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BCA 306

UNIT-1

OPERATING SYSTEM

SYLLABUS: Introduction to the Operating System, Types of Operating System: Batch System, Time Sharing System, Real Time System, Multi Programming, Distributed System, Functions and Services of OS.

The operating system is the most important program that runs on a computer. Every general purpose computer must have an operating system to run other programs and applications. Operating systems perform basic tasks, such as recognizing input from the keyboard, sending output to the display screen, keeping track of files and directories on the disk, and controlling peripheral devices such as disk drives and printers.

Definition:- An operating system is a system software which act as an interface between a user and computer hardware. It provides an environment in which a user may execute programs. A computer system can be divided in to four component.

Operating system as User Interface –

1. User
2. System and application programs
3. Operating system
4. Hardware

Every general-purpose computer consists of the hardware, operating system, system programs, and application programs. The hardware consists of memory, CPU, ALU, and I/O devices, peripheral device, and storage device. System program consists of compilers, loaders, editors, OS, etc. The application program consists of business programs, database programs.

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“Hardware Provides basic computing resources (CPU, memory, I/O devices).

Operating System- Controls and coordinates the use of hardware among application programs.

Application Programs- Solve computing problems of users (compilers, database systems, video

games, business programs such as banking software).

Users- People, machines, other computers"

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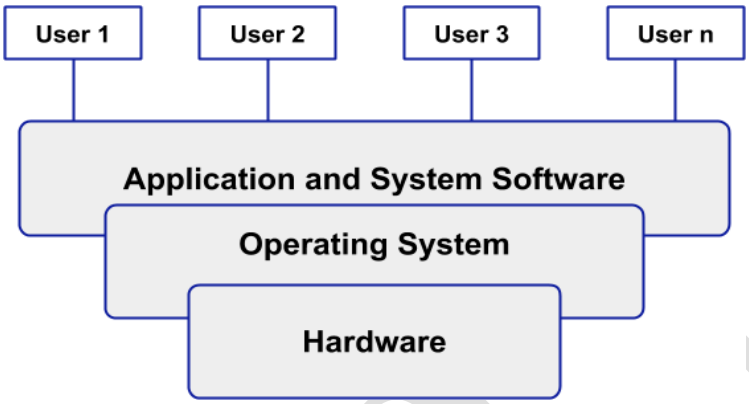


Fig1: Conceptual view of a computer system

Every computer must have an operating system to run other programs. The operating system coordinates the use of the hardware among the various system programs and application programs for various users. It simply provides an environment within which other programs can do useful work.

Goals of the Operating System:-

There are two types of goals of an Operating System i.e. Primary Goals and Secondary Goal.

- **Primary Goal:** The primary goal of an Operating System is to provide a user-friendly and convenient environment. We know that it is not compulsory to use the Operating System, but things become harder when the user has to perform all the process scheduling and converting the user code into machine code is also very difficult. So, we make the use of an Operating System to act as an intermediate between us and the hardware. All you need to do is give commands to the Operating System and the Operating System will do the rest for you. So, the Operating System should be convenient to use.
- **Secondary Goal:** The secondary goal of an Operating System is efficiency. The Operating System should perform all the management of resources in such a way that the resources are fully utilized and no resource should be held idle if some request to that resource is there at that instant of time

So, in order to achieve the above primary and secondary goals, the Operating System performs

a number of functions.

Evolution of Operating System:-

Evolution -Evolution mean the gradual development of something.

Evolution of operating system is divided into 5 phases

PHASE 0: IN THE BEGINNING (1940-1955):-

Phase 0: No operating system

- Computers are exotic experimental equipment.
- Program in machine language.
- Use plug boards to direct computer.
- No overlap between computation, I/O, think time, and response time.
- Programs manually loaded via card decks.

