Unit I

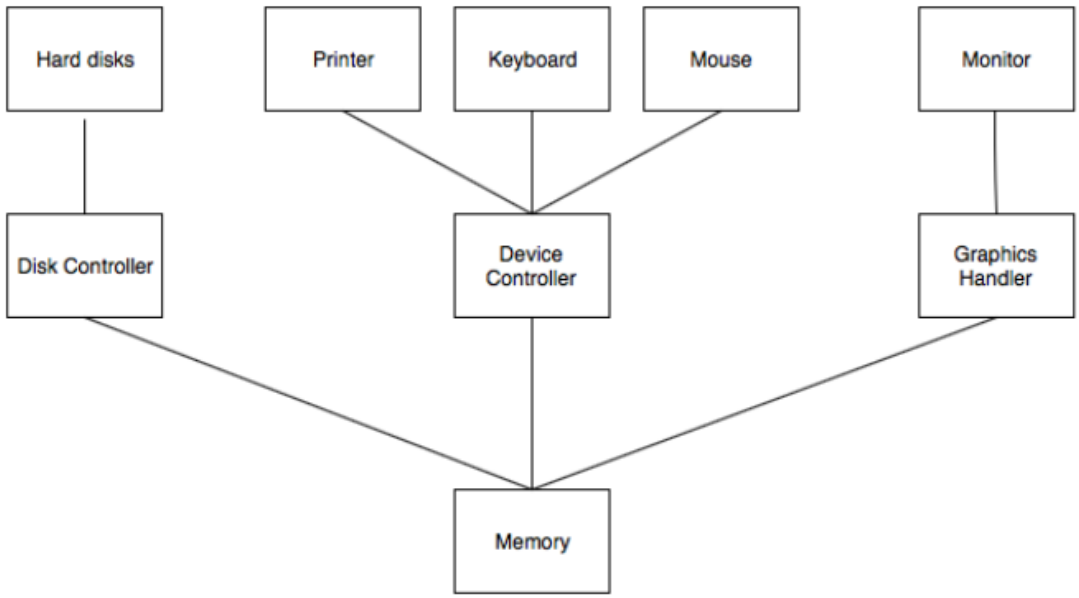
Operating system basics

Operating System:

- An **operating system** is a program that manages a computer's hardware.
- It also provides a basis for application programs and acts as an intermediary between the computer user and the computer hardware.

Computer System Organisation:

The computer system is a combination of many parts such as peripheral devices, secondary memory, CPU etc.

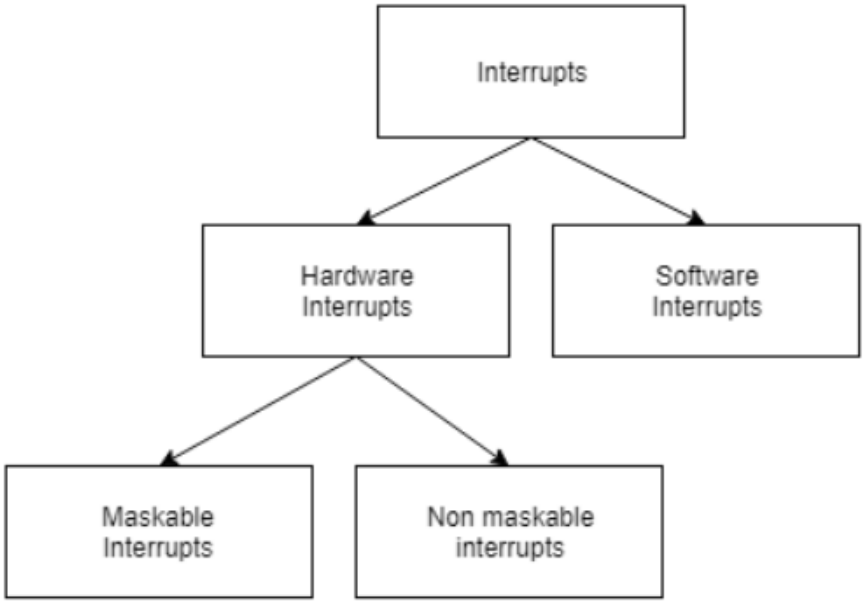


The salient points about the above figure displaying Computer System Organisation is −

