

Introduction to operating system

Date: _____

Page: _____

(*) Operating system is a system software that works as an interface between a user and computer hardware. It control and manages the computer hardware, software resources and provide common services for computer program. It creates an interface between user and system which provides or helps to run program or application.

An operating system acts like a government. An operating system performs no useful function by itself. Though it provides an environment with which other programs can do useful work.

(*) Four components of operating system

- (i) Computer hardware consists of CPU, the memory, I/O devices and it provides the basic computing resources for the system.
- (ii) The Application programs like spreadsheets, web browsers, word processor, etc. are used to define the ways in which these resources are used to solve the computing problem of the user. And the system program mainly consists of compilers, editors, etc.
- (iii) The operating system is mainly used to control the hardware and coordinate its use among the various application programs for the different users.
- (iv) User

It is mainly designed in order to serve two basic purposes:-

- (i) The OS mainly controls the allocation and the use

computer system's resources.

- (ii) It mainly provides an interface between computer hardware and the programmer that simplifies and makes feasible for coding / creation of application programs.

(*) Two views of the operating system

(i) Operating system as an Extended Machine or Virtual Machine (or AI & User/Computer Interface)

⇒ The operating system masks or hides the details of the hardware from the programmer and general users and provides a convenient interface for using the system. It supports abstraction. The program that hides the truth about the hardware from the user and presents a nice simple view of named files that can be read and written. It hides the implementation details from the user.

Operating system as a Resource manager

⇒ A computer system has many resources. Modern computers consist of processor, memories, timers, disks, mice, network, printers, and a wide variety of other devices. In the alternative view the job of the OS is to provide for an orderly and control allocation of processor, memories and I/O devices. It separates the work between different devices but doesn't performed by OS itself.

(X) Types of operating system:

- Batch operating system \rightarrow Some computer processes are very long and time-consuming. To speed the same process, a job with a similar type of needs is batched together and run as a group. The user of a batch operating system never directly interacts with the computer.
- Multi-Tasking / Time sharing operating system \rightarrow Time sharing operating system enables people located at a different terminal (shell) to use a single computer system at the same time.
- Real Time OS \rightarrow A real time OS time interval to process and respond to inputs is very small. Examples: Military systems, space software system are the real time OS.
- Distributed operating system \rightarrow They use many processors located in different machines to provide very fast compute to its users.
- Network OS \rightarrow Network operating system runs on a server. It provides the capability to serve to manage data, user, groups, security, application, and other networking functions.
- Mobile OS \rightarrow Mobile OS are those OS which is especially that are designed to power smartphones, tablets and wearable devices.

Functions of an operating system are as follows:

- (i) Memory Management
- (ii) Processor Management
- (iii) Device Management
- (iv) File Management

- (vi) Security
- (vii) Control over system performance
- (viii) Job Accounting
- (ix) Error detection & Response
- (x) Booting the computer
- (xi) Coordination between other software and user

Advantages:

- (i) Easy to use with GUI.
- (ii) Allows you to hide details by creating an abstraction.
- (iii) It provides the computer system resources with easy to format.
- (iv) Acts as an intermediary between all hardware's and software's of the system.

Disadvantages of OS

- It is never entirely secure system / system software
- Complexity.
- Expensive.
- Virus Threats
- Difficult to use for new users.

- (*) Why is OS very important in the computer system?
- (*) Describe briefly that OS act as resource manager.
- (*) OS is known as extended machine. Why?

(i) Kernel in OS → The kernel is ^{the} central component of OS. The only job performed by the kernel is to manage the communication between software and hardware. We can say that kernel acts as nucleus of computer. Kernel is the innermost part of OS and shell is the outermost part.

(ii) Features of kernel:

(i) Low level scheduling of process.

(ii) Inter process communication

(iii) Process synchronization

(iv) Context switching.

(v) Kernel mode and User Mode:

→ They are certain instructions that need to be executed by kernel only. i.e., the CPU executes these instructions in the kernel mode only. Example: For example memory management should be done in kernel mode only. While in the user mode CPU executes the process that are given by the user in the given space.