Phase 1 (1955-1970):-

- Make more efficient use of the computer
- computer: move the person away from the machine.
- User at console: one user at a time
- Batch monitor: load program, run, print
- OS becomes a batch monitor: a program that loads a user's
- If program failed, the OS record the contents of memory and saves it somewhere.
- Os/360 was introduced in 1963; worked in 1968.This Systems were enormously complicated. They were written in assembly code. No structured programming.

MODIFICATIONS:

- More efficient use of hardware.
- Efficiency increases because it processes the jobs as a batch collectively rather than individually.

Limitations

- No protection
- Difficult to debug!

Phase 2 (1970-1980):-

Interactive timesharing: CTSS:

- Developed at MIT. One of the first timesharing systems. to let multiple users interact with the system at the same time

- Sacrifice CPU time to get better response time
- Users do debugging, editing, and email online.

MODIFICATIONS:

- Better utilization of resources.
- More than one user executes their tasks simultaneously.

LIMITATIONS

- Thrashing- Thrashing caused by many Factors including
- Swapping
- Inefficient queuing
- Performance very non-linear response with load

Phase 3: 1980-1990:-

- OS becomes a subroutine library
- One application at a time (MSDOS,
- Required high level protection and privacy for user data.
- Mobile and computer operating systems have CP/M, …)
- Gates approached Seattle Computer Products, bought 86-DOS, and created MS- DOS.
- GUI operating systems was developed first time in phase 3.
- So many types of GUI operating systems are develop in phase 5 major types are:

First “mice”, “windows”

Apple Lisa/ Macintosh: 1984

Xerox Star

pp /

“Look and Feel” suit 1988

Microsoft Windows: Win 1.0 (1985) .

Modifications:

- OS becomes a subroutine library and command executive.
- finish quickly and run existing programs.

Limitations:-

- Eventually PCs become powerful: OS regains all the complexity of a "big" OS
- memory protection because of multiprogramming.

Phase 4: (1990-2000):-

Networked Systems:

- Networking (Local Area Networking)
- Different machines share resources Printers, File Servers, Web Servers Client – Server Model Services: Computing File Storage

Modifications:

- Internet service providers (service between OS and apps)
- Information becomes a commodity.
- Advertising becomes a computer marketplace.

Limitations

complicated as compare to uni programing been developed in different ways and for different uses. Computer OS products are older and more familiar to larger groups of users.

Phase 5: 2000??-???? Mobile:-

OS system of mobiles.
window 95,
window 98,
window XP,
window crystal vista window 8,
window 10,
Android all Versions.

The designers and developers try to develop operating system and make it user friendly all GUI operating System is user friendly operating system. it is more easy for the user to use GUI OS as compared to Unix, Linux, Ms. Dos etc. because while using these OS user must familiar with its commands . Through the last 22 years, the simple idea of a computer operating system has been continually built on and improved. Through this time, Microsoft Windows, Android and Apple's Mac OS have emerged as the two dominant operating system designs. The goal in OS development is to make the machine convenient to use.

Functions of an Operating System:-

To achieve the goals of an Operating system, the Operating System performs a number of

functionalities. They are:

