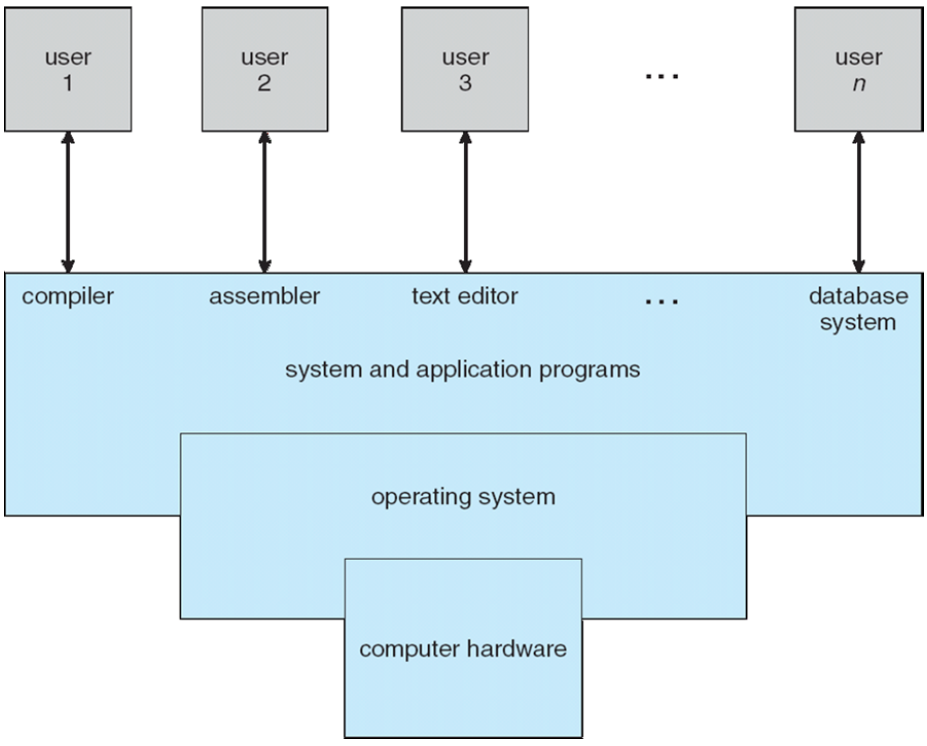
Dr. D. Y. Patil Institute of Management & Entrepreneur Development

Chapter 1 : Overview

★ Computer System Structure

Computer system can be divided into four components:

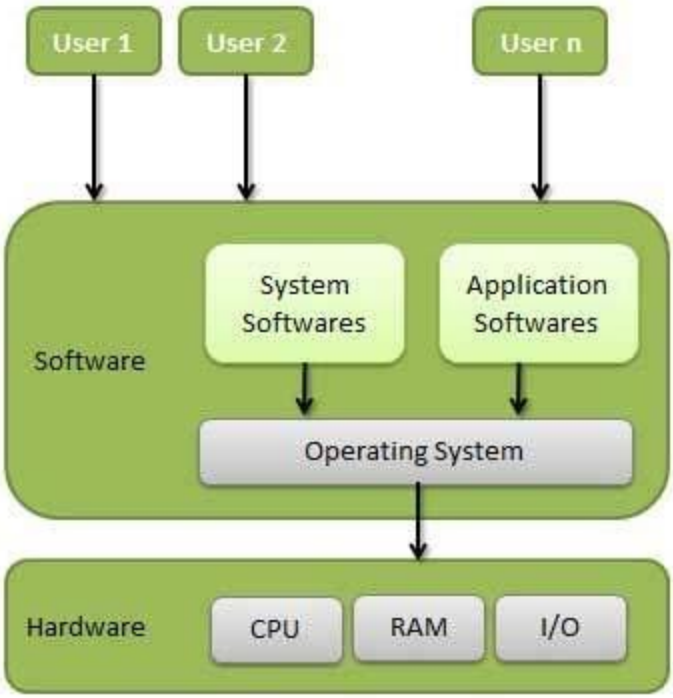
- Hardware – provides basic computing resources CPU, memory, I/O devices
- Operating system - Controls and coordinates use of hardware among various applications and users
- Application programs – define the ways in which the system resources are used to solve the computing problems of the users. Word processors, compilers, web browsers, database systems, video games
- Users - People, machines, other computers



