

By completing this lesson you will learn,

- the necessity of an operating system
- the function of an operating system
- user interfaces of an operating systems
- services of an operating system
- types of operating systems
- advantages of operating systems
- utility Programs of an operating system
- drives, folders and files.

5.1 Introduction to Operating Systems

A Computer consists of hardware, firmware, software and liveware.

Any physical component of a computer system that can be touched is called hardware. Examples of hardware include: mouse, keyboard, display unit, hard disk, speaker, printer etc.

The booting instructions stored in the ROM (Read Only Memory) are called firmware. The initial text information displayed on the screen are displayed by firmware.

The users who operate the computer are called liveware.

The booting process of the computer

Electrical power is supplied to all hardware components such as the processor, RAM, and ROM.

The BIOS stored in ROM then performs the POST (Power-On Self-Test). It configures the computer settings, such as the amount of RAM, hard disk, monitor, keyboard, mouse, and boot sequence.

After that, the BIOS loads and executes the Bootstrap Loader located in the boot sector of the secondary storage.

Finally, the Bootstrap Loader loads the operating system from the secondary storage into RAM and executes it. Thereafter, full control of the computer system is transferred to the operating system.

This process is called booting.

Computer Software

Software is a set of instructions given to the computer to perform some activity using a computer. There are many types of software. They can be broadly classified as follows:

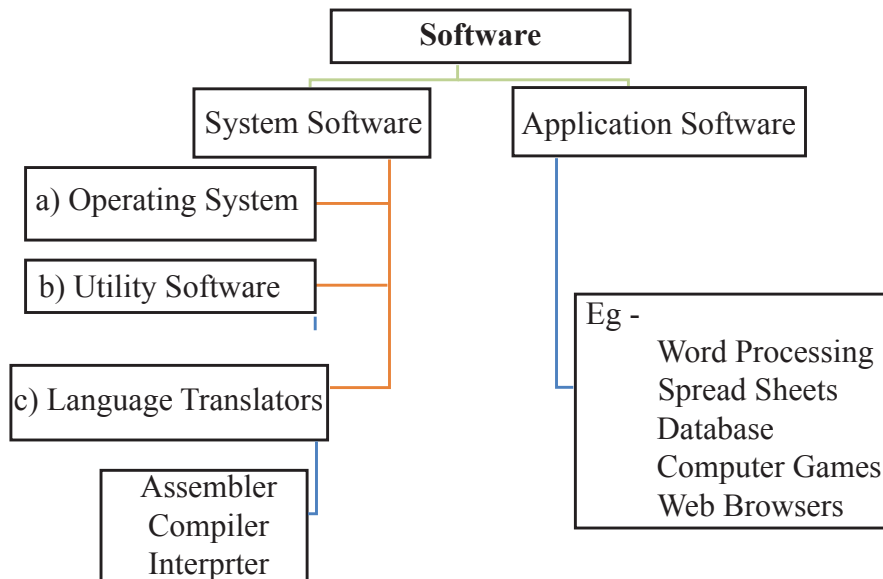


Figure 5.1 - Types of Software

5.1.1 System Software

System software is generally divided into three types. They are:

a. **Operating System** – The Operating System provides for the user to utilize the functions of a computer by managing the hardware and software in it. The operating system software provides the necessary instructions for installing and running various application software on the computer. It also manages the input devices, output devices, and computer memory, as well as handles other software installed on the computer. Thus, the overall operation of the computer system is carried out by the operating system.

The image 5.2 below depicts how the system software and application software interact with the hardware.