- **The I/O devices and the CPU both execute concurrently. Some of the processes are scheduled for the CPU and at the same time, some are undergoing input/output operations.**
- **There are multiple device controllers, each in charge of a particular device such as keyboard, mouse, printer etc.**
- **There is buffer available for each of the devices. The input and output data can be stored in these buffers.**
- **The data is moved from memory to the respective device buffers by the CPU for I/O operations and then this data is moved back from the buffers to memory.**
- **The device controllers use an interrupt to inform the CPU that I/O operation is completed.**

Interrupt Handling:

- An interrupt is a necessary part of Computer System Organisation as it is triggered by hardware and software parts when they need immediate attention.
- An interrupt can be generated by a device or a program to inform the operating system to halt its current activities and focus on something else. The types of interrupts are better explained using the following diagram −



- Hardware and software interrupts are two types of interrupts. Hardware interrupts are triggered by hardware peripherals while software interrupts are triggered by software function calls.
- Hardware interrupts are of further two types. Maskable interrupts can be ignored or disabled by the CPU while this is not possible for non maskable interrupts.

Computer-System Architecture:

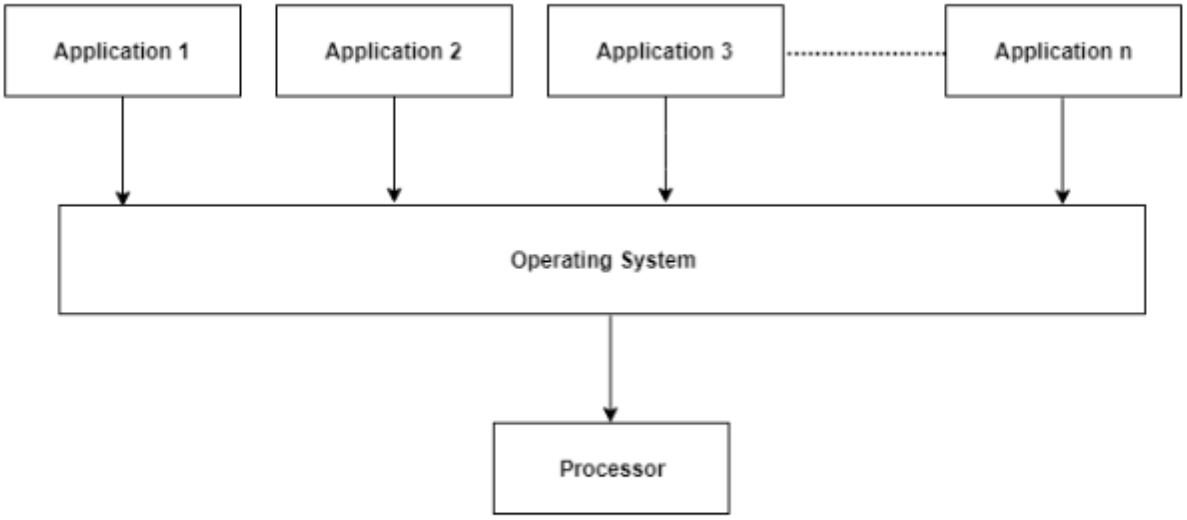
- In the general structure of a typical computer system.
- A computer system can be organized in a number of different ways, which we can categorize roughly according to the number of general-purpose processorsused.

Single-Processor Systems :

- A single processor system contains only one processor. So only one process can be executed at a time and then the process is selected from the ready

queue. Most general purpose computers contain the single processor systems as they are commonly in use.

