Introduction to Operating Systems

- What is meant by an operating system -

- An operating system is a program that manages a computer's hardware.

- Goals of O.S - (i) Execute user programs and make solving user problems easier
(ii) Make the computer system convinient to use
(iii) Use the computer hardware in an effecent manner

→ Computer System Structure -

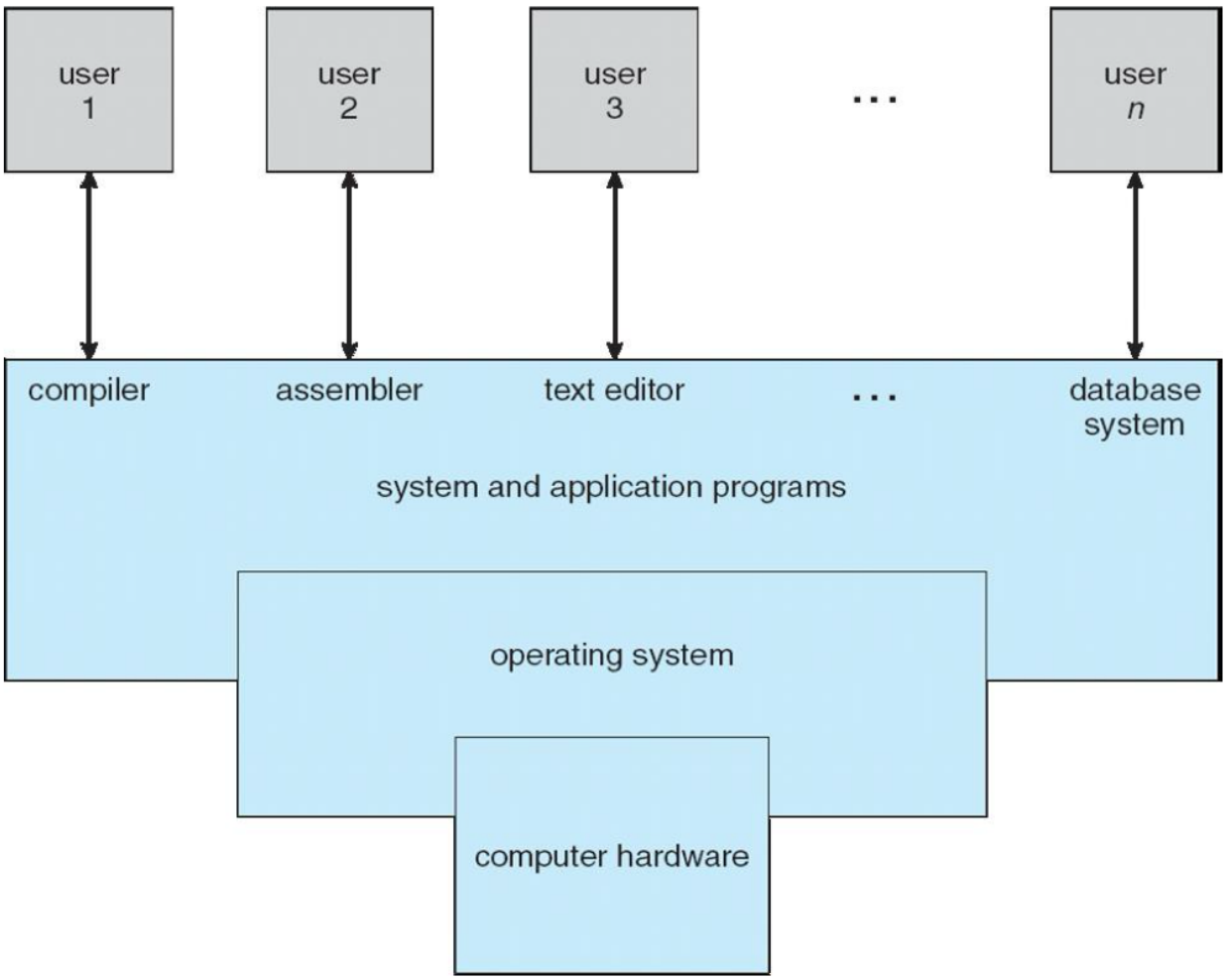
There are 4 major components present in a Computer System
(i) Hardware - provides basic computing resources
CPU, memory, I/O devices
(ii) Operating System - controls and coordinates use of hardware among various applications and users
- hides the background details of hardware &

makes it user friendly

(iii) **Application programs-** define the ways in which the system resources are used to solve the computing problems of the user

eg- word processors, compilers, web browsers

(iv) **Users-** people, machines, other computers



– What do operating systems do?