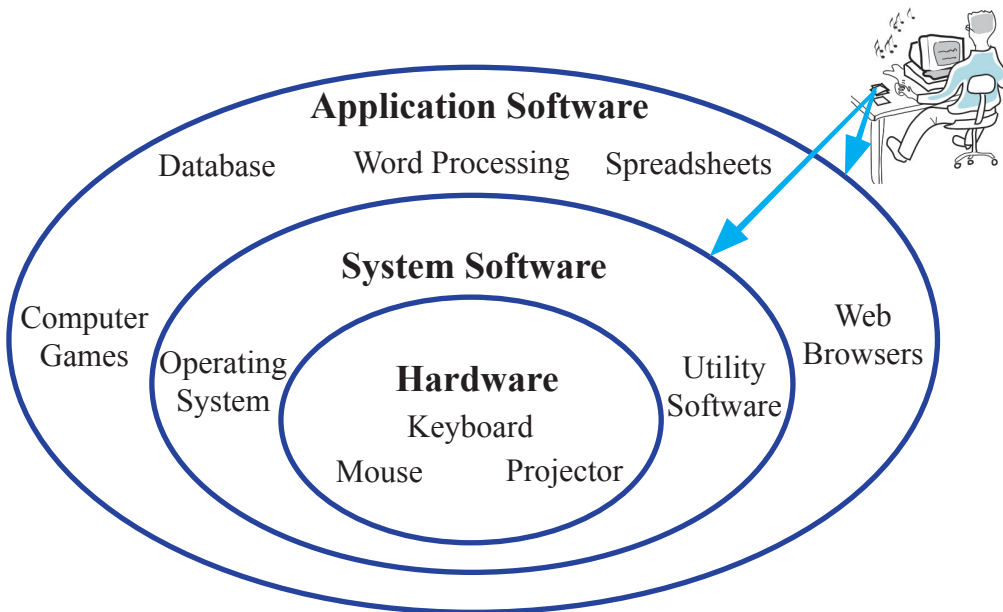


Figure 5.2 – Hardware, System Software, Application Software

Several Operating Systems

Operating System	Free and Open source/ Proprietary	Usage
Microsoft Windows	Proprietary	Desktop computer/ Laptop computer
Mac OS	Proprietary	
Ubuntu	Free and Open source	
Fedora	Free and Open source	
Android	Free and Open source	Mobile phone
Windows Mobile OS	Proprietary	
iOS	Proprietary	
Windows Server	Proprietary	Computer network
Linux	Free and Open source	

Types of Operating System

The main function of an Operating System is to provide an environment suitable for executing the commands issued by the user. Based on the functionality of the Operating System it can be classified as:

- **Single user Operating System**

The Operating System which provides service to one person at a time is called a Single User Operating System.

Example – MS Dos Operating System

- **Multi-User Operating System**

The Operating System which allows multiple users to use a system simultaneously is called a multi-user operating system. This type of Operating System is commonly used in Mainframe or Server computer where several users are connected to a computer system simultaneously.

Example – Linux, Windows server

- **Multi-tasking Operating System**

The operating system which allows to run multiple process at the same time is called a multi-tasking operating system. A single user can run multiple operations (tasks) at the same time on this type of operating system.

Example - Windows 7, Windows 8, Ubuntu, Mac OS

▪ **Real Time Operating System**

These are the Operating Systems which gives the output in real time without any observable delays. Real Time Operating Systems are mostly utilized in automatically controlled machines. Also, these kinds of Operating Systems are installed in scientific devices and small gadgets. These Operating Systems are specifically designed for particular devices.

Example - ATM machines, Calculators

Services of an Operating System

Functions of a computer operating system

The Operating System is a software which manages the hardware and other software in a computer system. It provides services to other software. There are three main services performed by an operating system.

They are:

- I. Providing a user interface
- II. Managing the hardware of a computer
- III. Executing application software

I) Providing user friendly interface

We need an interface to interact with the computer. An Operating System provides a user interface to input commands and instructions in a user friendly manner. Using this interface, we can perform tasks without using complex instructions.

There are two types of user interfaces provided by the Operating Systems. They are:

- 1. CLI - Command Line Interfaces
- 2. GUI - Graphical User Interfaces

The following section discusses in detail about each of the above interfaces.

1. Command Line Interface (CLI)

This kind of interface was used by early Operating Systems. This interface had a 'prompt' where the commands are keyed in using a keyboard. In using command line interface, the correct syntax has to be used.