★ What is an OS

- An operating system (OS) is a collection of software that manages computer hardware resources and provides common services for computer programs.
- The operating system is a vital component of the system software in a computer Application programs usually require a system.
- It is an interface between a 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.
- OS is a **resource allocator**
  - Manages all resources
  - Decides between conflicting requests for efficient and fair resource use
- OS is a **control program**
  - Controls execution of programs to prevent errors and improper use of the computer

★Architecture



★ Functionalities & Characteristics of OS

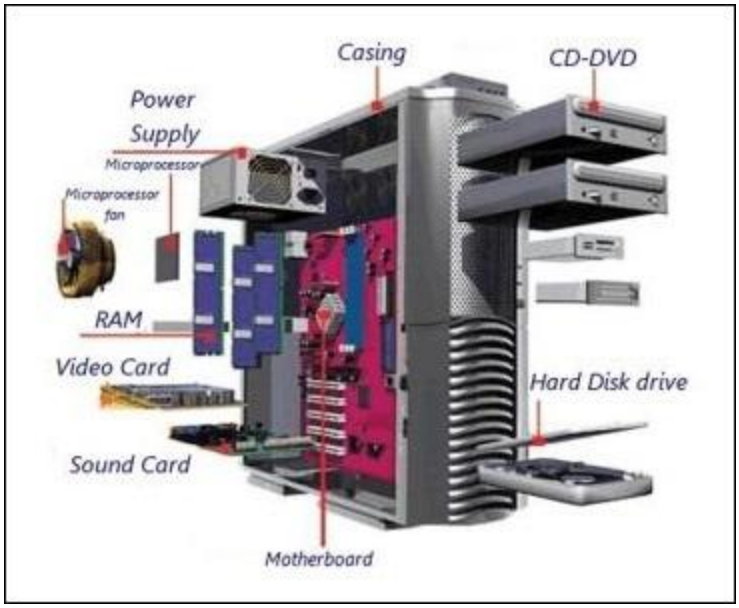
1. Process management: Process management helps OS to create and delete processes. It also provides mechanisms for synchronization and communication among processes.
2. Memory management: Memory management module performs the task of allocation and deallocation of memory space to programs in need of these resources.
3. File management: It manages all the file-related activities such as organization storage, retrieval, naming, sharing, and protection of files.
4. Device Management: Device management keeps tracks of all devices. This module also responsible for this task is known as the I/O controller. It also performs the task of allocation and deallocation of the devices.
5. I/O System Management: One of the main objects of any OS is to hide the peculiarities of hardware devices from the user.

6. Secondary-Storage Management: Systems have several levels of storage which includes primary storage, secondary storage, and cache storage. Instructions and data must be stored in primary storage or cache so that a running program can reference it.
7. Security: Security module protects the data and information of a computer system against malware threat and authorized access.
8. Command interpretation: This module is interpreting commands given by the and acting system resources to process those commands.
9. Networking: A distributed system is a group of processors which do not share memory, hardware devices, or a clock. The processors communicate with one another through the network.
10. Job accounting: Keeping track of time & resources used by various jobs and users.
11. Communication management: Coordination and assignment of compilers, interpreters, and another software resource of the various users of the computer systems

Hardware concepts related to OS

Hardware is the mechanical device in a computer system that is interconnected for operation.

Computer Hardware Components



1. Peripheral Devices : These devices are the ones that provide input/output to the computer externally. They are auxiliary devices meant to form a connection with the device externally via a cable or Bluetooth to function. Some examples are mouse, headphones, etc.

2. Input devices: The input device allows the user to send data or information to the computer to perform a task. Keyboards, joysticks, mouse, etc. are some of the examples.

3. Output devices: The output device completes the task related to the data sent by the input device. They receive the data from the input devices and execute the tasks accordingly. Printers, monitors, etc. are some of the output devices.

