Unit 1: Introduction

Prepared By : Prof. Pooja Makawana
Assistant Professor
Department of I.T
Dharmsinh Desai University

Topics to be covered

- **Introduction to an Operating system**
- Abstract view, User view and system view
- **Main frame systems**
- Batch Syatems
- Multi Programmed systems
- Time sharing Systems.
- **Desktop Systems**
- **Multi Processor Systems**
- **Distributed systems**
- Client Server Systems.
- Peer to Peer Systems
- **Clustered Systems**
- **Realtime systems.**
- **Hand Held systems**

Operating system by Galvin

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. An amazing aspect of operating systems is how they vary in accomplishing these tasks. Mainframe operating systems are designed primarily to optimize utilization of hardware. Personal computer (PC) operating systems support complex games, business applications, and everything in between. Operating systems for mobile computers provide an environment in which a user can easily interface with the computer to execute programs. Thus, some operating systems are designed to be *convenient*, others to be *efficient*, and others to be some combination of the two.

Before we can explore the details of computer system operation, we need to know something about system structure. We thus discuss the basic functions of system startup, I/O, and storage early in this chapter. We also describe the basic computer architecture that makes it possible to write a functional operating system.

Because an operating system is large and complex, it must be created piece by piece. Each of these pieces should be a well-delineated portion of the system, with carefully defined inputs, outputs, and functions. In this chapter, we provide a general overview of the major components of a contemporary computer system as well as the functions provided by the operating system. Additionally, we cover several other topics to help set the stage for the remainder of this text: data structures used in operating systems, computing environments, and open-source operating systems.

Introduction

1

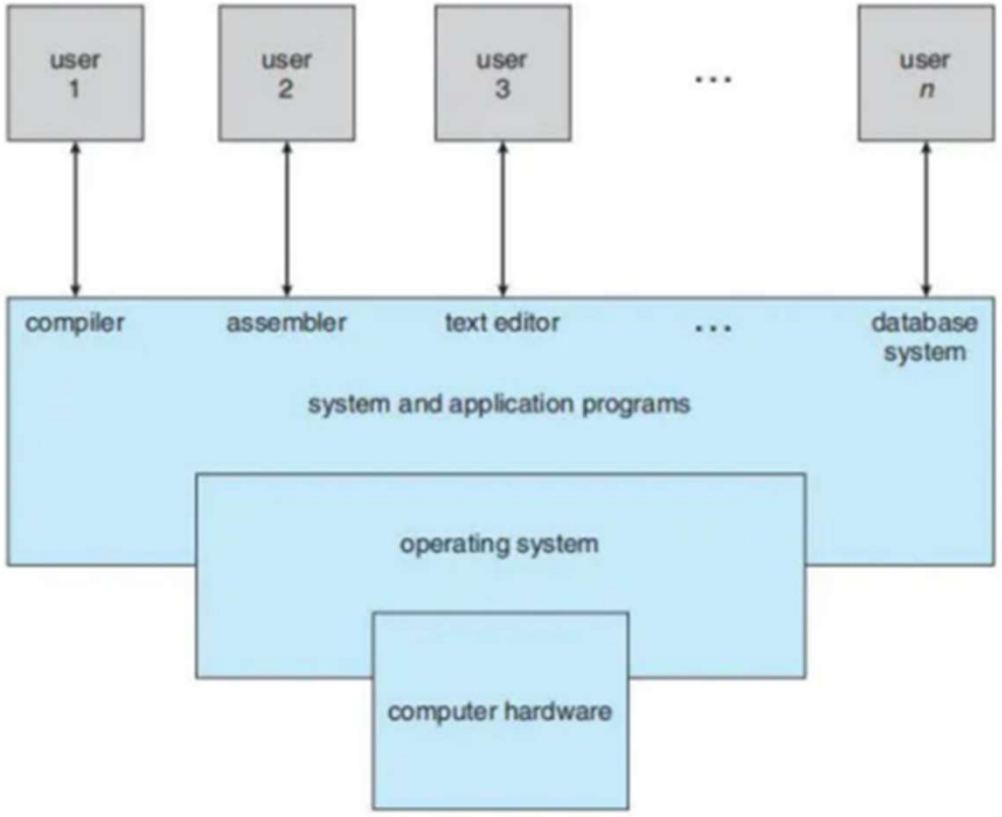
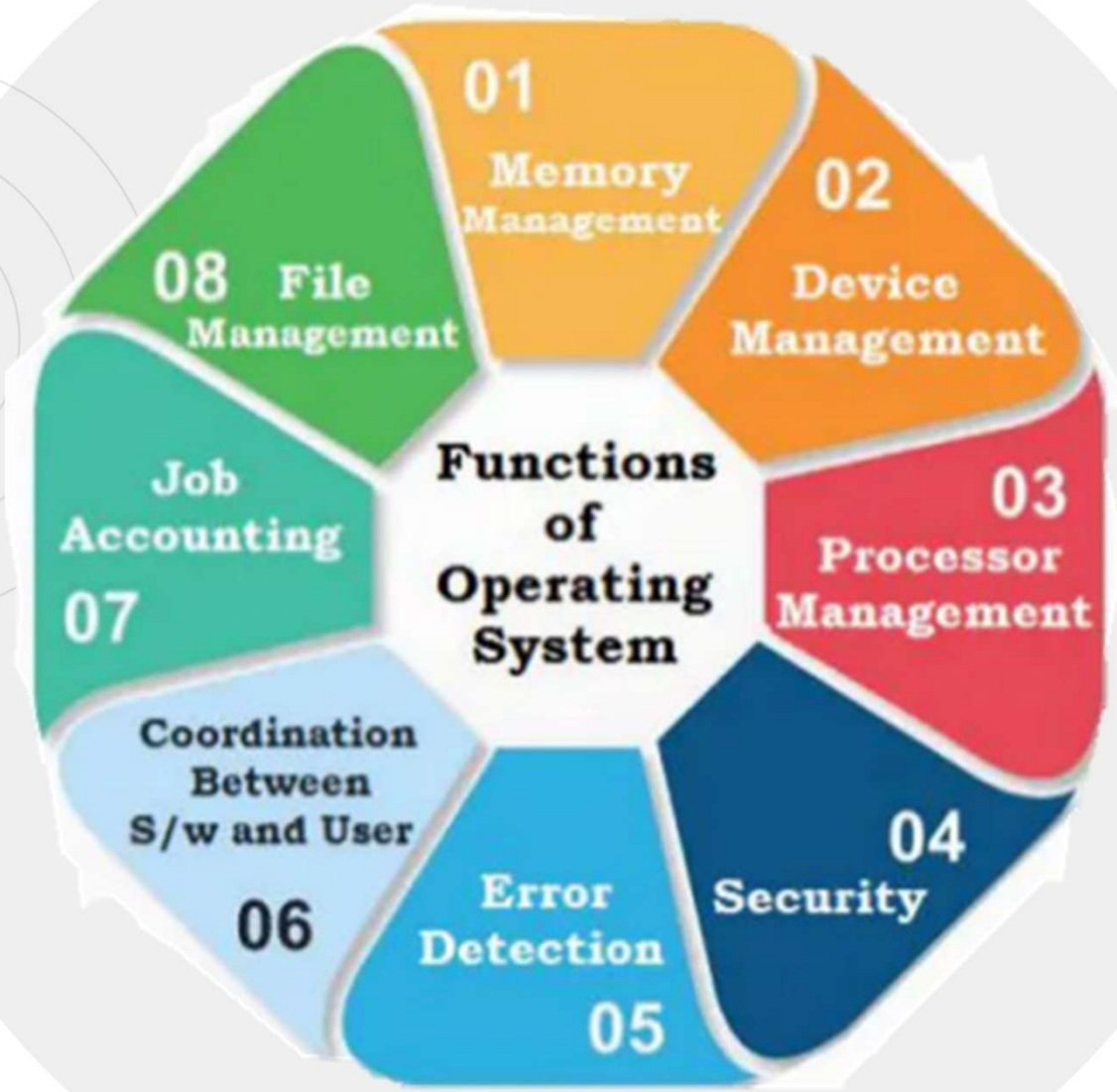