Types of kernel:

Initially there are 6 types of kernel. They are:

(i) Monolithic kernel → In such kernel, the user services and the kernel services are implemented in the same memory.

(ii) Micro kernel → In such kernel, the user services and kernel services are implemented in different separated memory.

(*) Structure of Operating System.

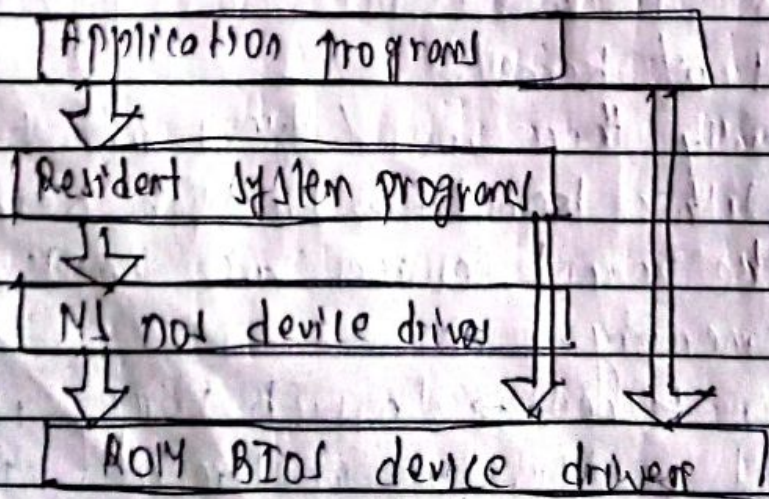
- (i) Simple Structure \Rightarrow Such operating systems do not have well defined structure are small, simple and limited system. The interface of functionality are not well separated. MS-DOS is an example of such OS. These type of OS cause the entire system to crash if one of the user programs fails. The interface of functionality may overlap each other.

(*) Advantages:-

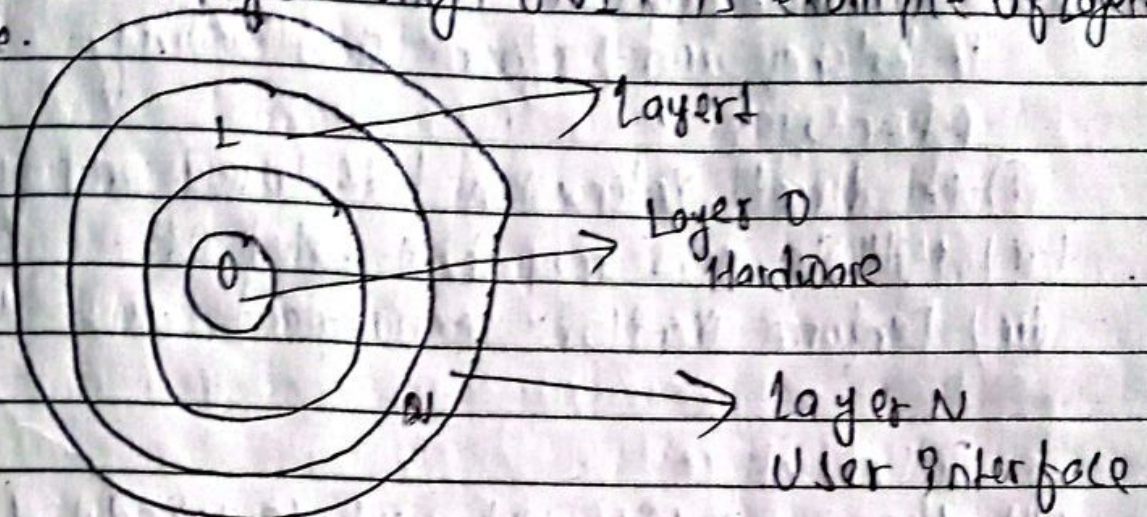
- (i) It is easy to develop because of the limited number of interface and layers.
- (ii) offers good performance due to less layers between hardware and applications.