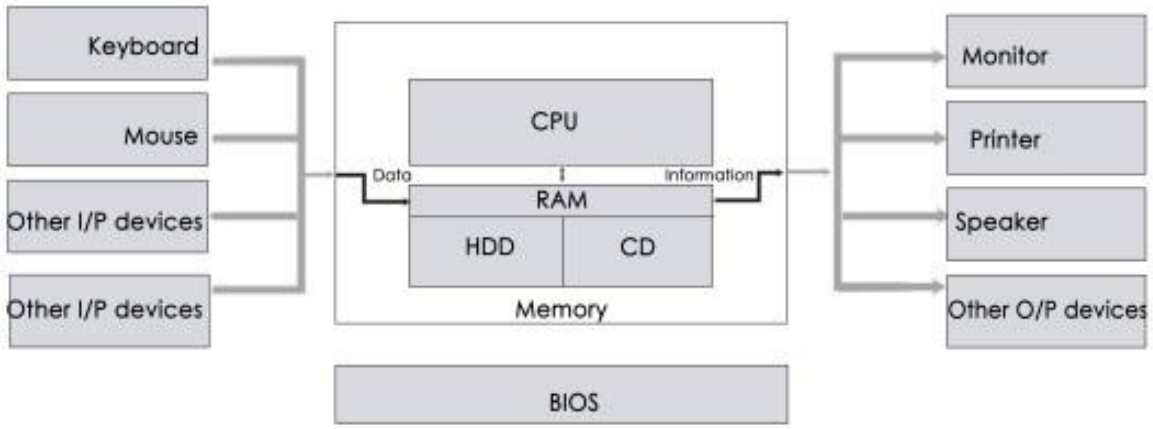
4. Secondary storage devices: The place where all the data on the computer goes is a storage device. This allows users to access all the data safely and without any trouble. This device is one of the core components of a computer system.

It is a hardware device to store digital data in multiple forms like text, images, audio, etc. Some examples are – hard drives, USBs, memory cards, etc.

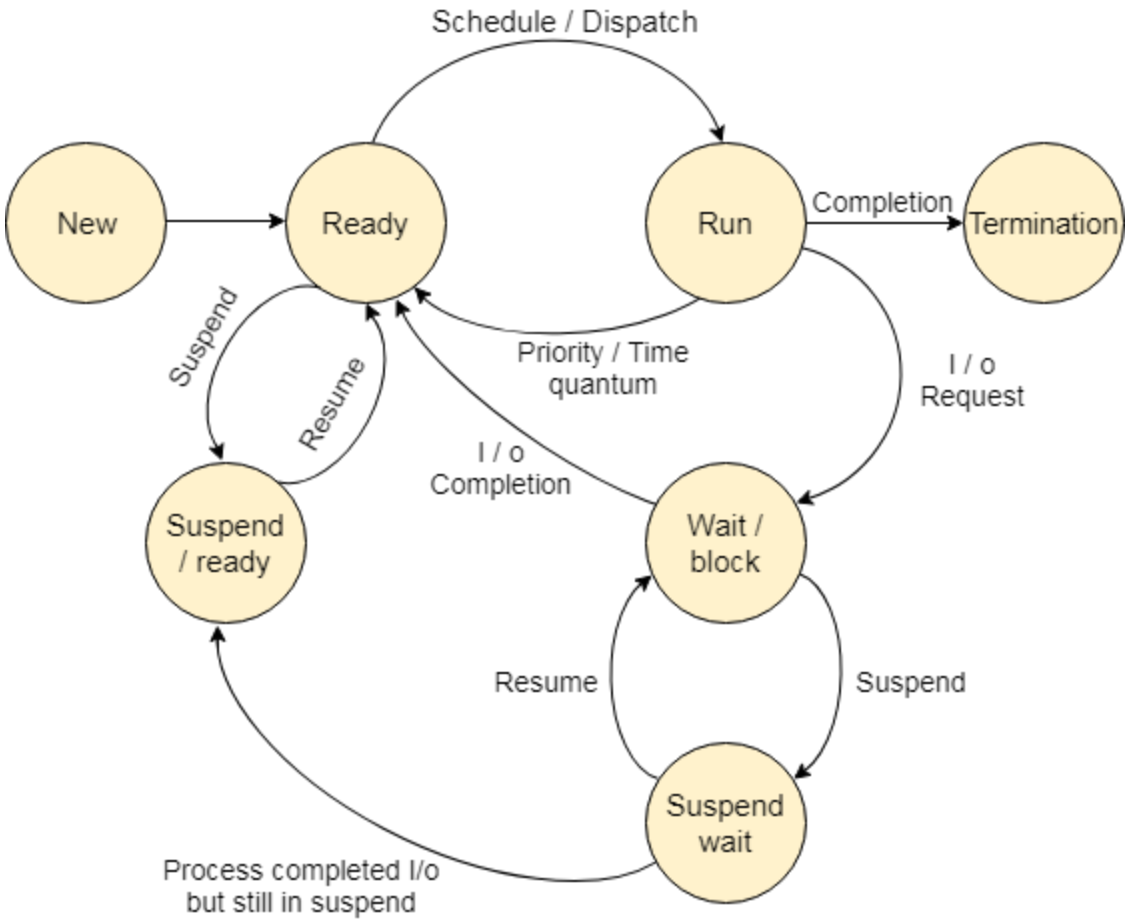
5. Internal components: The components that are already a part of the motherboard and the system are internal components. Computer memory is internal to the system, becoming a good example of this.