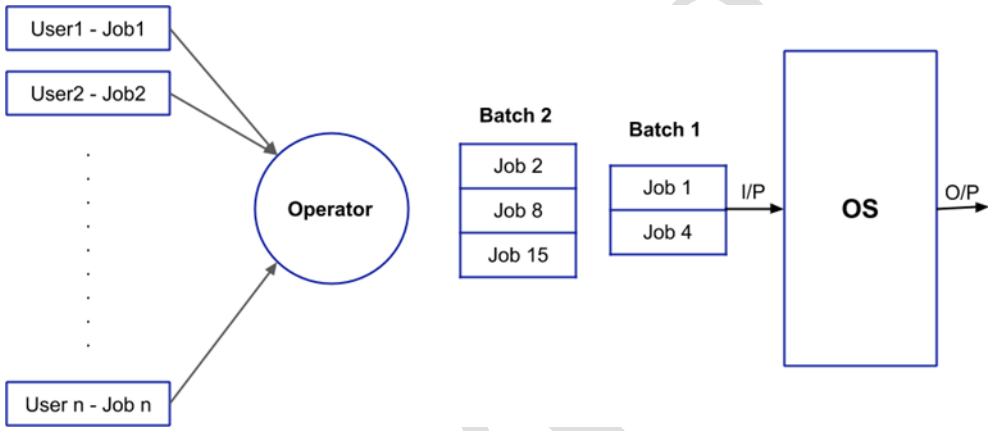
- **Process Management:** At a particular instant of time, the CPU may have a number of processes that are in the ready state. But at a time, only one process can be processed by a processor. So, the CPU should apply some kind of algorithm that can be used to provide uniform and efficient access to resources by the processes. The CPU should not give priority to only one process and it should make sure that every process which is in the ready state will be executed. Some of the CPU scheduling algorithms are First Come First Serve, Round Robin, Shortest Job First, Priority Scheduling, etc.
- **Memory Management:** For the execution of a process, the whole process is put into the main memory and the process is executed and after the execution of the process, the memory is freed and that memory can be used for other processes. So, it is the duty of the Operating System to manage the memory by allocating and deallocating the memory for the process.
- **I/O Device Management:** There are various I/O devices that are present in a system. Various processes require access to these resources and the process should not directly access these devices. So, it is the duty of the Operating System to allow the use of I/O devices by the various process that are requiring these resources.
- **File Management:** There are various files, folders and directory system in a particular computer. All these are maintained and managed by the Operating System of the computer. All these files related information are maintained by using a File Allocation Table or FAT. So, every detail related to the file i.e. filename, file size, file type, etc is stored in the File Allocation Table. Also, it is the duty of the Operating System to make sure that the files should not be opened by some unauthorized access.**Virtual Memory:** When the size of the program is larger than the main memory then itis the duty of the Operating System to load only frequently used pages in the main memory. This is called Virtual Memory.

Types of an Operating System:-

1. Batch Operating System

In a Batch Operating System, the similar jobs are grouped together into batches with the help of some operator and these batches are executed one by one. For example, let us assume that

we have 10 programs that need to be executed. Some programs are written in C++, some in C and rest in Java. Now, every time when we run these programmes individually then we will have to load the compiler of that particular language and then execute the code. But what if we make a batch of these 10 programmes. The benefit with this approach is that, for the C++ batch, you need to load the compiler only once. Similarly, for Java and C, the compiler needs to be loaded only once and the whole batch gets executed. The following image describes the working of a Batch Operating System



Advantages:

1. The overall time taken by the system to execute all the programmes will be reduced.
2. The Batch Operating System can be shared between multiple users.

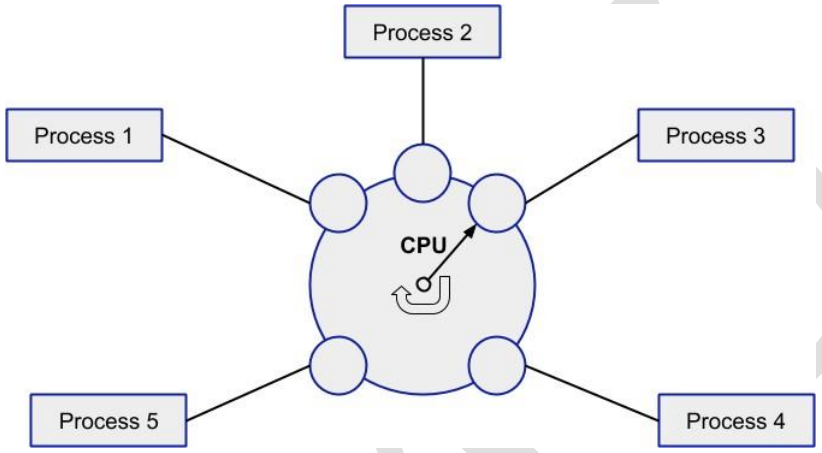
Disadvantages:

1. Manual interventions are required between two batches.
2. The CPU utilization is low because the time taken in loading and unloading of batches is very high as compared to execution time.