(*) Disadvantage

- If one user program fails, then entire OS crashes.
- Abstraction or data hiding is not present. All layers are connected and communicate with each other.
- No clear boundaries exist, so some times overlapping occurs.



(2) Layered structure \Rightarrow This structure breaks up OS into different layers. In layered structure approach, the bottom layer is hardware, while the highest layer is user interface. These layers are designed that each layer uses the functions of the lower-level layers only. UNIX is an example of layered structure.



Advantages of Layered Structure

- i) It is very easy to perform debugging and system verification.
- ii) Implementation of a layer can be changed without affecting other layers.
- iii) Functionalities of each layer are isolated, and abstraction is also available.

Disadvantages:-

- (i) In layered structure, layer causes degradation of performance.
- ii) It requires careful planning for designing the layers as higher layers use the functionalities of lower layers.

(2/11)

(X) Batch Operating System

⇒ Batch OS doesn't interact directly with the computer systems. Each user performs their tasks on a offline service, such as punch card, and submits it to the system. Jobs with similar requirement are grouped together in batches and perform simultaneously.

Advantages

- (i) No direct interaction betw user and system
- (ii) Multiple users may share batch OS.
- (iii) Perform similar requirement work simultaneously

Disadvantages

- (i) If a job fails, it must be scheduled for completion which may take time.
- (ii) If a task goes to infinite loop, subsequent jobs will have to wait for an indeterminate amount of time.
- (iii) Difficult to troubleshoot.

(X) Multiprogramming / Time sharing OS ⇒ Time sharing OS is a type of OS in which the user can perform more than one task and each task gets some amount of time to execute. It is also called multiprogramming OS.

Working

- When the user performs more than one task, each process (CPU) time is divided.
- For example if there are processes P_1, P_2, P_3 running on the system. Suppose the time quantum is fixed to 4.

Then P1 will execute first for 4ms of the given process P2 starts executing for 4ms and when P2 is executed for 4ms then process P3 executes for 4ms. Example time

Advantages

- (i) Provides the advantage of quick response
- (ii) Avoids duplication of software
- (iii) Reduces CPU idle time

Disadvantages:

- (i) Problem of reliability
- (ii) Problem of data communication
- (iii) Chance of mixing data during fast switching between the process.

(*) Real Time OS \Rightarrow Real Time Operating Systems (RTOS) are used in environments where a large number of events, mostly external to system, must be accepted and processed in a short time or within certain deadline. Such applications are industrial control, telephone switching, flight control, real time simulation. This system has time bound and has a fixed deadline.

Advantages

- Maximum utilization of device and system. Thus more output from all the resources.
- Time assigned for shifting tasks is very less.
- Focus on running applications and less focus on queue applications.
- Memory allocation is better managed and error free.

Disadvantages

- \Rightarrow very few tasks run simultaneously \Rightarrow complex algorithms
- \Rightarrow use heavy system resources \Rightarrow device drivers from

Kernel Types continue ↓

(iii) Hybrid - kernel → It is a combination of both monolithic kernel and micro kernel. It makes the use of the speed of monolithic kernel and modularity of micro kernel.

(iv) Nano kernel → In Nano kernel, the whole code of the kernel is very small. The term Nano kernel is used to describe a kernel that supports nano kernel clock resolution.

(v) Exo kernel → In this type of kernel, resource protection is separated from the management and this in turn results in the allowing us to perform application specific customization. Here, the idea is not implement all the abstraction but the idea is then implement few abstraction as possible and can be used when needed.

(vi) Macro kernel → Macro kernel is a special OS core that provides multiple and high end services to both the user and system and is generally used in the super computer and highend processing equipments.

Client - server Model → The client-server model is a distributed application structure that partitions task or work load between the providers of a resource or service called servers and service requesters called clients. In CS architecture, when the client computer sends requests for data to the server through the Internet, the server accepts the requested process and delivers the data packets requested back to the client.