Many devices may become a part of the system from inside using ribbon cables and insertion cards. Some examples are – RAM, CPU, etc.

Computer Hardware Architecture



★CPU States



1. **New**: A program which is going to be picked up by the OS into the main memory is called a new process

2. **Ready**: Whenever a process is created, it directly enters in the ready state, in which it waits for the CPU to be assigned. The OS picks the new processes from the secondary memory and puts all of them in the main memory.

The processes which are ready for the execution and reside in the main memory are called ready state processes. There can be many processes present in the ready state.

3. **Running**: One of the processes from the ready state will be chosen by the OS depending upon the scheduling algorithm. Hence, if we have only one CPU in our system, the number of running processes for a particular time will always be one. If

we have n processors in the system then we can have n processes running simultaneously.

4. **Block or wait**: From the Running state, a process can make the transition to the block or wait state depending upon the scheduling algorithm or the intrinsic behavior of the process.

When a process waits for a certain resource to be assigned or for the input from the user then the OS moves this process to the block or wait state and assigns the CPU to the other processes.

5. **Completion or termination**: When a process finishes its execution, it comes in the termination state. All the context of the process (Process Control Block) will also be deleted and the process will be terminated by the Operating system.

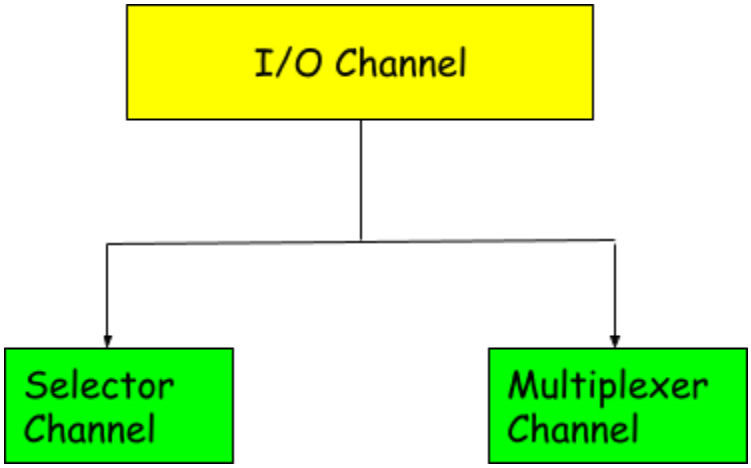
6. **Suspend ready**: A process in the ready state, which is moved to secondary memory from the main memory due to lack of the resources (mainly primary memory) is called in the suspended ready state.