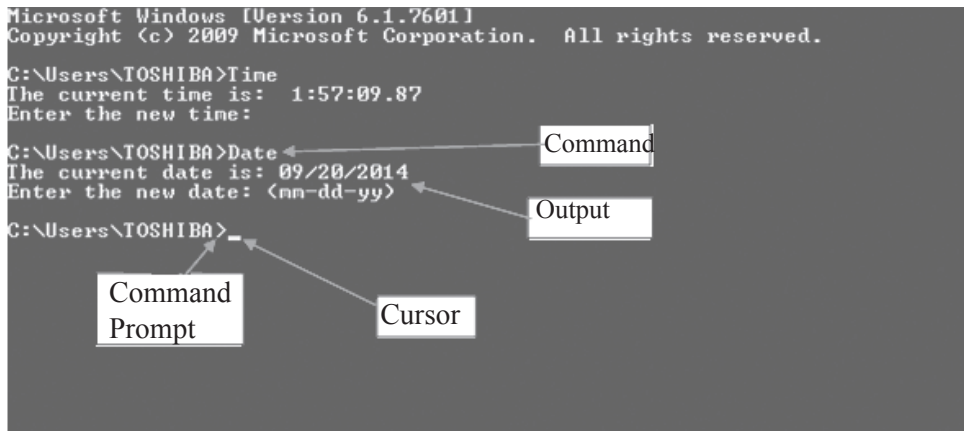


Figure 5.3 – Command Line Interface

2. Graphical User Interface (GUI)

Almost all the present day Operating Systems use graphics on their interfaces. This GUI provides the ability to use the mouse or finger tips to navigate the commands. Therefore it has become much easier to interact with the computers today.

These Operating System with GUI uses four components in order to make a friendly environment. These components are abbreviated as WIMP. WIMP stand for;

1. **Windows**
2. **Icons**
3. **Menus**
4. **Pointer**

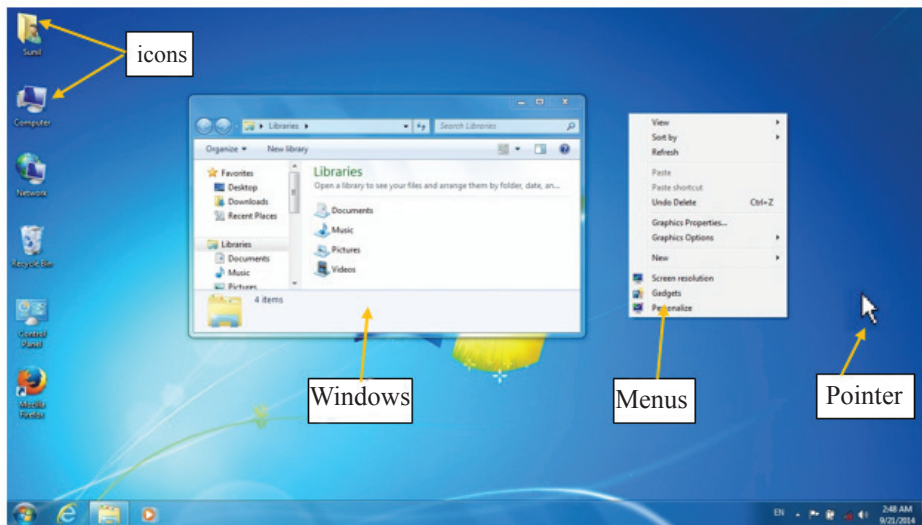


Figure 5.4 – Graphical User Interface

II) Managing the Hardware of a computer

Hardware of a computer are managed by using the following processes;

1. Process Management
2. Memory Management
3. Device Management
4. File Management
5. Security Management
6. Network Management

Let us now consider the above mentioned management tasks;

i. Process Management

We can call a running computer program or part of the program as a process. All the activities in a computer run as either a single process or a multiple processes.

Resource management activities such as allocation of CPU time, allocation of memory, and allocation of input output devices of each process are managed under the resource management of Operating System.

Odering of the processes (according to a sequence) is also performed under management.