   Examples of the batch operating system: transactions, payroll system, bank statements, reporting, integration, etc.

2. Time-Sharing or Multi-tasking Operating System

In a Multi-tasking Operating System, more than one processes are being executed at a particular time with the help of the time-sharing concept. So, in the time-sharing environment, we decide a time that is called time quantum and when the process starts its execution then the execution continues for only that amount of time and after that, other processes will be given chance for that amount of time only. In the next cycle, the first process will again come for its execution and it will be executed for that time quantum only and again next process will come. This process will continue. The following image describes the working of a Time-Sharing Operating System.



Advantages:

1. Since equal time quantum is given to each process, so each process gets equal opportunity to execute. The CPU will be busy in most of the cases and this is good to have case.

Disadvantages:

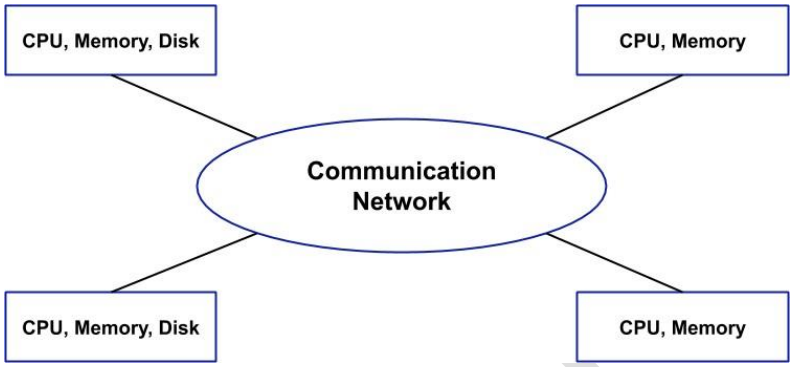
1. Process having higher priority will not get the chance to be executed first because the equal opportunity is given to each process.

   Examples of multitasking: eating and watching TV simultaneously, chatting during classes, eating chocolates while walking, talking on a phone while walking, etc.

3. Distributed Operating System

In a Distributed Operating System, we have various systems and all these systems have their own CPU, main memory, secondary memory, and resources. These systems are connected to each other using a shared communication network. Here, each system can perform its task individually. The best part about these Distributed Operating System is remote access i.e. one user can access the data of the other system and can work accordingly. So, remote access is possible in these distributed Operating Systems. The

following image shows the working of a Distributed Operating System.



Advantages:

1. Since the systems are connected with each other so, the failure of one system can't stop the execution of processes because other systems can do the execution.
2. Resources are shared between each other.
3. The load on the host computer gets distributed and this, in turn, increases the efficiency.

Disadvantages:

1. Since the data is shared among all the computers, so to make the data secure and accessible to few computers, you need to put some extra efforts.
2. If there is a problem in the communication network then the whole communication will be broken.

Examples of distributed OS: intranets, the internet, sensors networks, etc.

4. Embedded Operating System

An Embedded Operating System is designed to perform a specific task for a particular device which is not a computer. For example, the software used in elevators is dedicated to the working of elevators only and nothing else. So, this can be an example of Embedded Operating System. The Embedded Operating System allows the access of device hardware to the software that is running on the top of the Operating System.

The block diagram of an embedded system consists of input devices, output devices, and memory.

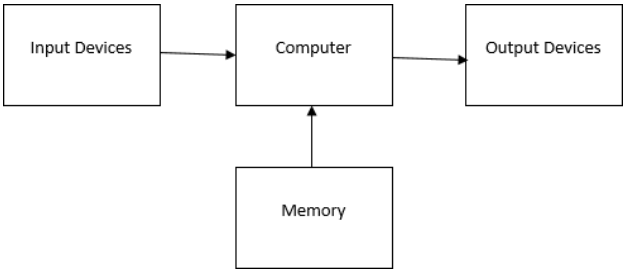


Fig The block diagram of an embedded

Input Devices: Input devices are used to send the data from the user to the system, here the user is the input. Some of the input devices are Keyboard, mouse, microphone, hard disk, sensors, switches, etc.