A single processor system can be further described using the diagram below −



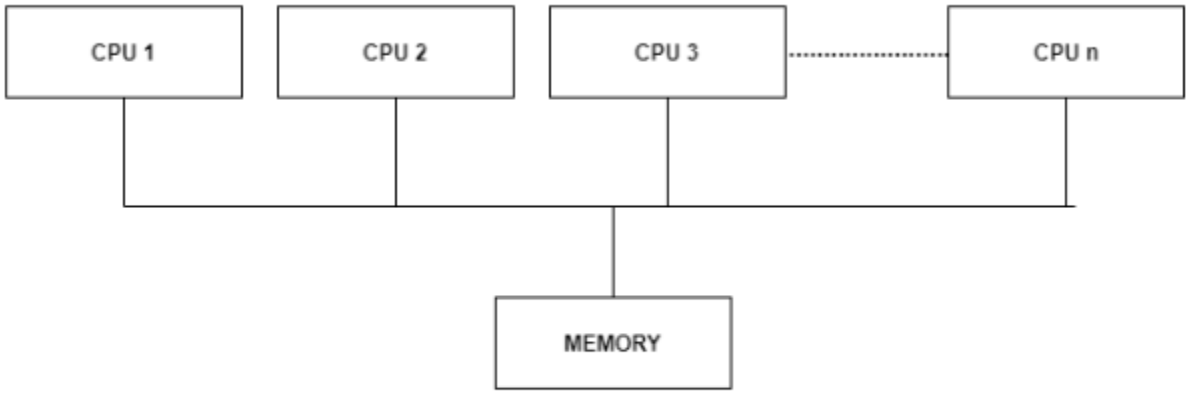
Single Processor System

As in the above diagram, there are multiple applications that need to be executed. However, the system contains a single processor and only one process can be executed at a time.

Multiprocessor Systems:

- Most computer systems are single processor systems i.e they only have one processor. However, multiprocessor or parallel systems are increasing in importance nowadays. These systems have multiple processors working in parallel that share the computer clock, memory, bus, peripheral devices etc.

An image demonstrating the multiprocessor architecture is –



Multiprocessing Architecture

Types of Multiprocessors

There are mainly two types of multiprocessors i.e. symmetric and asymmetric multiprocessors. Details about them are as follows −

Symmetric Multiprocessors

- In these types of systems, each processor contains a similar copy of the operating system and they all communicate with each other. All the processors are in a peer to peer relationship i.e. no master - slave relationship exists between them.
- An example of the symmetric multiprocessing system is the Encore version of Unix for the Multimax Computer.

Asymmetric Multiprocessors

- In asymmetric systems, each processor is given a predefined task. There is a master processor that gives instruction to all the other processors. Asymmetric multiprocessor system contains a master slave relationship.
- Asymmetric multiprocessor was the only type of multiprocessor available before symmetric multiprocessors were created. Now also, this is the cheaper option.

Advantages of Multiprocessor Systems

There are multiple advantages to multiprocessor systems. Some of these are :

- More reliable Systems
- Enhanced Throughput
- More Economic Systems

Disadvantages of Multiprocessor Systems

There are some disadvantages as well to multiprocessor systems. Some of these are:

- Increased Expense
- Complicated Operating System Required
- Large Main Memory Required

OPERATING SYSTEM STRUCTURE:

One of the most important aspects of operating systems is the ability to multiprogram. A single program cannot, in general, keep either the CPU or the I/O devices busy at all times. Single users frequently have multiple programs running. Multiprogramming increases CPUutilization by organizing jobs (code and data) so that the CPU always has one to execute.

The operating system keeps several jobs in memory simultaneously . Since, in general, main memory is too small to accommodate all jobs, the jobs are kept initially on the disk in the job pool.This pool consists of all processes residing on disk awaiting allocation of main memory.

Multiprogrammed systems provide an environment in which the various system resources (for example, CPU, memory, and peripheral devices) are utilized effectively, but they do not provide for user interaction with the computer system.

Time sharing requires an interactive computer system, which provides direct communication between the user and the system. The user gives instructions to the operating system or to a program directly, using a input device such as a keyboard, mouse, touch pad, or touch screen, and waits for immediate results on an output device. Accordingly, the response time should be short—typically less than one second.

