<u>**Unit 3: Computer Software**</u>

Introduction:

- Computer software, or simply software, is a collection of data or computer instructions that tell the computer how to work.
- The computer hardware cannot perform any task on its own. It needs to be instructed about the tasks to be performed. Software is a set of programs that instructs the computer about the tasks to be performed.
- Software tells the computer how the tasks are to be performed; hardware carries out these tasks. Different sets of software can be loaded on the same hardware to perform different kinds of tasks.

Types of Software:

Software can be broadly classified in two categories:

1. System Software, and
2. Application Software.

System software provides the basic functions that are performed by the computer. It is necessary for the functioning of a computer.

Application software is used by the users to perform specific tasks. The user may choose the appropriate application software, for performing a specific task, which provides the desired functionality.

The system software interacts with hardware at one end and with application software at the other end. The application software interacts with the system software and the users of the computer. Figure below shows the hierarchy of software, hardware and users.


Fig: Software Hierarchy

System Software:

- System software is a type of computer program that is designed to run a computer's hardware and application programs. If we think of the computer system as a layered model, the system software is the interface between the hardware and user applications.
- System software provides basic functionality to the computer and is required for the working of computer itself.
- The user of computer does not need to be aware about the functioning of system software, while using the computer.
- For example, when you buy a computer, the system software would also include different device drivers. When you request for using any of the devices, the corresponding device driver software interacts with the hardware device to perform the specified request. If the appropriate device driver for any device, say a particular model of a printer, is installed on the computer, the user does not need to know about the device driver, while printing on this printer.

The purposes of the system software are:

- ❖ To provide basic functionality to computer,
- ❖ To control computer hardware, and
- ❖ To act as an interface between user, application software and computer hardware.

On the basis of their functionality, system software may be broadly divided into two categories as follows:
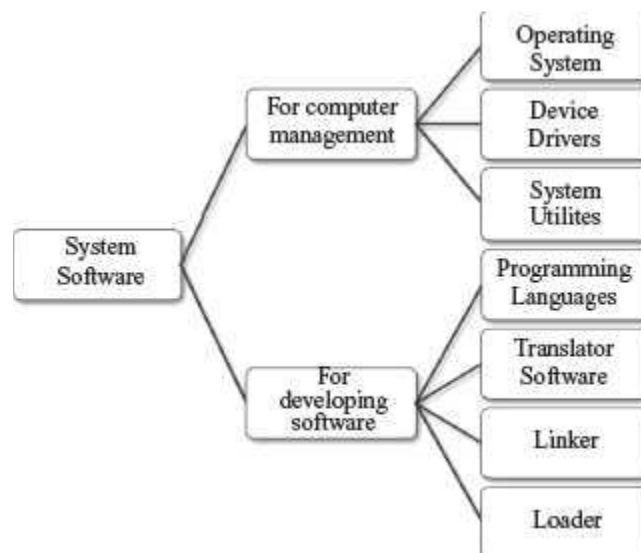
- System software for the management and functionality of computer relates to the functioning of different components of the computer like processor, input and output devices etc. System software is required for managing the operations performed by the components of computer and the devices attached to the computer. It provides support for various services, as requested by the application software. Operating system, device drivers, and system utilities constitute the system software for management of computer and its resources.

- System software for the development of application software provides services required for the development and execution of application software. System software provides the software tools required for the development of application software. The programming language software, translator software, loader, and linker are also categorized as system software, and are required for the application software development.

  Loader: A loader is the part of an operating system that is responsible for loading programs and libraries. It is one of the essential stages in the process of starting a program, as it places programs into memory and prepares them for execution.

  Linker: A linker is a computer program that takes one or more object files generated by a compiler and combines them into one, executable program.

Application Software

The software that a user uses for accomplishing a specific task is the application software. Application software may be a single program or a set of programs. A set of programs that are written for a specific purpose and provide the required functionality is called software package. Application software is written for different kinds of applications—graphics, word processors, media players, database applications, telecommunication, accounting purposes etc.

