# Lecture - 1

Introduction to Operating System:

An Operating System (OS) is an interface between computer user and computer hardware. An operating system is a software which performs all the basic tasks like file management, memory management, process management, handling input and output, and controlling peripheral devices such as disk drives and printers. Some popular Operating Systems include Linux Operating System, Windows Operating System, VMS, OS/400, AIX, z/OS, etc.

Definition- An operating system is a program that acts as an interface between the user and the computer hardware and controls the execution of all kinds of programs.
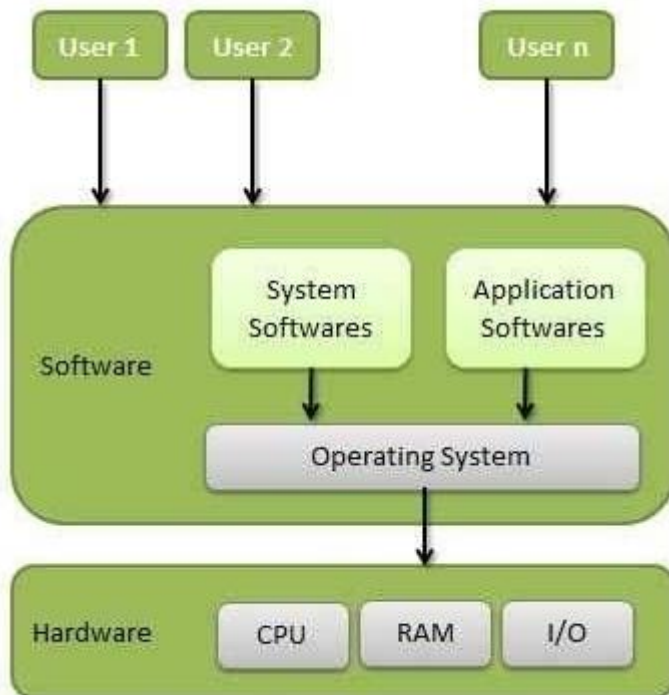
Functions of OS:
Following are some of important functions of an operating System.
● **Memory Management**
● **Processor Management**
● **Device Management**
● **File Management**
 ● **Security**
● **Control over system performance**
● **Job accounting**
● **Error detecting aids**
● **Coordination between other software and users**

Services of Operating System:

An Operating System provides different kinds of services to both the users and to the programs as well. It also provides application programs (that run within an Operating system) an environment to execute freely. It provides users the services to run various

programs in a convenient manner.
Following are a few common services provided by an operating system

    1. User Interface
    2. Program Execution
    3. File system manipulation
    4. Input / Output Operations
    5. Communication
    6. Resource Allocation
    7. Error Detection
    8. Accounting
    9. Security and protection

1. User Interface:

Usually Operating system comes in three forms or types. Depending on the interface their typeshave been further subdivided. These are:

- Command line interface
- Batch based interface
- Graphical User Interface

Let's get to know in brief about each of them.

The Command Line Interface (CLI) usually deals with using text commands and a technique for entering those commands.

The Batch interface (BI): commands and directives are used to manage those commands that are entered into files and those files get executed.

Graphical user interface (GUI): which is a window system with a pointing device (like mouseor trackball) to point to the I/O, choose from menus driven interface and to make choices viewing from a number of lists and a keyboard to entry the texts.

2. Program Execution:

The operating system must have the capability to load a program into memory and execute that program. Furthermore, the program must be able to end its execution, either normally or abnormally / forcefully.

To run a program, the program is required to be loaded into the RAM first and then to assign CPU time for its execution. Operating system performs this function for the convenience of the user. It also performs other important tasks like allocation and de-allocation of memory, CPU scheduling etc.

Following are the major activities of an operating system with respect to programmanagement –

- Loads a program into memory.
- Executes the program.
- Handles program's execution.
- Provides a mechanism for process synchronization.
- Provides a mechanism for process communication.
- Provides a mechanism for deadlock handling.

3. File system manipulation:

A file represents a collection of related information. Computers can store files on the disk (secondary storage), for long-term storage purpose. Examples of storage media include magnetic tape, magnetic disk and optical disk drives like CD, DVD. Each of these media has its own properties like speed, capacity, data transfer rate and data access methods.