Time sharing and multiprogramming require that several jobs be kept simultaneously in memory. If several jobs are ready to be brought into memory, and if there is not enough room for all of them, then the system must choose among them.

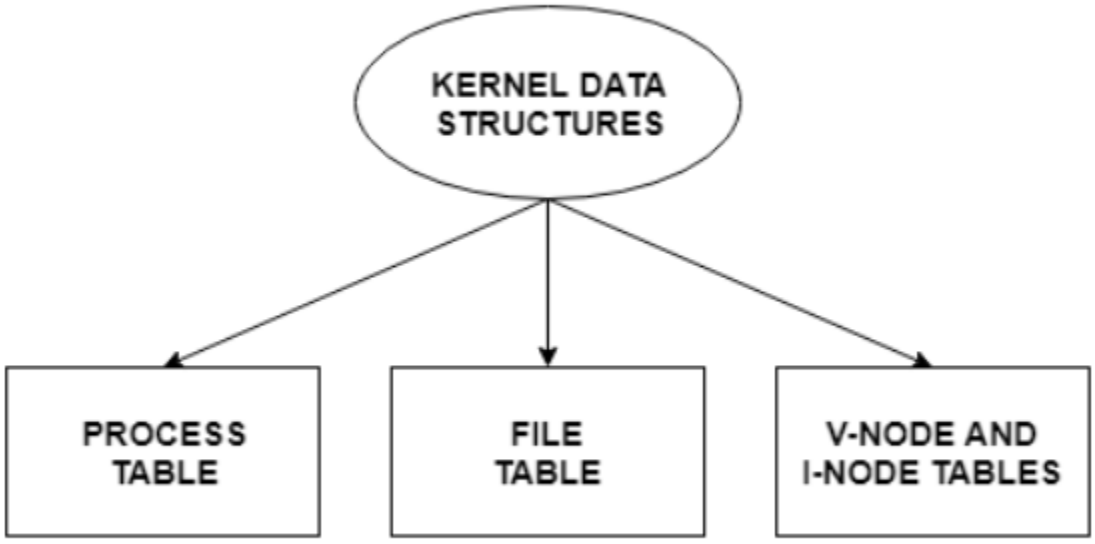
Kernel Data Structures:

The kernel data structures are very important as they store data about the current state of the system. For example, if a new process is created in the system, a kernel data structure is created that contains the details about the process.

Most of the kernel data structures are only accessible by the kernel and its subsystems. They may contain data as well as pointers to other data structures.

✓ Kernel Components

The kernel stores and organizes a lot of information. So it has data about which processes are running in the system, their memory requirements, files in use etc. To handle all this, three important structures are used. These are process table, file table and v node/ i node information.



Details about these are as follows:

✓ Process Table

The process table stores information about all the processes running in the system. These include the storage information, execution status, file information etc.

When a process forks a child, its entry in the process table is duplicated including the file information and file pointers. So the parent and the child process share a file.

✓ File Table

The file table contains entries about all the files in the system. If two or more processes use the same file, then they contain the same file information and the file descriptor number.

Each file table entry contains information about the file such as file status (file read or file write), file offset etc. The file offset specifies the position for next read or write into the file.

The file table also contains v-node and i-node pointers which point to the virtual node and index node respectively. These nodes contain information on how to read a file.

✓ V-Node and I-Node Tables

Both the v-node and i-node are references to the storage system of the file and the storage mechanisms. They connect the hardware to the software.

The v-node is an abstract concept that defines the method to access file data without worrying about the actual structure of the system. The i-node specifies file access information like file storage device, read/write procedures etc.

System Call:

- In computing, a system call is the programmatic way in which a computer program requests a service from the kernel of the operating system it is executed on.
- A system call is a way for programs to interact with the operating system. A computer program makes a system call when it makes a request to the operating system's kernel.
- System call provides the services of the operating system to the user programs via Application Program Interface(API). It provides an interface between a process and operating system to allow user-level processes to request services of the operating system.
- System calls are the only entry points into the kernel system. All programs needing resources must use system calls.