Some examples of application software packages are as follows:

- Word Processing Software: For writing letter, reports, documents etc. (e.g. MS-WORD).
- Image Processing Software: For assisting in drawing and manipulating graphics (e.g. Adobe Photoshop).
- Accounting Software: For assisting in accounting information, salary, tax returns (Tally software).

- Spreadsheet Software: Used for creating budget, tables etc. (e.g. MS-Excel).
- Presentation Software: To make presentations, slide shows (e.g. MS-PowerPoint)
- Suite of Software having Word Processor, Spreadsheet and Presentation Software: Some examples are MS-Office, Google Docs, Sun Open office, Apple iWork.
- CAD/CAM Software: To assist in architectural design. (e.g. AutoCAD, Autodesk)
- Geographic Information Systems: It captures, stores, analyzes, manages, and presents data, images and maps that are linked to different locations. (e.g. ArcGIS)
- Web Browser Software: To access the World Wide Web to search documents, sounds, images etc. (e.g. Internet Explorer, Chrome).

Software Acquisition:

Different kinds of software are made available for use to users in different ways. The user may have to purchase the software, can download for free from the Internet, or can get it bundled along with the hardware. Nowadays with the advent of Cloud computing, many application softwares are also available on the cloud for use through the Internet, e.g. Google Docs. The different ways in which the softwares are made available to users are:

- **Retail Software** is off-the-shelf software sold in retail stores. It comes with printed manuals and installation instructions. For example, Microsoft Windows operating system.
- **OEM Software** stands for "Original Equipment Manufacturer" software. It refers to software which is sold, and bundled with hardware. Microsoft sells its operating system as OEM software to hardware dealers. OEM software is sold at reduced price, without the manuals, packaging and installation instructions. For example, Dell computers are sold with the "Windows 7" OS pre-loaded on them.
- **Demo Software** is designed to demonstrate what a purchased version of the software is capable of doing and provides a restricted set of features. To use the software, the user must buy a fully-functional version.
- **Shareware** is a program that the user is allowed to try for free, for a specified period of time, as defined in the license. It is downloadable from the Internet. When the trial period ends, the software must be purchased or uninstalled.
- **Freeware** is software that is free for personal use. It is downloadable from the Internet. The commercial use of this software may require a paid license. The author of the freeware software is the owner of the software, though others may use it for free. The users abide by the license terms, where the user cannot make changes to it, or sell it to someone else.
- **Public Domain Software** is free software. Unlike freeware, public domain software does not have a copyright owner or license restrictions. The source code is publicly available for anyone to use. Public domain software can be modified by the user.
- **Open-Source Software** is software whose source code is available and can be customized and altered within the specified guidelines laid down by the creator. Unlike public domain software, open-source software has restrictions on their use and modification, redistribution limitations, and copyrights. Linux, Firefox, OpenOffice are some examples of open-source software.

Operating System:

An operating system (OS) is system software that manages computer hardware, software resources, and provides common services for computer programs. It is the program that, after being initially loaded into the computer by a boot program, manages all of the other application programs in a computer.

In other words, an operating system is a program on which application programs are executed and acts as a communication bridge (interface) between the user and the computer hardware.

Users can interact directly with the operating system through a user interface such as a command line or a graphical user interface (GUI).

OS intermediates between the user of a computer and the computer hardware. Different kinds of application software use specific hardware resources of a computer like CPU, I/O devices and memory, as needed by the application software. OS controls and coordinates the use of hardware among the different application software and the users.

Some available operating systems are Microsoft Disk Operating System (MS-DOS), Windows 7, Windows 8, Windows 8.1, Windows 10, Windows XP, Linux, UNIX, and Mac OS X Snow Leopard.