There are 2 points of views :-

User view –

1.) Users want convenience, ease of use and good performance
2.) In shared computer such as mainframe must keep all users happy and maximum resource utilization
3.) Users of dedicated systems such as workstations have dedicated resources but frequently use shared resources from servers, thus O.S is designed b/w individual usability and resource utilization
4.) Some computers don't have a user interface such as embedded computers

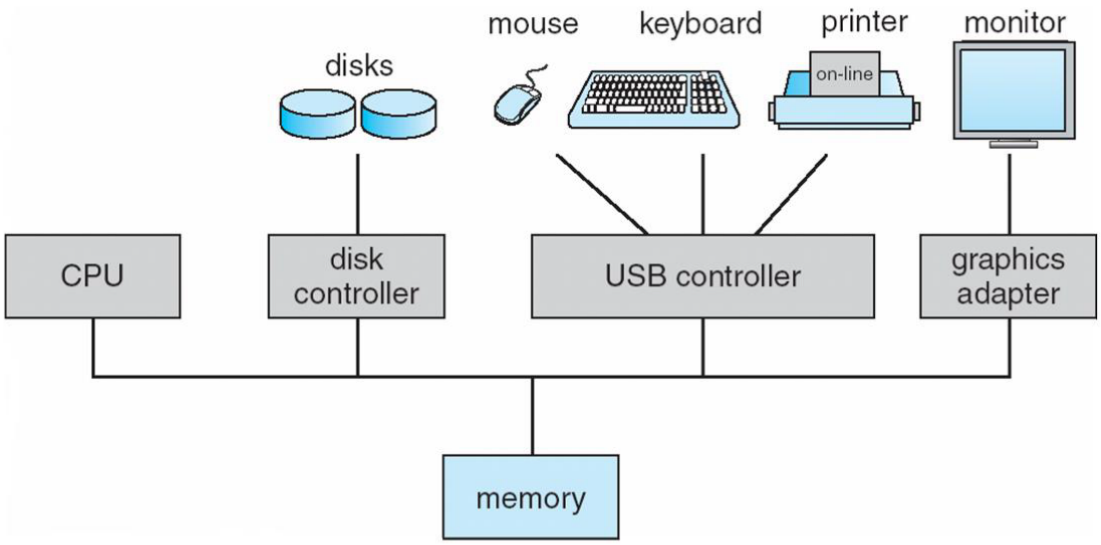
System view –

1.) OS is a resource allocator which manages all the resources and decides b/w conflicting requests for efficient and fair resource use

2.) OS is a control program that controls and manages the execution of programs to prevent errors and improper use of the computer.

→ Computer System Organization

1.) One or more CPU's, device controllers connect through common bus providing access to shared memory
2.) Each device controller is in charge of a particular device type
3.) Concurrent execution of CPU's and devices competing for memory cycles



A modern computer system

Computer System operation -

1.) I/O devices and the CPU can execute concurrently
2.) Each device controller is in charge of a particular device type
3.) Each device has a local buffer
4.) CPU moves data from/ to main memory to/ from local buffers
5.) I/O is from the device to local buffer of controller
6.) Device controller informs CPU that it has finished its operation by causing an interrupt.