2. Memory Management

Memory (We specifically talk about RAM – Random Access Memory) plays a major role during the functioning of the computer. The Operating System employs various techniques to memory management. The Operating System utilizes both the Random Access Memory (RAM) and the Secondary Memory efficiently in order to manage the memory for various processes.

The input data are stored in the RAM before being transferred to the CPU and the processed data i.e. information is also stored in the RAM before being sent to the Output devices. Hence systematic management of the memory is vital for the proper functioning of a computer. Memory management process makes sure that enough memory is allocated for each process and it also makes sure that the memory is freed once a particular process ends.

3. Device Management

There are several peripheral devices connected to a computer system. The operating system is responsible for the management of those devices. Device controllers are used to control the peripheral devices whereas device drivers are used to control software components.

Today there are devices which work once they are connected (plug and play). The relevant device drivers are installed automatically once the device is connected to the computer for the first time. Therefore nowadays the process of installation of the device driver has become easy.

4. File Management

There are many file names used in the storage media which are relevant to a particular Operating System and Application Software. All these file names consist of two components, namely file name and file extension.

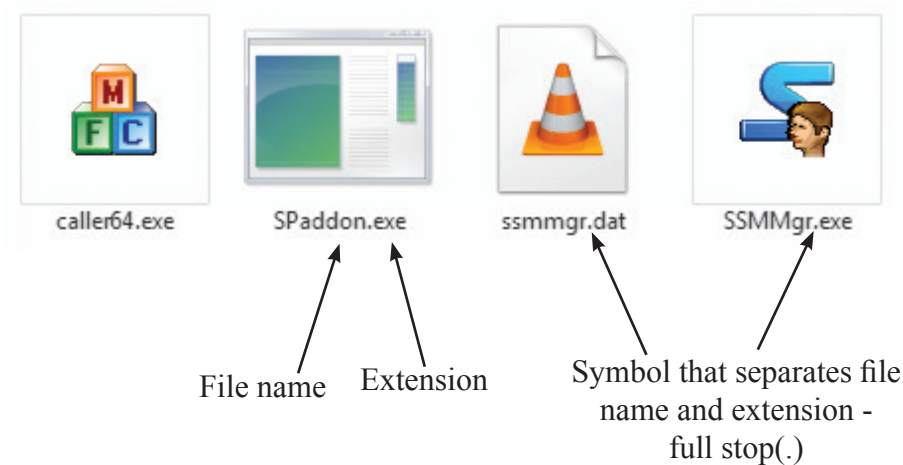


Figure 5.5 - Window to set up display of file extensions

Note: The Operating System identifies the file type using the file extensions.

There are many file extensions in use. Some of them are listed below:

File Extension	File Type
exe	Executable
docx	Word
xlsx	Excel
pptx	PowerPoint
accdb	Access

File management includes handling file operations, file properties, file access methods, file access permissions and file systems.

• File operations

Some of the services performed by the Operating System in file management are listed below:

- Making new files and saving them at suitable places
- Deleting the unnecessary files
- Arranging the folders in order and deleting the unnecessary folders
- Renaming the files and folders
- Changing the storage location of files and folders
- Creating backups of the files and folders as needed

- **File properties**

A file name and a location are given when saving a file in the computer. The Operating System maintains many other information relevant to the file.

To view these data, right click on a particular file and then click on 'properties' from the list that appears.