Objectives of OS:

The objectives of the operating system are:

- To make the computer system convenient to use in an efficient manner.
- To hide the details of the hardware resources from the users.
- To provide users a convenient interface to use the computer system.
- To act as an intermediary between the hardware and its users, making it easier for the users to access and use other resources.
- To manage the resources of a computer system.
- To keep track of who is using which resource, granting resource requests, and mediating conflicting requests from different programs and users.
- To provide efficient and fair sharing of resources among users and programs.

Types of OS:

Depending on the nature and functionality of OS, they have several types as:

1. **Single-tasking and multi-tasking**
   A single-tasking system can only run one program at a time, while a multi-tasking operating system allows more than one program to be running in concurrency. This is achieved by time-sharing, where the available processor time is divided between multiple processes.
2. **Single- and multi-user**
   Single-user operating systems have no facilities to distinguish users, but may allow multiple programs to run in tandem. A multi-user operating system extends the basic concept of multi-tasking with facilities that identify processes and resources, such as disk space, belonging to multiple users, and the system permits multiple users to interact with the system at the same time.

3. **Distributed**

   A distributed operating system manages a group of distinct computers and makes them appear to be a single computer. The development of networked computers that could be linked and communicate with each other gave rise to distributed computing. Distributed computations are carried out on more than one machine. When computers in a group work in cooperation, they form a distributed system.

4. **Embedded**

   Embedded operating systems are designed to be used in embedded computer systems. They are designed to operate on small machines like PDAs with less autonomy. They are able to operate with a limited number of resources. They are very compact and extremely efficient by design. Windows CE and Minix 3 are some examples of embedded operating systems.

5. **Real-time**

   A real-time operating system is an operating system that guarantees to process events or data by a specific moment in time. A real-time operating system may be single- or multi-tasking, but when multitasking, it uses specialized scheduling algorithms so that a deterministic nature of behavior is achieved.

Functions of OS:

Major Functions of Operating Function are:

- Process management
- Memory management
- File management
- Device management
- Protection and Security
- User Interface

Process management:

In a multi programming environment, the OS decides the order in which processes have access to the processor, and how much processing time each process has. This function of OS is called process scheduling. An Operating System keeps tracks of the status of processes. The program which perform this

task is known as traffic controller. Allocates the CPU (i.e. processor) to a process. De-allocates processor when a process is no more required.

Memory Management

The operating system manages the Primary Memory or Main Memory. Main memory is made up of a large array of bytes or words where each byte or word is assigned a certain address. Main memory is a fast storage and it can be accessed directly by the CPU. For a program to be executed, it should be first loaded in the main memory.

An Operating System performs the following activities for memory management:

It keeps tracks of primary memory, i.e., which bytes of memory are used by which user program. The memory addresses that have already been allocated and the memory addresses of the memory that has not yet been used. In multi programming, the OS decides the order in which process are granted access to memory, and for how long. It Allocates the memory to a process when the process requests it and deallocates the memory when the process has terminated or is performing an I/O operation.

File Management

A file system is organized into directories for efficient or easy navigation and usage. These directories may contain other directories and other files. An Operating System carries out the following file management activities. It keeps track of where information is stored, user access settings and status of every file. These facilities are collectively known as the file system.

Device Management

An OS manages device communication via their respective drivers. It performs the following activities for device management. Keeps tracks of all devices connected to system. designates a program responsible for every device known as the Input/output controller. Decides which process gets access to a certain device and for how long, allocates devices in an effective and efficient way and Deallocates devices when they are no longer required.

Protection and Security:

The operating system uses password protection to protect user data and similar other techniques. It also prevents unauthorized access to programs and user data.

User Interface:

Operating system provides interface to the user to access the hardware. The user interface is a set of commands or a graphical user interface via which the user interacts with the applications and the hardware.

Process management:

- A process is a program in a state of execution. It is a unit of work for the operating system. A process can be created, executed, and stopped. In contrast, a program is always static and does not have any state. A program may have two or more processes running. A process and a program are, thus, two different entities.