Bootstrap program -

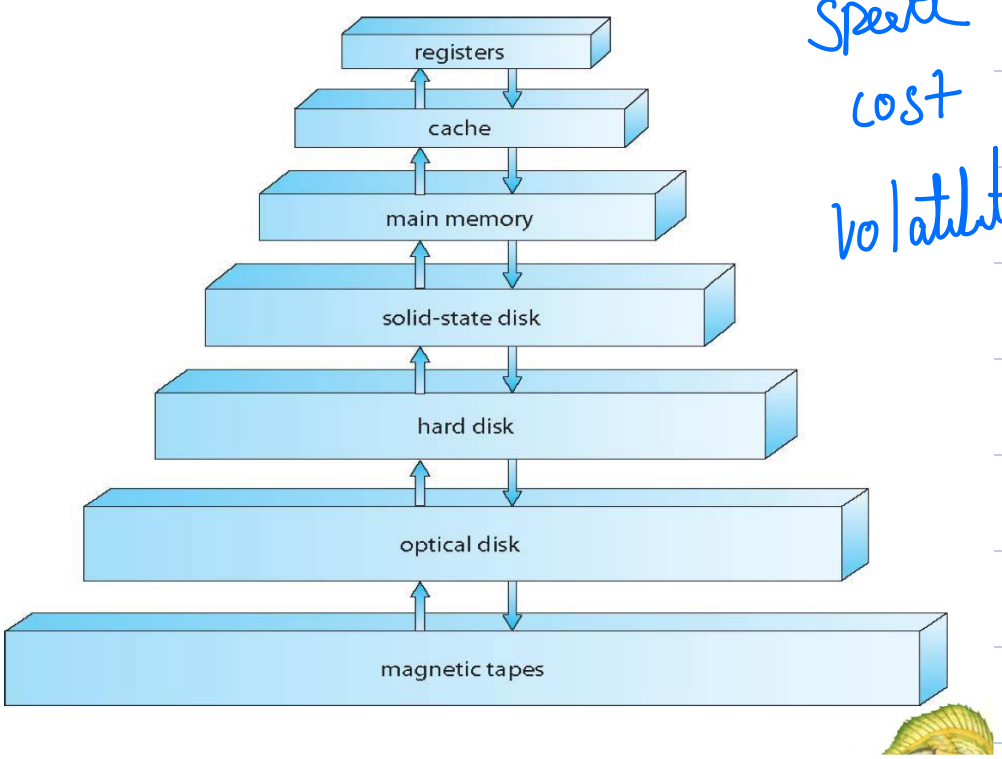
- Initial program that runs during the power up of a computer
- Stored in ROM and is known as firmware.
- locates OS kernal and loads into the memory for execution
- once loaded the computer can provide services to users

→ Storage Structure -

- Memory which can be accessed by the CPU directly - Random access and volatile.
- Secondary Storage - extension of main memory that provides large non volatile capacity

Hard disks - rigid metal (or) glass platters covered with magnetic recording material.

Solid state disks - faster than HDD, non volatile, more popular



Speed
cost
volatility

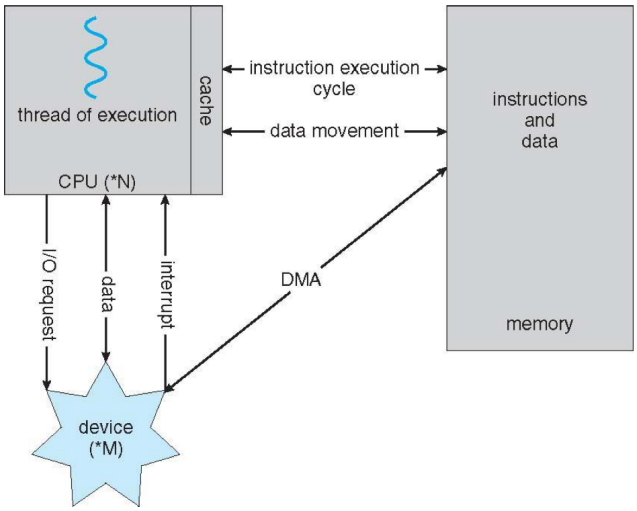
→ Caching-

- What is caching ?- Information in use copied from slower to faster storage temporarily

Faster storage (cache) checked first to determine if information is there :-

1) If it is, information used directly from the cache (fast)
2) If not, data copied to cache and used there
3) Cache management important design problem
4) Cache size and replacement policy.

