Unit–I

Operating system

An operating system (OS) is the program that, after being initially loaded into the computer by a boot program, manages all the other programs in a computer. The other programs are called applications or application programs. The application programs make use of the operating system by making requests for services through a defined application program interface (API). In addition, users can interact directly with the operating system through a user interface such as a command line or a graphical user interface (GUI).

BIOS (basic input/output system) is the program a personal computer's microprocessor uses to get the computer system started after you turn it on. It also manages data flow between the computer's operating system and attached devices such as the hard disk, video adapter, keyboard, mouse and printer.

BIOS is a program that is made accessible to the microprocessor on an erasable programmable read-only memory (EPROM) chip. When you turn on your computer, the microprocessor passes control to the BIOS program, which is always located at the same place on EPROM.

When BIOS boots up (starts up) your computer, it first determines whether all of the attachments are in place and operational. Then, it loads the operating system (or key parts of it) into your computer's random access memory (RAM) from your hard disk or diskette drive.

An operating system performs these services for applications:

- In a multitasking operating system, where multiple programs can be running at the same time, the operating system determines which applications should run in what order and how much time should be allowed for each application before giving another application a turn.
- It manages the sharing of internal memory among multiple applications.
- It handles input and output to and from attached hardware devices, such as hard disks, printers, and dial-up ports.
- It sends messages to each application or interactive user about the status of operation and any errors that may have occurred.
- It can offload the management of what are called batch jobs (for example, printing) so that the initiating application is freed from this work.
- On computers that can provide parallel processing, an operating system can manage how to divide the program so that it runs on more than one processor at a time.

All major computer platforms (hardware and software) require an operating system, and operating systems must be developed with different features to meet the specific needs of various form factors.

Common desktop operating systems:

- **Windows** is Microsoft's flagship operating system. Introduced in 1985, the GUI-based OS has been released in many versions since then. The user-friendly Windows 95 was largely responsible for the rapid development of personal computing.
- **Mac OS** is the operating system for Apple's Macintosh line of personal computers and workstations.
- **Linux** is a Unix-like operating system that was designed to provide personal computer users a free or very low-cost alternative. Linux has a reputation as a very efficient and fast-performing system.
- A mobile OS allows smartphones, tablet PCs and other mobile devices to run applications and programs. Mobile operating systems include **Apple iOS, Google Android, BlackBerry OS and Windows 10 Mobile**.
- An **embedded operating system** is specialized for use in the computers built into larger systems, such as cars, traffic lights, digital televisions, ATMs, airplane controls, point of sale (POS) terminals, digital cameras, GPS navigation systems, elevators, digital media receivers and smart meters.

Simple batch system

- A batch system is when a computer is programmed to batch together a number of transactions for processing at a specific time.
- For example a bank may run batch jobs to update all payments into customer accounts at midnight, 3am and 5am. In fact a lot of banks actually do this and it explains why you spend money on your account but it is not reflected at the hole in the wall/cash machine statement instantly.
- The main idea behind this is to save processing time and resource so these are available for more urgent transactions that need to be processed quicker.
- The operator .batched similar jobs together and then ran in the computer to speed up the processing.
- The resources are utilized and jobs are performed more efficiently with the help of job scheduling.
- Job scheduling is possible because all jobs are present on the disk.

- The memory contains operating system in one part and user program in other part.
- The user space can contain only one process at a time in batch systems.
- Digital equipment VMS is an example of a batch operating system.

The users of a batch operating system do not interact with the computer directly. Each user prepares his job on an off-line device like punch cards and submits it to the computer operator. To speed up processing, jobs with similar needs are batched together and run as a group. The programmers leave their programs with the operator and the operator then sorts the programs with similar requirements into batches.

Problems with Batch Systems are as follows –

- Lack of interaction between the user and the job.
- CPU is often idle, because the speed of the mechanical I/O devices is slower than the CPU.
- Difficult to provide the desired priority.

Time sharing system

- Time-sharing is a technique which enables many people, located at various terminals, to use a particular computer system at the same time.
- Time-sharing or multitasking is a logical extension of multiprogramming.
- Processor's time which is shared among multiple_users simultaneously is termed as time-sharing.
- The main difference between Multiprogrammed Batch Systems and Time-Sharing Systems is that in case of Multiprogrammed batch systems, the objective is to maximize processor use, whereas in Time-Sharing Systems, the objective is to minimize response time.
- Multiple jobs are executed by the CPU by switching between them, but the switches occur so frequently. Thus, the user can receive an immediate response.

Example - in a transaction processing, the processor executes each user program in a short burst or quantum of computation. That is, if n users are present, then each user can get a time quantum. When the user submits the command, the response time is in few seconds at most.

- The operating system uses CPU scheduling and multiprogramming to provide each user with a small portion of a time.

Advantages of Time-sharing operating systems are as follows –

- Provides the advantage of quick response.

- Avoids duplication of software.
- Reduces CPU idle time.

Disadvantages of Time-sharing operating systems are as follows –

- Problem of reliability.
- Question of security and integrity of user programs and data.
- Problem of data communication.