Output Devices: Out devices show the result to the humans in the form of text, image or sounds. Some of the output devices are printers, monitors, LCD, LED, motors, relays, buzzers, etc.

Memory: The memory is used to store the data. Some of the memory devices are SD card, EEPROM (Electrically Erasable Programmable Read-Only Memory), Flash memory. The memory devices used in the embedded system are Non-volatile RAM, volatile RAM, Dynamic Random Access Memory), etc.

Advantages:

1. Since it is dedicated to a particular job, so it is fast.
2. Low cost.
3. These consume less memory and other resources.

Disadvantages:

1. Only one job can be performed.
2. It is difficult to upgrade or is nearly scalable.

Some applications of the embedded operating system are shown in the below

- **Mobiles, Washing machines, Televisions, Microwave Ovens, Televisions, Computers, Laptops, Dishwashers, ATM's, Satellites, Vehicles**

5. Real-time Operating System

The Real-time Operating Systems are used in the situation where we are dealing with some real-time data. So, as soon as the data comes, the execution of the process should be done and there should be no delay i.e. no buffer delays should be there. Real-time OS is a time-sharing system that is based on the concept of clock interrupt. So, whenever you want to process a

large number of request in a very short period of time, then you should use Real-time Operating System. For example, the details of the temperature of the petroleum industry are very crucial and this should be done in real-time and in a very short period of time. A small delay can result in a life-death situation. So, this is done with the help of Real-time Operating System. There are two types of Real-time Operating System:

1. **Hard Real-time:** In this type, a small delay can lead to drastic change. So, when the time constraint is very important then we use the Hard Real-time.
2. **Soft Real-time:** Here, the time constraint is not that important but here also we are dealing with some real-time data.

Advantages:

1. There is maximum utilization of devices and resources. These systems are almost error-free.

Disadvantages:

1. The algorithms used in Real-time Operating System is very complex.
2. Specific device drivers are used for responding to the interrupts as soon as possible.

Example of real time OS:-

- **Radar systems, network switching control systems, satellite monitoring systems, satellite launch-control and maneuvering mechanisms, global positioning systems all have their roots in RTOS.**
- **Now a days RTOS are increasingly finding use in strategic and military operations. These are used in guided missile launching units, track-and-trace spy satellites, etc.**

6. Network operating System

A Network Operating System runs on a server and provides the server the capability to manage data, users, groups, security, applications, and other networking functions. The primary purpose of the network operating system is to allow shared file and printer access among multiple computers in a network, typically a local area network (LAN), a private network or to other networks.

Examples of network operating systems include Microsoft Windows Server 2003, Microsoft Windows Server 2008, UNIX, Linux, Mac OS X, Novell NetWare, and BSD.

The advantages of network operating systems are as follows −

- Centralized servers are highly stable.
- Security is server managed.
- Upgrades to new technologies and hardware can be easily integrated into the system.

- Remote access to servers is possible from different locations and types of systems.

The disadvantages of network operating systems are as follows −

- High cost of buying and running a server.
- Dependency on a central location for most operations.
- Regular maintenance and updates are required.

Examples of network OS: Windows 2000, Linux, Microsoft windows, etc.

Multiprogramming

Definition: Multiprogramming OS is an ability of an operating system that executes more than one program using a single processor machine. More than one task or program or jobs are present inside the main memory at one point of time.

Buffering and spooling can overlap I/O and CPU tasks to improve the system performance but it has some limitations that a single user cannot always keep CPU or I/O busy all the time. To increase resource utilization, multiprogramming approaches. The OS could pick and start the execution of one of the jobs in memory, whenever the jobs does not need CPU that means the job is working with I/O at that time the CPU is idle at that time the OS switches to another job in memory and CPU executes a portion of it till the job issues a request for I/O and so on.