- To accomplish a task, a process needs to have access to different system resources like I/O devices, CPU, memory etc. The process management function of an operating system handles allocation of resources to the processes in an efficient manner. The allocation of resources required by a process is made during process creation and process execution.
- A process changes its state as it is executed. The various states that a process changes during execution are as follows:
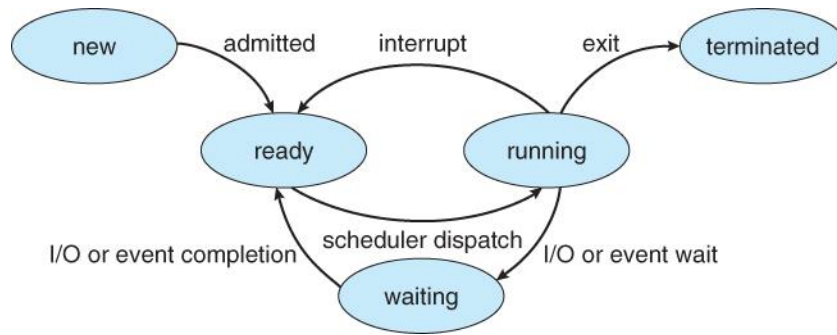
- New—process is in a new state when it is created,
- Ready—process is in ready state when it is waiting for a processor,
- Running—process is in running state if processor is executing the process,
- Waiting—process is in waiting state when it waits for some event to happen (I/O etc.), and
- Terminated—process that has finished execution is in terminated state.

The concurrent execution of the process requires process synchronization and CPU scheduling. The CPU scheduling, process synchronization, communication, and deadlock situations are described as follows:

CPU Scheduling: CPU scheduling is a process which allows one process to use the CPU while the execution of another process is on hold (in waiting state) due to unavailability of any resource like I/O etc., thereby making full use of CPU. The aim of CPU scheduling is to make the system efficient, fast and fair.

Process Synchronization: Process Synchronization is a technique which is used to coordinate the process that use shared Data. Concurrent access to shared data is handled to minimize the possible conflicts and chance of inconsistent data.

Communication (Inter-process Communication- IPC): Inter process communication (IPC) is a mechanism which allows processes to communicate each other and synchronize their actions.

Deadlock: A deadlock is a situation in which two computer programs sharing the same resource are effectively preventing each other from accessing the resource, resulting in both programs ceasing to function.
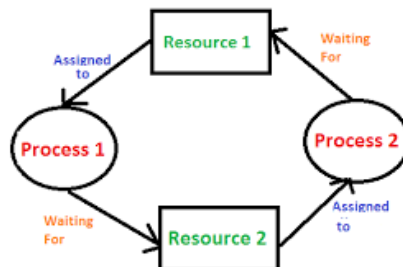
Memory Management:

In a computer, there may be multiple processes executing at the same time. Every process that needs to execute, requires a certain amount of memory. Memory management is one of the tasks handled by the operating system. Memory management schemes handle the allocation of memory to different processes. On completion of process execution, the memory is de-allocated and made available to another process. Additionally, different processes that have been allocated memory should not interfere into each other's memory space. This requires some memory protection and sharing mechanism.

Memory Allocation: Memory allocation is a process by which computer programs and services are assigned with physical or virtual memory space. Memory allocation is the process of reserving a partial or complete portion of computer memory for the execution of programs and processes.

Memory Deallocation: Deallocation is a process performed by a computer where a block of information is released from memory so that it may be used by a different program.

Memory Protection: The main purpose of memory protection is to prevent a process from accessing memory that has not been allocated to it.