A file system is normally organized into directories for easy navigation and usage. Thesedirectories may contain files and other directions. Following are the major activities of anoperating system with respect to file management –

- Program needs to read a file or write a file.
- The operating system gives the permission to the program for operation on file.
- Permission varies from read-only, read-write, denied and so on.
- Operating System provides an interface to the user to create/delete files.
- Operating System provides an interface to the user to create/delete directories.
- Operating System provides an interface to create the backup of file system.

4. Input / Output Operations:

Each program requires an input and after processing the input submitted by user it producesoutput. This involves the use of I/O devices. The operating system hides the user from all thesedetails of underlying hardware for the I/O. So the operating system makes the users convenient to run programs by providing I/O functions. The I/O service cannot be provided by user-level programs and it must be provided by the operating system.
An Operating System manages the communication between user and device drivers.
- I/O operation means read or write operation with any file or any specific I/O device.
- Operating system provides the access to the required I/O device when required.

5. Communication

Operating system performs the communication among various types of processes in the form of shared memory. In multitasking environment, the processes need to communicate with each other and to exchange their information.
Following are the major activities of an operating system with respect to communication:
- Two processes often require data to be transferred between them
- Both the processes can be on one computer or on different computers, but areconnected through a computer network.
- Communication may be implemented by two methods, either by Shared Memory or by Message Passing.

6. Resource Allocation:

In the multitasking environment, when multiple jobs are running at a time, it is the responsibility of an operating system to allocate the required resources (like as CPU, main memory, tape drive or secondary storage etc.) to each process for its better utilization. For thispurpose, various types of algorithms are implemented such as process scheduling, CPU scheduling, disk scheduling etc.

Following are the major activities of an operating system with respect to resourcemanagement –

- The OS manages all kinds of resources using schedulers.
- CPU scheduling algorithms are used for better utilization of CPU.

7. Error Detection:

Errors may occur within CPU, memory hardware, I/O devices and in the user program. For each type of error, the OS takes adequate action for ensuring correct and consistent computing.Operating system also deals with hardware problems. To avoid hardware problems, the operating system constantly monitors the system for detecting the errors and fixing these errors (if found). The main function of operating system is to detect the errors like bad sectors on hard disk, memory overflow and errors related to I/O devices. After detecting the errors, operating system takes an appropriate action for consistent computing.

8. Accounting:

Operating system keeps an account of all the resources accessed by each process or user. Inmultitasking, accounting enhances the system performance with the allocation of resourcesto each process ensuring the satisfaction to each process.

9. Security and protection

If a computer system has multiple users and allows the concurrent execution of multiple processes, then the various processes must be protected from one another's activities. Protection includes in ensuring all access to system resources in a controlled manner. Formaking a system secure, the user needs to authenticate him or her to the system before using.

System calls

Concepts:

The system call provides an interface to the operating system services. The interface betweena process and an operating system is provided by system calls. In general, system calls are available as assembly language instructions. System calls are usually made when a process inuser mode requires access to a resource. Then it requests the kernel to provide the resource via a system call.

When a program in user mode requires access to RAM or a hardware resource, it must ask the kernel to provide access to that resource. This is done via something called a **system call**.

When a program makes a system call, the mode is switched from user mode to kernel mode.This is called a **context switch**.

Then the kernel provides the resource which the program requested. After that, another contextswitch happens which results in change of mode from kernel mode back to user mode.

Generally, system calls are made by the user level programs in the following situations:

- Creating, opening, closing and deleting files in the file system.
- Creating and managing new processes.
- Creating a connection in the network, sending and receiving packets.
- Requesting access to a hardware device, like a mouse or a printer.