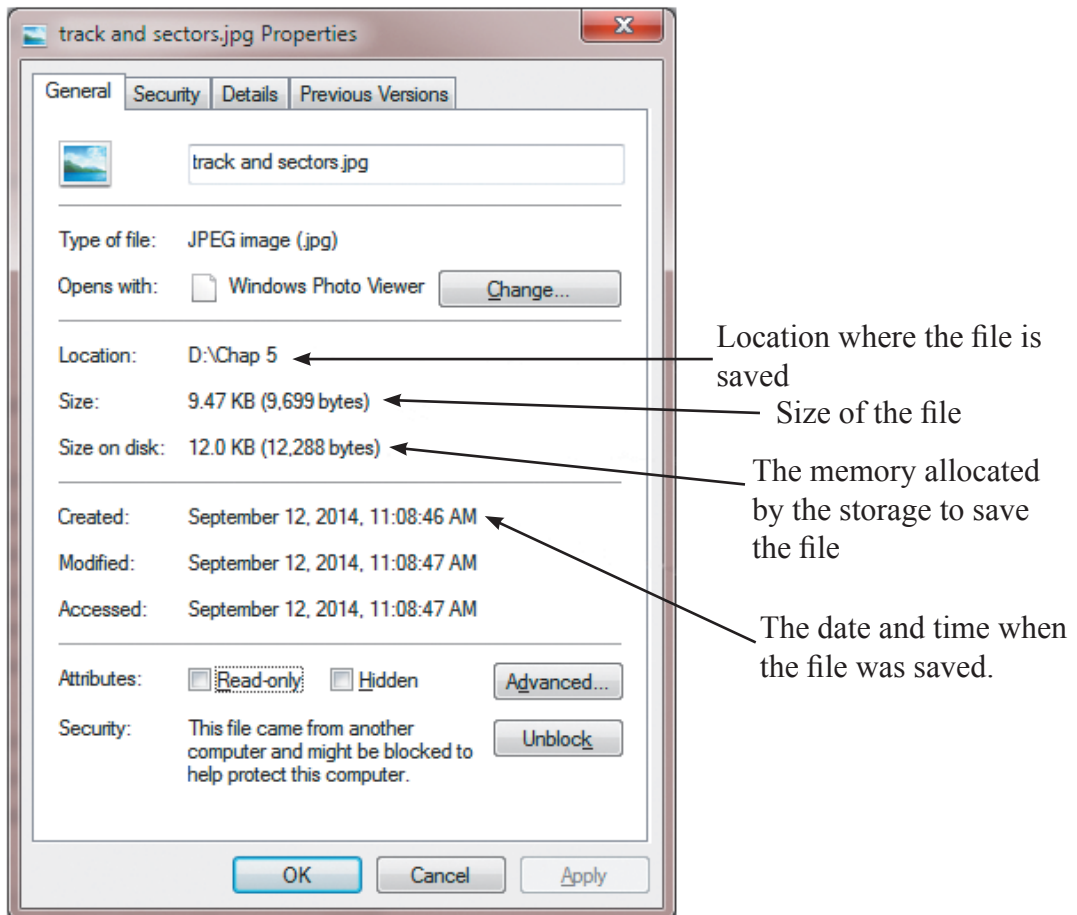


Figure 5.6 - Viewing details of a file

- **File access methods**

In sequential access, reading data and writing data in a file is done in order from the beginning to the desired location, and direct access to a specific location is not possible.

Ex: - Magnetic tape

In random access, it is possible to directly access the specific location of the required data.

Ex: - Hard disk/ SSD
RAM
CD/ DVD

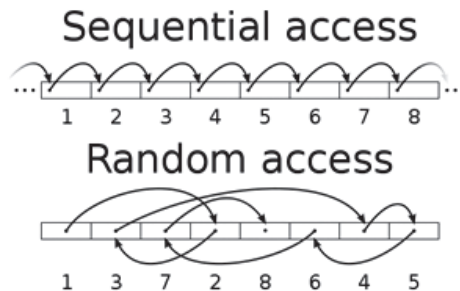


Figure 5.7 - Sequential Access and Random Access

- **File access permissions**

The operating system controls which users can access a file by using file access permissions to ensure file security.

Through this, reading, modifying, and executing the file can be properly managed according to the privileges of the user access.



Figure 5.8 - File access permissions

- **File systems**

The method used to organize, store, and manage the files in a computer storage device is referred to as a file system.

File system	Maximum capacity of the file	File security	Operating systems
FAT16	2 GB	NO	MS-DOS, Win 95/98, Linux
FAT32	4 GB	NO	Windows ME/98, Linux, Mac os
NTFS	16 TB	YES	Windows XP/7/8/10/8,Mac os, Linux (default for windows)

5. Security Management

There are many security threats to a computer.

