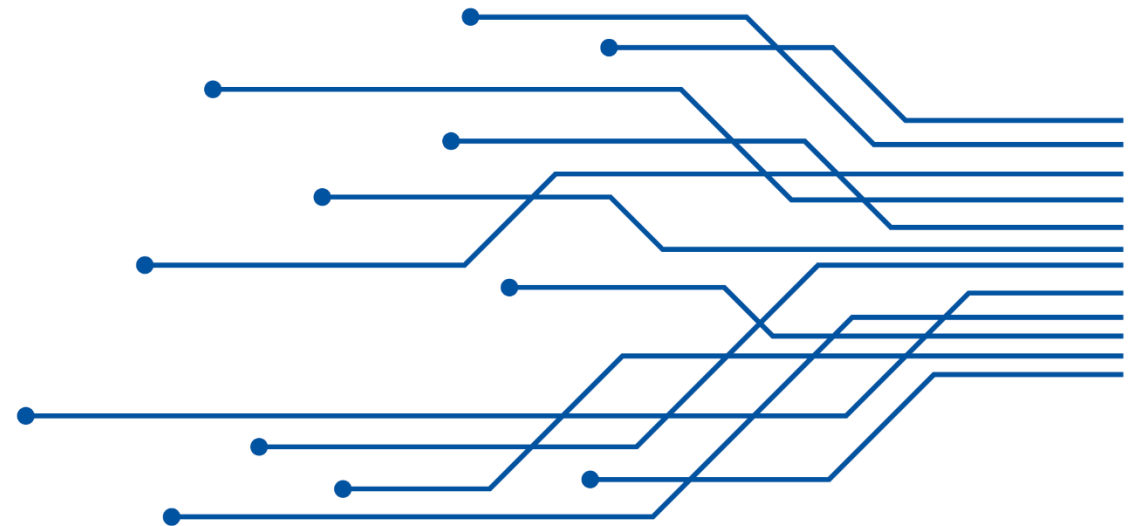
The background of the slide features a collection of 3D-rendered, hollow geometric shapes in various colors including teal, orange, blue, purple, and grey. These shapes, which include rectangles, squares, and rounded rectangles, are scattered across the surface. Interspersed among these shapes are several grey 3D arrows of different sizes, pointing in various directions, creating a sense of movement and flow.

# Manage Disk Storage

In the third module of this course, we will learn how to manage devices available to the Linux system for long term storage.

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# Learning Objectives

## Manage Disk Storage

Upon completion of this module, learners will be able to:

- Partition Hard Drives
- Manage Linux File Systems
- Mount Linux File Systems
- Monitor Linux File Systems

# Lesson 1

## Hard Drive Partitions

In this lesson, we look at how to partition hard drives

# Hard Drive Partitions

Most operating systems, including Linux, allow you to partition a drive into multiple sections.

A partition is a self-contained section within the drive that the operating system treats as a separate storage space.

Partitioning drives can help you better organize your data, such as segmenting operating system data from user data.

# Managing disk partitions



MASTER BOOT RECORD (MBR) -  
SUPPORTS UP TO FOUR PRIMARY  
PARTITIONS ON A DRIVE.  
PRIMARY PARTITIONS CAN BE  
SPLIT INTO MULTIPLE EXTENDED  
PARTITIONS.

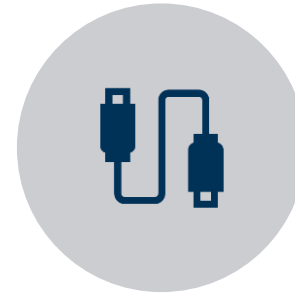


UEFI BOOT LOADER -  
ADVANCED GUID PARTITION  
TABLE (GPT) METHOD FOR  
MANAGING PARTITIONS, WHICH  
SUPPORTS UP TO 128 PARTITIONS  
ON A DRIVE.