Real Time System

- A real-time system is defined as a data processing system in which the time interval required to process and respond to inputs is so small that it controls the environment.
- The time taken by the system to respond to an input and display of required updated information is termed as the **response time**. So in this method, the response time is very less as compared to online processing.
- Real-time systems are used when there are rigid time requirements on the operation of a processor or the flow of data.
- A real-time operating system must have well-defined, fixed time constraints, otherwise the system will fail.

Example - Scientific experiments, medical imaging systems, industrial control systems, weapon systems, robots, air traffic control systems, etc.

Types of real-time operating systems:

1) **Hard real-time systems**

- Hard real-time systems guarantee that critical tasks complete on time.
- In hard real-time systems, secondary storage is limited or missing and the data is stored in ROM.
- In these systems, virtual memory is almost never found.

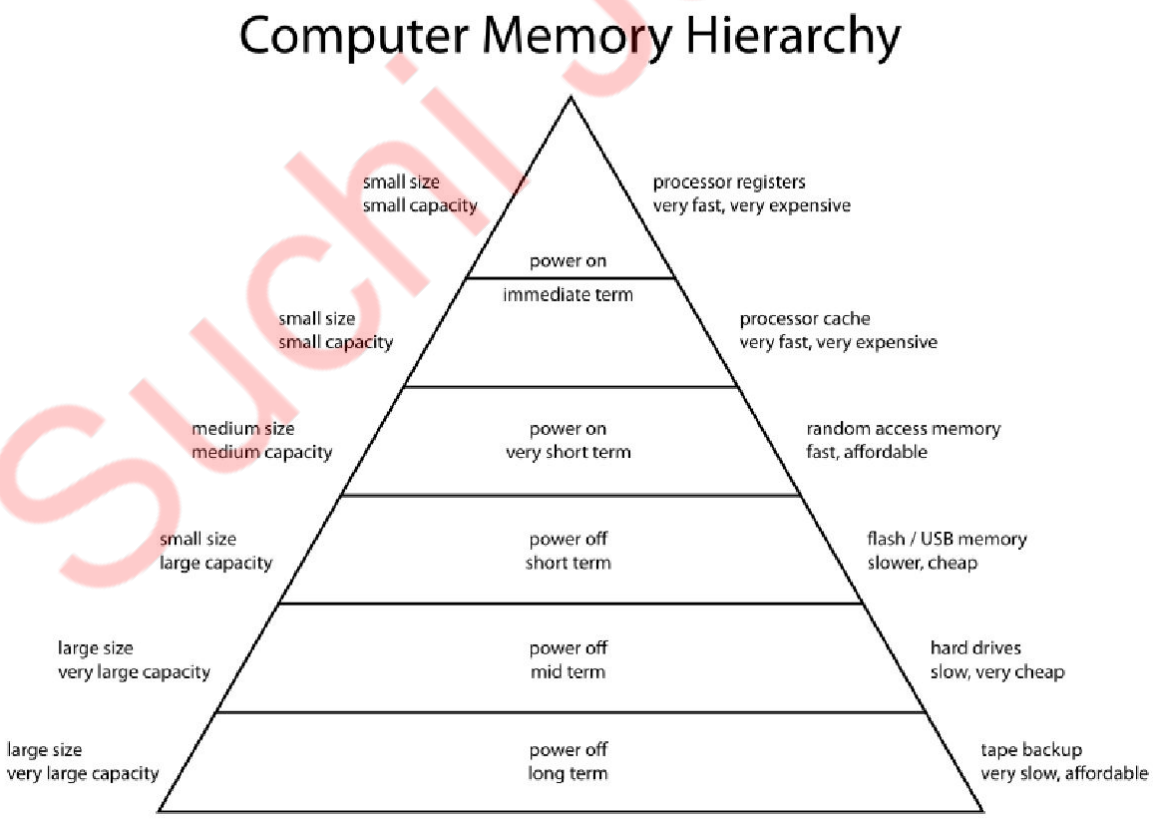
2) **Soft real-time systems**

- Soft real-time systems are less restrictive.
- A critical real-time task gets priority over other tasks and retains the priority until it completes.
- Soft real-time systems have limited utility than hard real-time systems.

Example - multimedia, virtual reality, Advanced Scientific Projects like undersea exploration and planetary rovers, etc.

Storage hierarchy

- In computer architecture, the memory hierarchy separates computer storage into a hierarchy based on response time.
- Since response time, complexity, and capacity are related, the levels may also be distinguished by their performance and controlling technologies.
- Designing for high performance requires considering the restrictions of the memory hierarchy, i.e. the size and capabilities of each component.
- Each of the various components can be viewed as part of a hierarchy of memories (m1,m2,...,mn) in which each member mi is typically smaller and faster than the next highest member mi+1 of the hierarchy.
- To limit waiting by higher levels, a lower level will respond by filling a buffer and then signaling to activate the transfer.



There are four major storage levels:

Internal – Processor registers and cache.
Main – the system RAM and controller cards.
On-line mass storage – Secondary storage.
Off-line bulk storage – Tertiary and Off-line storage.

Note: This is a general memory hierarchy structuring. Many other structures are useful such as a paging algorithm, etc.

Operating system service

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***
  - 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 operations***
  - 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***
  - OS helps when 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***
    - 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 Detection***
    - The OS constantly checks for possible errors.
    - The OS takes an appropriate action to ensure correct and consistent computing.

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

- ***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.