Let's P1 and P2 are two programs present in the main memory. The OS picks one program and starts executing it. During execution if the P1 program requires I/O operation, then the OS will simply switch over to P2 program. If the p2 program requires I/O then again it switches to P3 and so on. If there is no other program remaining after P3 then the CPU will pass its control back to the previous program.

Advantages

The advantages of multiprogramming operating system are as follows −

- CPU utilization is high because the CPU is never goes to idle state.
- Memory utilization is efficient.
- CPU throughput is high and also supports multiple interactive user terminals.

Disadvantages

The disadvantages of multiprogramming operating system are as follows −

- CPU scheduling is compulsory because lots of jobs are ready to run on CPU simultaneously.
- User is not able to interact with jobs when it is executing.
- Programmers also cannot modify a program that is being executed.

Note: If several jobs are ready in main memory and if there is not enough space for all of them, then the system has to choose them by making a decision, this process is called job scheduling. When the OS selects a job from the group of jobs and loads that job into memory for execution, therefore it needs memory management, if several such jobs are ready then it needs CPU scheduling.

Operating System Services:-

An Operating System provides services to both the users and to the programs.

- It provides programs an environment to execute.
- It provides users the services to execute the programs in a convenient manner.

Following are a few common services provided by an operating system −

- Program execution
- I/O operations
- File System manipulation
- Communication
- Error Detection
- Resource Allocation
- Protection

Program execution:-

Operating systems handle many kinds of activities from user programs to system programs like printer spooler, name servers, file server, etc. Each of these activities is encapsulated as a process.

A process includes the complete execution context (code to execute, data to manipulate, registers, OS resources in use). Following are the major activities of an operating system with respect to program management −

- 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.

I/O Operation:-

An I/O subsystem comprises of I/O devices and their corresponding driver software. Drivers hide

the peculiarities of specific hardware devices from the users. 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.

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. These directories may contain files and other directions. Following are the major activities of an operating 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.

Communication:-

In case of distributed systems which are a collection of processors that do not share memory, peripheral devices, or a clock, the operating system manages communications between all the processes. Multiple processes communicate with one another through communication lines in the network.

The OS handles routing and connection strategies, and the problems of contention and security. 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 are connected through a computer network.
- Communication may be implemented by two methods, either by Shared Memory or by Message Passing.

Error handling:-

Errors can occur anytime and anywhere. An error may occur in CPU, in I/O devices or in the memory

hardware. Following are the major activities of an operating system with respect to errorhandling −

- The OS constantly checks for possible errors.
- The OS takes an appropriate action to ensure correct and consistent computing.

Resource Management:-

In case of multi-user or multi-tasking environment, resources such as main memory, CPU cycles and files storage are to be allocated to each user or job. Following are the major activities of an operating system with respect to resource management −

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

Protection:-

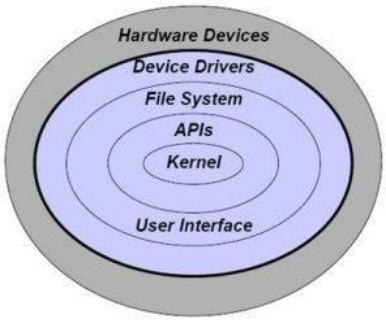
Considering a computer system having multiple users and concurrent execution of multiple processes, the various processes must be protected from each other's activities.