7. **Suspend wait**: Instead of removing the process from the ready queue, it's better to remove the blocked process which is waiting for some resources in the main memory.

- Since it is already waiting for some resource to get available hence it is better if it waits in the secondary memory and makes room for the higher priority process.
- These processes complete their execution once the main memory gets available and their wait is finished.

★ I/O Channel

An I/O channel, also known as an input channel, is a data communication channel between the input/output bus and memory to a computer peripheral or CPU.
It executes I/O instructions and controls I/O operations based on the CPUs instructions.



Selector Channel**:** This channel can handle only one I/O operation at a time and is used to control one high speed device at a time.

Multiplexer Channel: The Multiplexer channel can be connected to a number of slow and medium

speed devices. It is capable of operating a number of I/O devices simultaneously.

★ Memory Management

Memory Management is the process of controlling and coordinating computer memory, assigning portions known as blocks to various running programs to optimize the overall performance of the system.

Memory management is the functionality of an operating system which handles or manages primary memory and moves processes back and forth between main memory and disk during execution. Memory management keeps track of each and every memory location, regardless of either it is allocated to some process or it is free. It checks how much memory is to be allocated to processes.

Virtual Memory

Virtual Memory is a storage allocation schema which offers users an illusion of having a very big main memory. It is done by treating a part of secondary memory as the main memory. In Virtual memory, the user can store processes with a bigger size than the available main memory.

Advantages of Virtual Memory

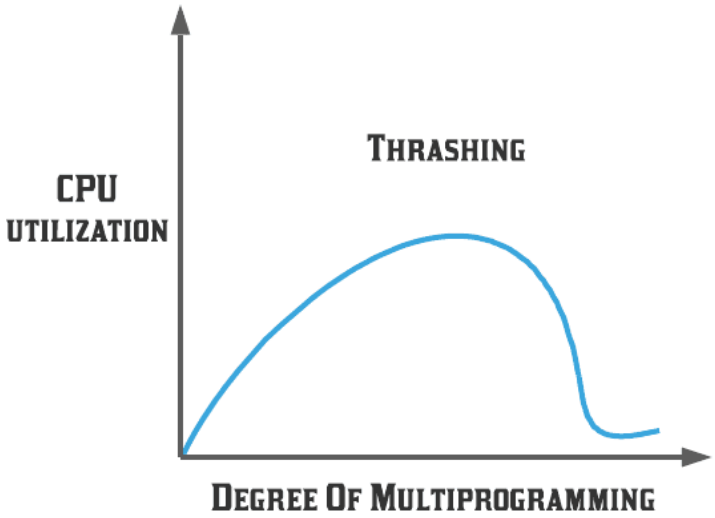
- More processes should be maintained in the main memory, which increases the effective use of CPU.
- Each page is stored on a disk until it is required after that, it will be removed.
- It allows more applications to be run at the same time.
- There is no specific limit on the degree of multiprogramming.
- Virtual memory helps to gain speed when only a particular segment of the program is required for the execution of the program.
- It is very helpful in implementing a multiprogramming environment.
- It allows you to run more applications at once.
- It helps you to fit many large programs into smaller programs.
- Common data or code may be shared between memories.
- Processes may become even larger than all of the physical memory.
- Data / code should be read from disk whenever required.
- The code can be placed anywhere in physical memory without requiring relocation.

Disadvantages of Virtual Memory

- It reduces system stability.
- It allows larger applications to run in systems that don’t offer enough physical RAM alone to run them.
- It doesn’t offer the same performance as RAM.
- It negatively affects the overall performance of a system.
- Applications may run slower if the system is using virtual memory.
- Likely takes more time to switch between applications.
- Offers lesser hard drive space for your use.

Thrashing

Thrashing is when the page fault and swapping happens very frequently at a higher rate, and then the operating system has to spend more time swapping the pages. This state in the operating system is known as thrashing.



Thrashing's Causes

- Thrashing has an impact on the operating system's execution performance.
- Thrashing also causes serious performance issues with the operating system.

Note: Some notes are dictated in the class so please refer to them.