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

Computing Environments:

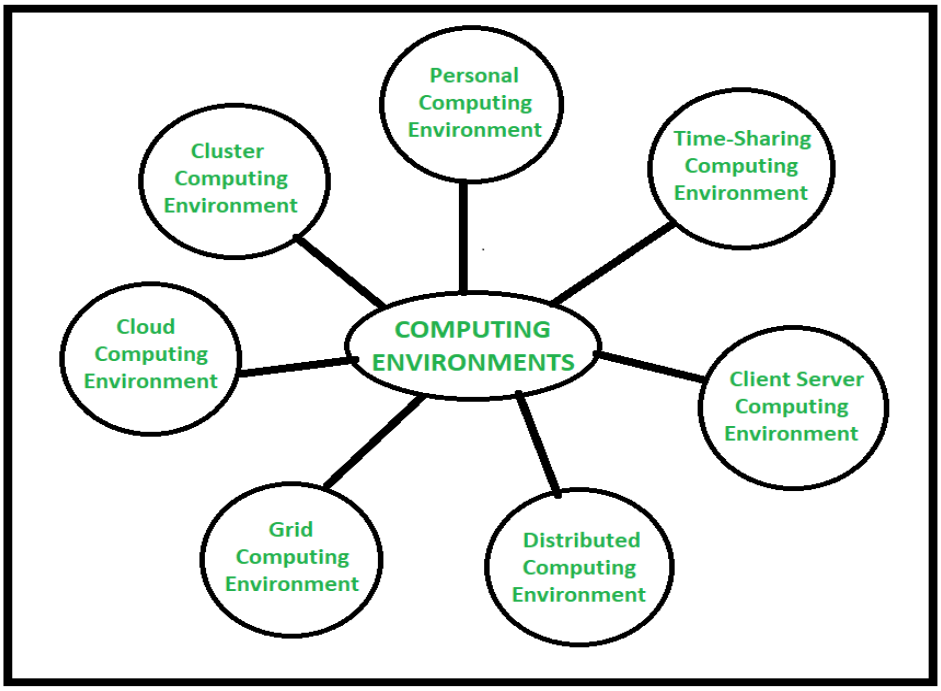
Computing Environments :

- When a problem is solved by the computer, during that computer uses many devices, arranged in different ways and which work together to solve problems.
- This constitutes a computing environment where various number of computer devices arranged in different ways to solve different types of problems in different ways.
- In different computing environments computer devices are arranged in different ways and they exchange information in between them to process and solve problem.
- One computing environment consists of many computers other computational devices, software and networks that to support processing and sharing information and solving task.
- Based on the organization of different computer devices and communication processes there exists multiple types of computing environments.

Now lets know about different types of computing environments.

Types of Computing Environments :

There are the various types of computing environments. They are :



1. **Personal Computing Environment :**

   In personal computing environment there is a stand-alone machine. Complete program resides on computer and executed there. Different stand-alone machines that constitute a personal computing environment are laptops, mobiles, printers, computer systems, scanners etc. That we use at our homes and offices.

2. **Time-Sharing Computing Environment :**

In Time Sharing Computing Environment multiple users share system simultaneously. Different users (different processes) are allotted different time slice and processor switches rapidly among users according to it. For example, student listening to music while coding something in an IDE. Windows 95 and

later versions, Unix, IOS, Linux operating systems are the examples of this time sharing computing environment.

3. **Client Server Computing Environment :**

   In client server computing environment two machines are involved i.e., client machine and server machine, sometime same machine also serve as client and server. In this computing environment client requests resource/service and server provides that respective resource/service. A server can provide service to multiple clients at a time and here mainly communication happens through computer network.

4. **Distributed Computing Environment :**

   In a distributed computing environment multiple nodes are connected together using network but physically they are separated. A single task is performed by different functional units of different nodes of distributed unit. Here different programs of an application run simultaneously on different nodes, and communication happens in between different nodes of this system over network to solve task.