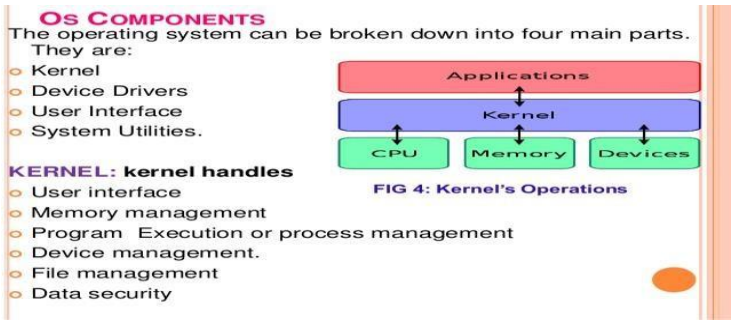
Protection refers to a mechanism or a way to control the access of programs, processes, or users to the resources defined by a computer system. Following are the major activities of an operating system with respect to protection −

- The OS ensures that all access to system resources is controlled.
- The OS ensures that external I/O devices are protected from invalid access attempts.
- The OS provides authentication features for each user by means of passwords.

Components of Operating System:-

The components of an operating system play a key role to make a variety of computer system parts work together. The operating components are discussed below.





Kernel

The kernel in the OS provides the basic level of control on all the computer peripherals. In the operating system, the kernel is an essential component that loads firstly and remains within the main memory. So that memory accessibility can be managed for the programs within the RAM, it creates the programs to get access from the hardware resources. It resets the operating states of the CPU for the best operation at all times.

Process Execution

The OS gives an interface between the hardware as well as an application program so that the program can connect through the hardware device by simply following procedures & principles configured into the OS. The program execution mainly includes a process created through an OS kernel that uses memory space as well as different types of other resources.

Interrupt

In the operating system, interrupts are essential because they give a reliable technique for the OS to communicate & react to their surroundings. An interrupt is nothing but one kind of signal between a device as well as a computer system otherwise from a program in the computer that requires the OS to leave and decide accurately what to do subsequently. Whenever an interrupt signal is received, then the hardware of the computer puts on hold automatically whatever computer program is running presently, keeps its status & runs a computer program which is connected previously with the interrupt.

Memory Management

The functionality of an OS is nothing but memory management which manages main memory & moves processes backward and forward between disk & main memory during implementation. This tracks each & every memory position; until it is assigned to some process otherwise it is open. It verifies how much memory can be allocated to processes and also makes a decision to know

which process will obtain memory at what time. Whenever memory is unallocated, then it tracks correspondingly to update the status. Memory management work can be divided into three important groups like memory management of hardware, OS and application memory management.

Multitasking

It describes the working of several independent computer programs on a similar computer system. Multitasking in an OS allows an operator to execute one or more computer tasks at a time. Since many computers can perform one or two tasks at a time, usually this can be done with the help of time-sharing, where each program uses the time of a computer to execute.

Networking

Networking can be defined as when the processor interacts with each other through communication lines. The design of communication-network must consider routing, connection methods, safety, the problems of opinion & security.

Presently most of the operating systems maintain different networking techniques, hardware, & applications. This involves that computers that run on different operating systems could be included in a general network to share resources like data, computing, scanners, printers, which uses the connections of either wired otherwise wireless.

Security

If a computer has numerous individuals to allow the immediate process of various processes, then the many processes have to be protected from other activities. This system security mainly depends upon a variety of technologies that work effectively. Current operating systems give an entry to a number of resources, which are obtainable to work the software on the system, and to external devices like networks by means of the kernel. The operating system should be capable of distinguishing between demands which have to be allowed for progressing & others that don't need to be processed. Additionally, to permit or prohibit a security version, a computer system with a high level of protection also provides auditing options. So this will allow monitoring the requests from accessibility to resources

User Interface

A GUI or user interface (UI) is the part of an OS that permits an operator to get the information. A user interface based on text displays the text as well as its commands which are typed over a

command line with the help of a keyboard.

The OS-based applications mainly provide a specific user interface for efficient communication. The main function of a user interface of an application is to get the inputs from the operator & to provide o/ps to the operator. But, the sorts of inputs received from the user interface as well as the o/p types offered by the user interface may change from application to application. The UI of any application can be classified into two types namely GUI (graphical UI) & CLI (command line user interface).

Thus, this is all about an overview of an operating system. The main components of an OS mainly include kernel, API or application program interface, user interface & file system, hardware devices and device drivers.

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