Virtual Memory:

Virtual memory is a memory management capability of an operating system (OS) that uses hardware and software to allow a computer to compensate for physical memory shortages by temporarily transferring data from random access memory (RAM) to disk storage. Virtual Memory is a storage allocation scheme in which secondary memory can be addressed as though it is part of main memory.
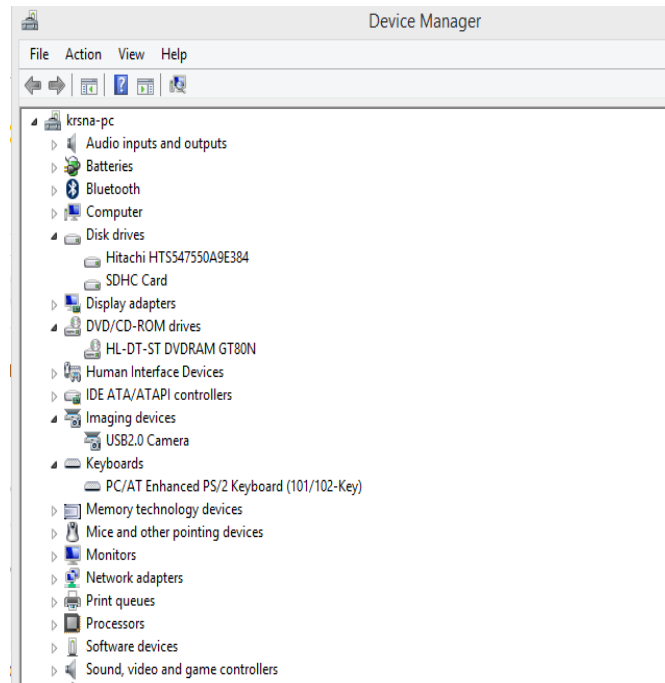
File management:

The file management function of the operating system involves handling the file system which consists of two parts—a set of files, and a directory structure.

- File is a collection of related information, has a name, and is stored on a secondary storage. It is the smallest named unit that can be written to a secondary storage device. Data cannot be stored on the secondary storage if it is not in the form of a file. A file has attributes like its name, location, size, type, time, and date of creation etc. The information stored in a file can be accessed in different ways—sequential access (access is in a sequential order from start to end) and direct access (the file can be accessed in any order).

Name	Date modified	Type	Size
Unit 1 Introduction to Computer.docx	11/12/2019 8:12 PM	DOCX File	876 KB
Unit 1 Introduction to Computer.pdf	11/12/2019 8:16 PM	Adobe Acrobat D...	322 KB
Unit 2 Computer Hardware.docx	11/27/2019 10:33 ...	DOCX File	904 KB
Unit 2 Computer Hardware.pdf	11/27/2019 10:33 ...	Adobe Acrobat D...	745 KB
Unit 3 Computer Software.docx	12/3/2019 8:16 PM	DOCX File	272 KB
Unit 3 Computer Software.pdf	12/2/2019 9:30 PM	Adobe Acrobat D...	194 KB

- Directory structure provides information about the files stored on the secondary storage. Directory contains information about all the files within it. The information about the files is kept

as entries in the directory of device. A directory further may have a subdirectory defined within it. Directory contains the name, location, size, and type of all the files defined on the device.

Device management:

Device management in operating system implies the management of the peripheral devices.

Protection and Security:

The access of programs, processes, and users, to the resources defined by the computer are controlled by the protection mechanism. Protection ensures that the resources of the computer are used in a consistent way. Security mechanism prevents unauthorized access to the computer. Security concerns include— security of software, security of data stored in the computer, and security of physical resources of the computer.

In a personal computer, security can be ensured using:

(1) user accounts—individual accounts for each user,
(2) user authentication—using password protection,
(3) access rights—define rights for access of different kind of information for different people,
(4) data encryption—store data in computer in encrypted form, and
(5) data backup—storing data on a peripheral device other than the hard disk.

User Interface:

The primary goal of operating system is to make the computer convenient for use by its user. It should allow users to easily access and communicate with the applications and the hardware.