- Malicious Software (Malware) such as a virus could harm the smooth functioning of a computer.
- Deletion or destruction of data/ information by unauthorized access to the system.

Protecting the computer from these kinds of attacks also managed by the Operating System up to some extend. Various kinds of techniques are used by the Operating System to perform function.

- Password/PIN and biometric techniques to identify users accessing the computer.
- Data encryption and file permissions.
- Third-party software such as antivirus software and firewalls.

6. Network Management

In computer networks, the operating systems,

- perform network configuration management, fault management, performance management and security management.
- support different types of network protocols.
- support wired and wireless connectivity for hardware devices in the system such as computers, printers, scanners that exist in the network.
- help in accessing one computer from a remote computer.

A computer network facilitates from simple text communication to a multimedia data communication. Today data communication is utilized at a greater scale in networks. This concept is well demonstrated by Cloud Computing.

III) Executing application software

All the application software installed in the computer secondary memory. When we need to run an application program, the operating system loads it into the Random Access Memory (RAM), and at that moment, control of the computer is handed over to the application software. Once the execution of the application software is completed, control of the system is returned to the operating system.

b) Utility software

Several processes are performed by the Operating System for the functioning of the computer. Many utility programs are available in the Operating System for the functioning of the machine as well as to protect from security threats.

In the past we had to buy different utility programs and install whereas nowadays most of the required utilities come with the Operating System.

Utility software	Usage
Backup software	To copy files and take back up of hard drives
Disk scanner	To check the errors in hard drive
Task manager	To display information regarding the processes and programs in a computer and the general status of the computer
Anti-Virus software	To protect the computer by identifying and eliminating malicious software
Screen savers	To blank the screen or fill it with moving images or patterns when the computer is not in use.
Clipboard	Temporary storage of data/files for cut/copy and paste operations
File/data compression	To compress larger files into smaller files
Disk partitioning software	To divide an individual drive into multiple logical drives
Disk formatting	To prepare a partitioned disk for storing data using file formats
Disk defragmentation	To organize the hard disk by rearranging clusters of small spaces together and creating a larger free space

Here, let us consider in detail several of the following utility programs.

- Disk Partitioning
- Disk Formatting
- Defragmentation

Drives

By default, a computer uses the hard drive to save data. If the hard drive is not partitioned then it would be labelled as C: drive. If the hard drive is partitioned then the partitions could be named in order as [C:], [D:], [E:] etc.

If there are other storage media such as CD, DVD or Blu-ray Disk drives in a computer then these drives are given different letter names. For example, if the hard disk is partitioned into four separate partitions, then they would be labelled [C:], [D:], [E:] and [F:] drives whereas a CD, DVD or Blue Ray Disk drive would be named as [G:] drive.

In the same manner when a pen drive is connected to the computer the new drive would be labelled as [K:] drive.

If you want to see the number of drives in a computer, observe the following steps: Open the icon “Computer”. Now you can see, the externally connected drives such as CD, DVD, Blue Ray Disk drives and pen drives are shown as devices with removable storage.