Working of a modern computer-

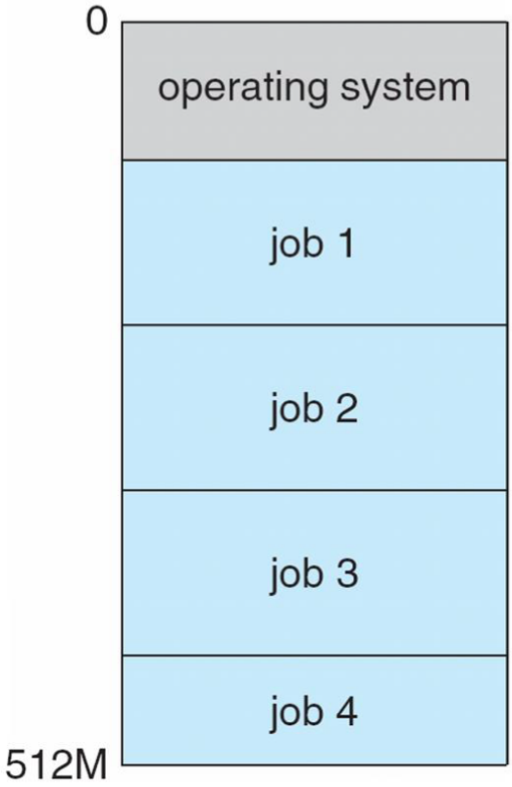


A von Neumann architecture

→ Operating System Structure-

- Multiprogramming - needed for efficiency
(i) Single user cannot keep CPU and I/O devices busy at all times
(ii) Organizes code and data so CPU always has one to execute
(iii) Uses JOB scheduling

- Timesharing - Logical extension of multiprogramming in which CPU executed multiple jobs and switches jobs so frequently that users can interact with each job while it is running, creating interactive computing
(i) Response time - < 1 sec
(ii) Process - each user has atleast one program executing in memory
(iii) CPU Scheduling - Several jobs at the same time
(iv) Swapping - if processes don't fit in memory swapped from main memory to disk to run and ensure reasonable response time



→ Operating Systems operations -

* OS is interrupt driven - depends on external factors
- Hardware interrupt is caused by one of the devices
- Software interrupt is caused by - (i) Software error
(ii) Infinite loop
(iii) Request for OS service

* Interrupt service routine - provided to deal with the interrupt

2 modes of operation -

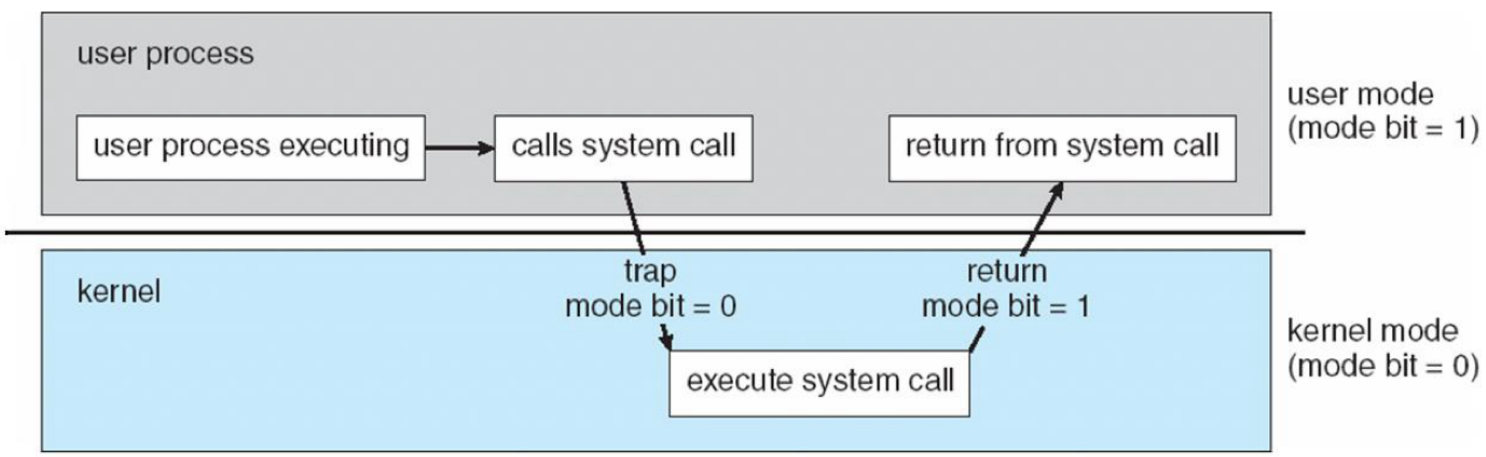
Dual mode - allows OS to protect itself and other system components

- user mode and kernel mode

Mode bit is provided by hardware -

(i) used to distinguish when the system is running kernel code (or) user code

(ii) Some instructions designated as privileged only executable in kernel mode



Transition from user to kernel mode.