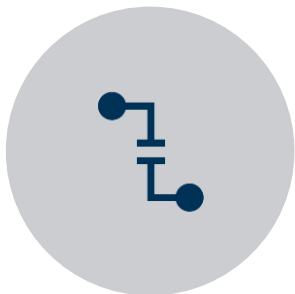
# Drive Detection



Linux systems detect drives and partitions at boot time and assign each one a unique device file name.



The invention of removable USB drives which can be added and removed while the system is running.



When you add or remove a removable storage device, the /dev name assigned to it may change, depending on what devices are connected at that time.

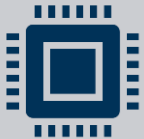


These changes can make it difficult for applications to find the same storage device each time.

# Fdisk Command



The fdisk program allows you to create, view, delete, and modify partitions on any drive that uses the MBR method of indexing partitions.



Example Usage:

```
fdisk /dev/sdb
```



Common Commands:

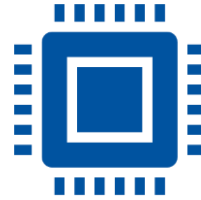
- a: toggle a bootable flag
- d: delete a partition
- n: add a new partition
- p: print partition table
- v: verify the partition table
- w: write disk to table and exit



# Gdisk Command



The gdisk program allows you to create, view, delete, and modify partitions on any drive that uses the GPT method of indexing partitions.



## Example Usage:

```
gdisk /dev/sdb
```



## Common Commands:

- d: delete a partition
- n: add a new partition
- p: print partition table
- v: verify the partition table
- w: write disk to table and exit

# Lesson 1 Review



Partitioning separates a drive into multiple sections



Fdisk is used with MBR indexing method



Gdisk is used with GPT indexing method

# Lesson 2

## Linux File Systems

In this lesson, we look at Linux file systems

# Linux Virtual Directory Structure

The Linux virtual directory structure contains a single base directory, called the root directory



The root directory lists files and folders beneath it based on the folder path used to get to lower folders and files.



Here is an example Linux file path:

`/home/aspeno/coursera/assignment1.txt`

# Filesystem Hierarchy Standard (FHS)

- The FHS defines core folder names and locations that should be present on every Linux system and what type of data they should contain.

Folder	Description
/boot	Contains bootloader files used to boot the system
/home	Contains user data files
/media	Used as a mount point for removable devices
/mnt	Also used as a mount point for removable devices
/opt	Contains data for optional third-party programs
/tmp	Contains temporary files created by system users
/usr	Contains data for standard Linux programs
/usr/bin	Contains local user programs and data
/usr/local	Contains data for programs unique to the local installation
/usr/sbin	Contains data for system programs and data

# File Systems



Before you can assign a drive partition to a mount point in the virtual directory, you must format it using a filesystem.



Each operating system utilizes its own filesystem type for storing data on drives.



Linux not only supports several of its own filesystem types, it also supports filesystems of other operating systems.

# Linux File Systems

File System	Description
btrfs	A newer, high-performance filesystem that supports files up to 16 exbibytes (EiB) in size and a total filesystem size of 16EiB.
eCryptfs	The Enterprise Cryptographic File System (eCryptfs) applies a POSIX-compliant encryption protocol to data before storing it on the device.
ext3	Also called ext3fs, this is a descendant of the original Linux ext filesystem. It supports files up to 2 terabytes (TiB), with a total filesystem size of 16TiB. It supports journaling as well as faster startup and recovery.
ext4	Also called ext4fs, it's the current version of the original Linux filesystem. It supports files up to 16TiB, with a total filesystem size of 1EiB. It also supports journaling and utilizes improved performance features.
reiserFS	Created before the Linux ext3fs filesystem and commonly used on older Linux systems.
swap	The swap filesystem allows you to create virtual memory for your system using space on a physical drive. The system can then swap data out of normal memory into the swap space, providing a method of adding additional memory to your system.