The users can interact with the computer by using mainly two kinds of interfaces:

(1) Command Line Interface (CLI), and
(2) Graphical User Interface (GUI).

- CLI requires the user to interact with operating system in the form of text keyed in from the keyboard. In this, the user has to learn and remember the different commands required for copying, deleting, opening a file or folder etc. MS-DOS and Linux shell are examples of command line mode of interfaces.

- GUI use graphics to display the various commands. The interface consists of icons, menus, windows, and pointers. The user need not learn the commands, instead, the user can give instructions by moving the pointer on the screen using a mouse and pressing the mouse button. Microsoft Windows 7 is an example of graphical mode operating system.

Examples of Operating Systems:

MS-DOS, Windows family of operating systems, Unix OS, Linux OS, and Mac OS X are some of examples of commonly used OSs. Each operating system has specific characteristics.

MS-DOS

- MS-DOS was the first widely-installed operating system for PCs in 1980s.
- MS-DOS is easy to load and install. It neither requires much memory for the operating system, nor a very powerful computer to run on.
- MS-DOS is a command line user interface operating system. This means that the user has to type single line commands through the command interface. So, user has to remember the different commands and their syntax.
- It is a single-user and single-tasking operating system for the PC. Only one user can use it and only one task can be executed, at a given point of time. Also, it does not have a built-in support for networking.
- MS-DOS is a 16-bit OS, meaning thereby that it can send or receive 16 bits of data at a time and can process 16 bits of data. It is not able to take the advantage of 32-bit processors.
- To use MS-DOS, user must know where the programs and data are stored and how to interact with it. In the MS-DOS command mode, command.com routine interprets the typed in command from the keyboard.
- To get the window of the command prompt in the Windows environment
  <Start> <Run> Type "cmd" <Enter>, or
  <Start> <All programs> <Accessories> <Command Prompt>
- cmd.exe or command prompt is the command line interpreter on the current Windows-based OS. It is similar to command.com in MS-DOS.
- cmd.exe is a Windows program that acts as a DOS like command line interpreter.

Windows Family of OS

- Windows is a personal computer operating system from Microsoft.
- The Windows family of OS which is currently in use includes the Windows 9x family (Windows 95, Windows 98 and Windows 2000), Windows XP, Windows Vista, Windows 7, Windows 8, and Windows 10 operating systems.
- Windows family of OS is GUI-based operating system. Since GUI interfaces are easy to use and are user-friendly, these have become very popular.
- Windows support multi-tasking. It means Windows OS allows simultaneous execution of multiple tasks.
- Windows contains built-in networking, which allows users to share files and applications with each other, if their PCs are connected to a network.

- Windows 7 comes in six different editions, Starter, Home Basic, Home Premium, Professional, Enterprise and Ultimate.
- With each new version of the Windows OS, the user interface undergoes some changes and the user has to learn to use the new interface. This becomes troublesome for the user.

Linux OS

- Linux is a Unix-like OS. Unix OS has a user interface called shell. It provides interface for the programs to interact with the hardware, and provides services like process management and memory management.
- Linux was developed by Linus Torvalds in 1992. Linux is copyright under the GNU Public License. Linux is a "free" operating system that is easily available. Since Linux follows the open development model, it is being constantly upgraded by programmers across the globe.
- Some organizations offer Linux with add-on features and capabilities. Red Hat, Mandrake, Debian and Novell are the popular vendors of Linux OS.
- Tux, the Linux penguin is the official mascot of Linux.
- Linux is a command line user interface OS. Linux has GUI interfaces called desktop environments. The GUI interface is convenient for the user to use.
- Linux is a 32-bit, multi-tasking OS. It supports multiple users and multiple processors.
- Linux is a reliable and secure OS, and is available almost for free. So, Linux is becoming very popular and powerful OS.
- Linux OS is easily available, such as Redhat Linux, and, Debian—Ubuntu.