→ Timer-

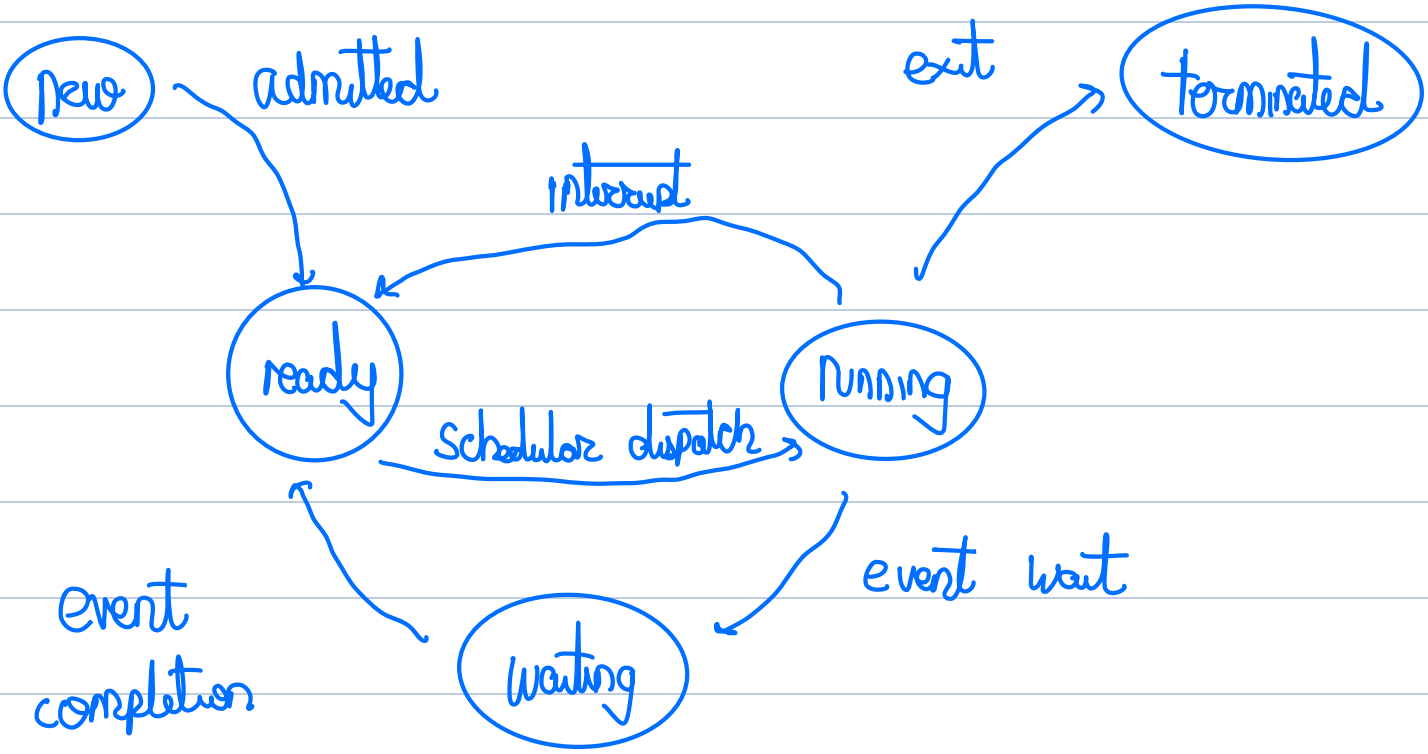
- prevents infinite loop / process hogging resources and never return control to the O.S

(i) timer can be set to interrupt the computer after some time period

(ii) Keep a counter that is decremented by the physical clock.

(iii) OS ensures to set up the timer before scheduling process to regain the control (or) terminate program that exceeds allotted time

→ Process Management Activities -



OS is responsible for the following activities w.r.t process management

→ Creating and deleting both user and system processes
→ Suspending and resuming processes
→ Providing mechanisms for process synchronization
→ Providing mechanisms for process communication
→ Providing mechanisms for deadlock handling

→ Memory management -

Activities - (i) Keeping track of which part of memory are currently being used and by whom
(ii) Deciding which processes and data to move into and out of memory
(iii) Allocating and deallocating memory space as needed.

→ Storage management -

Activities - (i) Creating and deleting files and directories
(ii) Primitive to manipulate files and directories
(iii) Backup files on to stable storage media

→ Mass Storage management -

Activities - (i) Free Space management
(ii) Storage allocation
(iii) Disk scheduling

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