# Non-Linux File Systems

File System	Description
CIFS	The Common Internet File System (CIFS) is a filesystem protocol created by Microsoft for reading and writing data across a network using a network storage device.
ISO-9660	The ISO-9660 standard is used for creating filesystems on CD-ROM devices.
NFS	The Network File System (NFS) is an open-source standard for reading and writing data across a network using a network storage device.
NTFS	The New Technology File System (NTFS) is the filesystem used by the Microsoft NT operating system and subsequent versions of Windows.
SMB	The Server Message Block (SMB) filesystem was created by Microsoft as a proprietary filesystem used for network storage and interacting with other network devices (such as printers).
UDF	The Universal Disc Format (UDF) is commonly used on DVD-ROM devices for storing data.
VFAT	The Virtual File Allocation Table (VFAT) is an extension of the original Microsoft File Allocation Table (FAT) filesystem.
XFS	The X File System (XFS) was created by Silicon Graphics for its (now defunct) advanced graphical workstations.
ZFS	The Zettabyte File System (ZFS) was created by Sun Microsystems for its Unix workstations and servers.



# Lesson 2

## Review



The /home folder contains user data files



Linux uses a virtual directory structure starting at the root folder



The swap filesystem does not persist data over a reboot

# Lesson 3

## Linux File Systems Management

In this lesson we drill into how to  
manage Linux File Systems

# Mkfs Command

The mkfs program is a front end to several individual tools for creating specific filesystems, such as the mkfs.ext4 program for creating ext4 filesystems.

Example Usage:

- `mkfs -t ext4 /dev/sda1`

Options:

- `-t`: type of filesystem

# Mount Command

The mount program temporarily mounts a filesystem to the Linux virtual directory.

## Example Usage:

```
mount -t ext4  
/dev/sda1  
/mnt/media
```

## Options:

-t: type of  
filesystem

# Automatically Mounting Devices

For permanent storage devices, Linux maintains the `/etc/fstab` file to indicate which drive devices should be mounted to the virtual directory at boot time.

Each line consists of six fields:

- Device – the first field specifies the mount device. These are usually device filenames. Most distributions now specify partitions by their labels or UUIDs.
- Mount point – the second field specifies the mount point, the directory where the partition or disk will be mounted. This should usually be an empty directory in another file system.
- File system type – the third field specifies the file system type.
- Options – the fourth field specifies the mount options. Most file systems support several mount options, which modify how the kernel treats the file system. You may specify multiple mount options, separated by commas.
- Backup operation – the fifth field contains a 1 if the dump utility should back up a partition or a 0 if it shouldn't.
- File system check order – the sixth field specifies the order in which fsck checks the device/partition for errors at boot time. A 0 means that fsck should not check a file system. Higher numbers represent the check order.

# Lesson 3

## Review



The mkfs command creates a new filesystem on a partition



The mount command will temporarily mount a filesystem



Use the /etc/fstab file to permanently mount a filesystem

# Lesson 4

## Linux File Systems Monitoring

In this lesson, we look at how to  
Monitor Linux File Systems

# File System Stats Tools

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There are a several tools to retrieve file system statistics:

df - displays disk usage by partition.

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du - displays disk usage by directory, good for finding users or applications that are taking up the most disk space.

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iostat - displays a real-time chart of disk statistics by partition.

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lsblk - displays current partition sizes and mount points.

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# Df Command

Displays disk usage by partition.

Example Usage:

- `df /home/aspeno/assignment1/bmi.cpp`

Options:

- `-a` : Displays all filesystems
- `-h`: Print sizes in human readable form
- `-l` : Displays local filesystems

# Du Command



Displays disk usage by directory, good for finding users or applications that are taking up the most disk space.



Example Usage:

```
du /home/aspeno/assignment1
```



Options:

- a : Displays count of all files not just directories
- h: Print sizes in human readable form
- s : Summary only

# iotat Command

Displays a real-time chart  
of disk statistics by  
partition

Example  
Usage:

iotat

Options:

-d: Only  
one device  
report

-x : More  
detailed  
statistics

# Lsblk Command

Displays a real-time chart of disk statistics by partition

Example Usage:

lsblk

Options:

-b : Show sizes in bytes

-o: Print selected columns

# Lesson 4 Review



The `df` command displays disk usage by partition



The `du` command is good for finding users or applications that are taking up the most disk space



The `iostat` command displays a real-time chart of disk statistics