A figure representing the execution of the system call is given as follows:
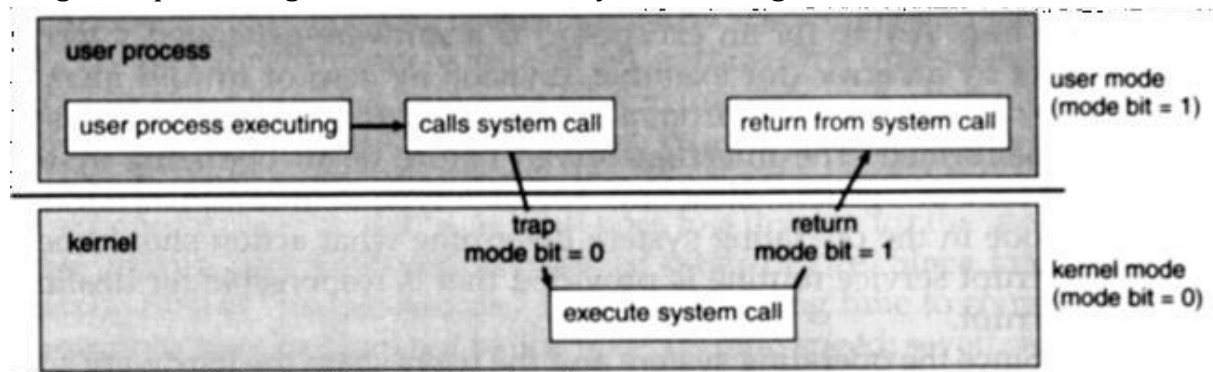
Services Provided by System Calls :

1. Process creation and management
2. Main memory management
3. File Access, Directory and File system management
4. Device handling(I/O)
5. Protection
6. Networking, etc.

Types of System Calls : There are 5 different categories of system calls –

1. **Process control:** end, abort, create, terminate, allocate and free memory.
2. **File management:** create, open, close, delete, read file etc.
3. Device management
4. Information maintenance
5. Communication

Examples of Windows and Unix System Calls

	Windows	**Unix**
Process Control	CreateProcess() ExitProcess() WaitForSingleObject()	fork() exit() wait()
File Manipulation	CreateFile() ReadFile() WriteFile() CloseHandle()	open() read() write() close()

Device Manipulation	SetConsoleMode() ReadConsole() WriteConsole()	ioctl() read() write()
Information Maintenance	GetCurrentProcessID() SetTimer() Sleep()	getpid() alarm() sleep()
Communication	CreatePipe() CreateFileMapping() MapViewOfFile()	pipe() shmget() mmap()
Protection	SetFileSecurity() InitlializeSecurityDescriptor() SetSecurityDescriptorGroup()	chmod() umask() chown()

Operating System Components

From the virtual machine point of view (also resource management) these components **reflect** the services made available by the O.S.

1. Process Management
   - Process is a program in execution --- numerous processes to choose from in a *multiprogrammed* system,
   - Process creation/deletion (bookkeeping)
   - Process suspension/resumption (scheduling, system vs. user)
   - Process synchronization
   - Process communication
   - Deadlock handling
2. Memory Management
   1. Maintain bookkeeping information
   2. Map processes to memory locations
   3. Allocate/deallocate memory space as requested/required
3. I/O Device Management
   0. Disk management functions such as free space management, storageallocation, fragmentation removal, head scheduling
   1. Consistent, convenient software to I/O device interface throughbuffering/caching, custom drivers for each device.
4. File System

Built on top of disk management
- 0. File creation/deletion.
- 1. Support for hierarchical file systems
- 2. Update/retrieval operations: read, write, append, seek
- 3. Mapping of files to secondary storage

5. Protection

Controlling access to the system
- 0. Resources --- CPU cycles, memory, files, devices
- 1. Users --- authentication, communication
- 2. Mechanisms, not policies

6. Network Management

Often built on top of file system
- 0. TCP/IP, IPX, IPng
- 1. Connection/Routing strategies
- 2. ``Circuit'' management --- circuit, message, packet switching
- 3. Communication mechanism
- 4. Data/Process migration

7. Network Services (Distributed Computing)Built on top of networking
- 0. Email, messaging (GroupWise)
- 1. FTP
- 2. gopher, www
- 3. Distributed file systems --- NFS, AFS, LAN Manager
- 4. Name service --- DNS, YP, NIS
- 5. Replication --- gossip, ISIS
- 6. Security --- kerberos

8. User Interface
- 0. Character-Oriented shell --- sh, csh, command.com (*User replaceable*)
- 1. GUI --- X, Windows 95

Use of Operating system tools
- Users and groups management: Creation, deletion of users and group
- Security policy: Permission to group and users , permission types, viewing the permission, modify the permissions, user authentication
- Device Management: loading of Device driver depending on its types such as block, character or network device, partition of HDD, Checking the disk space
- Monitor: Performance of CPU usage, Memory usage, Swap memory, Cachesize, buffer size, process ID, Users, Command etc.
- Task Scheduler