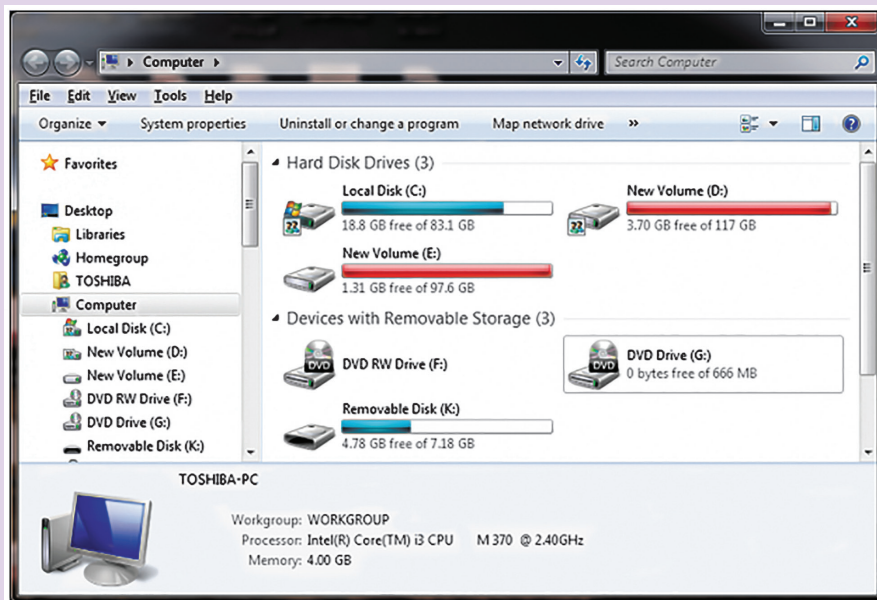


Figure 5.9 - - Viewing the drives

Disk Partitioning

What is a Partition?

By default, there will be only one physical drive in a hard drive. But this drive is normally divided into many logical partitions. This process of dividing an individual drive into multiple logical drives is called disk partitioning.

Normally partitioning is performed at the time when a hard disk is configured for the first time. Partitioning could also be performed when a new hard disk is to be added or when an existing hard disk is replaced with a new hard disk.

We may need to change the existing partition. When an already partitioned hard disk is partitioned again, all the data in that hard disk would be deleted. Therefore, it is necessary to keep it a point to keep a backup copy of the existing data before partitioning again.

The following image depicts how a hard disk would look before and after partitioning.

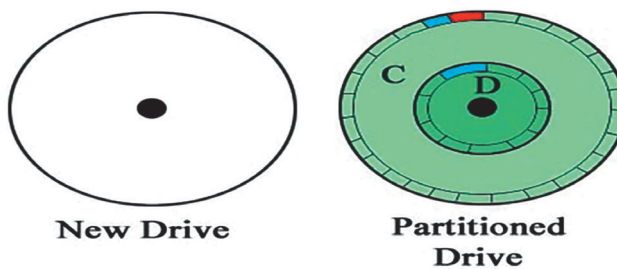


Figure 5.10 – Partitioning of a Hard Disk

Why do we need partitioning?

There could be many reasons for undertaking partitioning. Below are some of the reasons for partitioning.

- When we need to save different items in different places. (Ex: Software in one drive and all other data in another drive).
- When we need to have more than one Operating System in the same machine. (Ex: When we need to install both Windows and Ubuntu Operating System)
- To meet the requirement of the Operating System (Ex: Sometimes it becomes mandatory that a separate partition is allocated for the Operating System)

We can see each of the divided partition as separate drives. In Windows environment, it is a customary to name the first drive as C: drive and go on. This means that the First partition becomes the first drive and would be named as C: drive and the second drive would be named as D: drive and so on.

Note: In windows environment, Multimedia drives (DVD, CD), flash drives etc. which are connected to the computer would be identified as ‘Drives’ and they would be named using an English letter after C (after partitioning the hard disk).

However, in Linux environment all the partitions, multimedia drives, flash drives etc. would be identified as individual folders (in Linux they are called Directories). Therefore, it cannot be seen drives named C: D: etc. in Linux environment.

Disk Formatting

A hard disk cannot be used once partitioning is completed. We need to format each of the drives individually.

Formatting is the process of preparing a data storage device such as a hard disk drive, solid-state drive, floppy disk or USB flash drive for storing data. This is done using a file format in the Operating System.

The USB Flash Drives come pre-formatted so that they can be put into use directly.

We can format hard disk drive, solid-state drive, floppy disk or USB flash drive whenever need arises. Every time we perform formatting the data in the drive would be deleted. Therefore, it is necessary to keep backup copies of the data before formatting.

Once a hard disk is partitioned and formatted, we can start saving data on it. Usually, a hard disk is partitioned and formatted before installing an Operating System for the first time. After the first time the need for partitioning or formatting could arise very rarely.