5. **Grid Computing Environment :**

   In grid computing environment, multiple computers from different locations works on single problem. In this system set of computer nodes running in cluster jointly perform a given task by applying resources of multiple computers/nodes. It is network of computing environment where several scattered resources provide running environment for single task.

6. **Cloud Computing Environment :**

   In cloud computing environment on demand availability of computer system resources like processing and storage are availed. Here computing is not done in individual technology or computer rather it is computed in cloud of computers where all required resources are provided by

cloud vendor. This environment primarily comprised of three services i.e software-as-a-service (SaaS), infrastructure-as-a-service (IaaS), and platform-as-a-service (PaaS).

7. **Cluster Computing Environment :**

In cluster computing environment cluster performs task where cluster is a set of loosely or tightly connected computers that work together. It is viewed as single system and performs task parallelly that's why also it is similar to parallel computing environment. Cluster aware applications are especially used in cluster computing environment.

OPEN SOURCE OPERATING SYSTEM:

The term **"open source"** refers to computer software or applications where the owners or copyright holders enable the users or third parties to use, see, and edit the product's source code.

The source code of an open-source OS is publicly visible and editable. The usually operating systems such as Apple's iOS, Microsoft's Windows, and Apple's Mac OS are closed operating systems.

Open-Source Software is licensed in such a way that it is permissible to produce as many copies as you want and to use them wherever you like. It generally uses fewer resources than its commercial counterpart because it lacks any code for licensing, promoting other products, authentication, attaching advertisements, etc.

The open-source operating system allows the use of code that is freely distributed and available to anyone and for commercial purposes. Being an open-source application or program, the program source code of an open-source OS is available. The user may modify or change those codes and develop new applications according to the user requirement.

Some basic examples of the open-source operating systems are **Linux, Open Solaris, Free RTOS, Open BDS, Free BSD, Minix,** etc.

In **1997**, the first Open-Source software was released. Despite the industry, there are now Open-Source alternatives for every Software program. Thanks to technological developments and innovations, many Open-Source Operating Systems have been developed since the dawn of the **21st** century.

Linux lite:

Linux Lite is another free and open-source operating system that can run on lower-end hardware. It is a lightweight operating system designed to help users who are unfamiliar with Linux-based operating systems. The operating system includes all of the required programs, capabilities, tools, and desktops.

Chrome os:

Chrome OS is a partly open-source operating system with various attractive features. It's a part of the Chromium and Linux families, with features including better security, compatibility for supported Android and Chrome apps, Aura windows manager, Google cloud print, integrated media player, virtual desktop access, and cloud-based management. The only issue with the operating

system is that it only supports Nexus devices or its hardware. As a result, if you're a Google fan, you'll love Chrome OS on a Chromebook.

Solaris:

Solaris is the commercial UNIX-based operating system of Sun Microsystems.Originally, Sun's **SunOS** operating system was based on BSD UNIX. Sunmoved to AT&T's System V UNIX as its base in 1991. In 2005, Sun open-sourced most of the Solaris code as the OpenSolaris project. The purchase of Sun by Oracle in 2009, however, left the state of this project unclear.

Advantages and Disadvantages of Open-Source Operating System

Various advantages and disadvantages of the open-source operating system are as follows:

Advantages:

1. Reliable and efficient

The open-source operating systems are most reliable and efficient. Thousands of eyes monitor these because the source code is public. As a result, if there are any bugs or errors, they are fixed by the best developers worldwide.

2. Cost-efficient

Most of the open-source operating systems are free. And some of them are far less expensive than commercially closed products.

3. Flexibility

The great advantage is you may customize it as per your requirement. And there is creative freedom.

Disadvantages:

1. Complicated

It is not as user-friendly as the ones that are closed. To use this software, you must have a basic understanding of technology.

2.Security risk

Despite the defects having been detected, there is a risk of assaults because the attackers have access to the source code.

3. No support

If you run across an issue, there is no customer support available to assist you.