You can see in the image below how a hard disk would look like after partitioning and formatting.

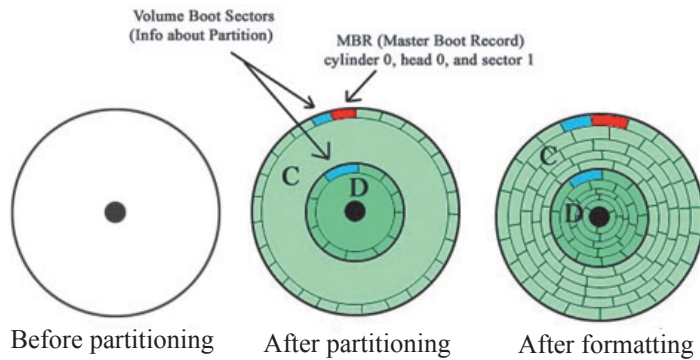


Figure 5.11 – Hard Disk – before and after partitioning and formatting

Defragmentation

The following shows the defragment in Windows. Sometimes a file (which is larger in size) may not be stored as a single track in the hard disk. This process where a single file is broken into different pieces and stored in different parts of the disk is called fragmentation.



Figure 5.12 - How a file is stored in different places of a disk

The Operating System splits a file into several portions and saves them in different places in the disk especially when a saved file becomes larger due to multiple editing. Further, the empty spaces that are created in the disk due to the deletion of files is used to save new files which causes fragmentation.

It takes longer time to read a file when a file is defragmented and saved in different places in the disk. It affects the efficiency of the computer.

If you observe a slowness of the machine (there could be many reasons for the slowness of the computer, whereas fragmentation could be a one reason) the best action to take would be to start defragmentation.



Figure 5.13 - Defragmentation

However, Linux based Operating Systems use a different method to store files. Linux Operating System makes sure that ample space is left between the saved files so that they can be saved at the same location as a single intact file even when the file expands due to editing. Therefore, there is very little possibility for fragmentation to happen. It is also because Linux based Operating Systems have the ability even to relocate the file in a new place if the file exceeds its allocated memory space. Therefore, there is no need for ‘defragmentation utility’ in Linux based Operating Systems.

c). Language Translators

A computer program (software) is made up by using a set of instruction codes. These instructions are written in high level languages which are very close to the human languages. These high-level languages are translated into machine language (i.e. 0’s and 1’s) which are understood by the computer by language translators. assembler, compiler and interpreter are examples for language translators.

5.1.2. Application Software

The application software which runs on the Operating System is used to carry out computer-based activities of the user such as creating documents, mathematical functions, data entry and, computer games.

- Ex: Word processing, spread sheets, database, computer games, Web browsers

Activity



1. There are many properties of a file/folder. Write down how you can find the properties of a file/folder and write down the properties.
2. Write down the names of the Operating System which uses the following file types;
 - FAT16
 - FAT32
 - NTFS
 - ext4
 - ReiserFS
3. Explain the following two methods used for accessing the files.
 - Sequential Access
 - Random Access
4. Explain how you can obtain the CLI of the Operating System you use.
5. List out a few commands used in CLI and the function performed by these commands.
6. Write down all the components of two different windows in the Operating System that you use.
7. Name all the icons in your desktop.
8. Explain how you use the options in two menus of two applications that you use.
9. Write down the advantages and disadvantages of using the finger point against the mouse pointer of an Operating System.
10. List out and explain each of the methods used by Operating System to prevent and control unauthorized access.
11. Briefly explain why partitioning is not necessary within an Linux operating system.

12. As Operating System cannot control or mitigate all the threats brought in by external malicious software. An Operating System gets the support of external (third party) software for this purpose. List out all the threats which are difficult to be controlled by Operating System alone and write down the names of different software which can be used against each of those threats.
13. Name 5 utility software that support the operating system to maintain the computer's performance at a high level, and describe their uses.
14. Write 2 differences between FAT32 and NTFS file systems.
15. Explain the essential steps that must be performed before storing data on a hard disk.