Figure 1.1 Abstract view of the components of a computer system.

Generally operating system have two major goals/Objectives:
(1 convenience – (primary goal)
(2 efficiency task-- (secondary goal)

Operating system objectives and functions

- An OS is a program that controls the execution of an application programs and act as an interface b/w applications and the computer hardware. It can be thought of as having three objectives:
- **Convenience**: An OS makes a computer more convenient to use.
- **Efficiency:** An OS allows the computer system resource to be used in an efficient manner.
- **Ability to evolve:** An OS should be constructed in such a way as to permit the efficient development, testing, and introduction of new system functions without interfering with service.


01
Memory Management
02
Device Management
03
Processor Management
04
Security
05
Error Detection
06
Coordination Between S/w and User
07
Job Accounting
08
File Management
Functions of Operating System

Operating systems from two viewpoints:
(1). user view
(2). system view

User View

(Ref.gelvin)

The user's view of the computer varies according to the interface being used.

- In computer systems for one user, monopolize its resources.
  - The goal is to **maximize the work** (or play) that the user is performing. In this case, the operating system is designed mostly for **ease of use**, with some attention paid to performance and none paid to resource utilization.
- In other case, Users are accessing the same computer through terminals.
  - These users share resources and may exchange information. The operating system in such cases is designed to **maximize resource utilization**— to assure that all available CPU time, memory, and I/O are used efficiently and that no individual user takes more than her fair share.

- In still other cases, users sit at workstations connected to networks of other workstations and servers. These users have dedicated resources at their disposal, but they also share resources such as networking and servers, including file, compute, and print servers. Therefore, their operating system is designed to **compromise between individual usability and resource utilization**.

- In smartphones and tablets connected to networks through cellular or other wireless technologies. The user interface for mobile computers generally features **a touch screen**, where the user interacts with the system by pressing and swiping fingers across the screen rather than using a physical keyboard and mouse.

- **embedded computers** in home devices and automobiles may have numeric keypads and may turn indicator lights on or off to show status, but they and their operating systems are designed primarily **to run without user intervention.**

System view

- From the computer's point of view, the operating system is the program most intimately involved with the hardware.
- In this context, we can view an operating system as a **resource allocator**.

  A computer system has many resources that may be required to solve a problem: **CPU time, memory space, file-storage space, I/O devices, and so on.**

- The operating system acts as the **manager** of these resources.

  Facing numerous and possibly conflicting requests for resources, aiming to operate the computer system **efficiently and fairly.** As we have seen, resource allocation is especially important where many users access the same mainframe or minicomputer.

- an operating system control the various I/O devices and user programs.

  An operating system is a **control program**. A control program manages the execution of user programs **to prevent errors** and **improper use of the computer.** It is especially concerned with the operation and control of I/O devices.

2

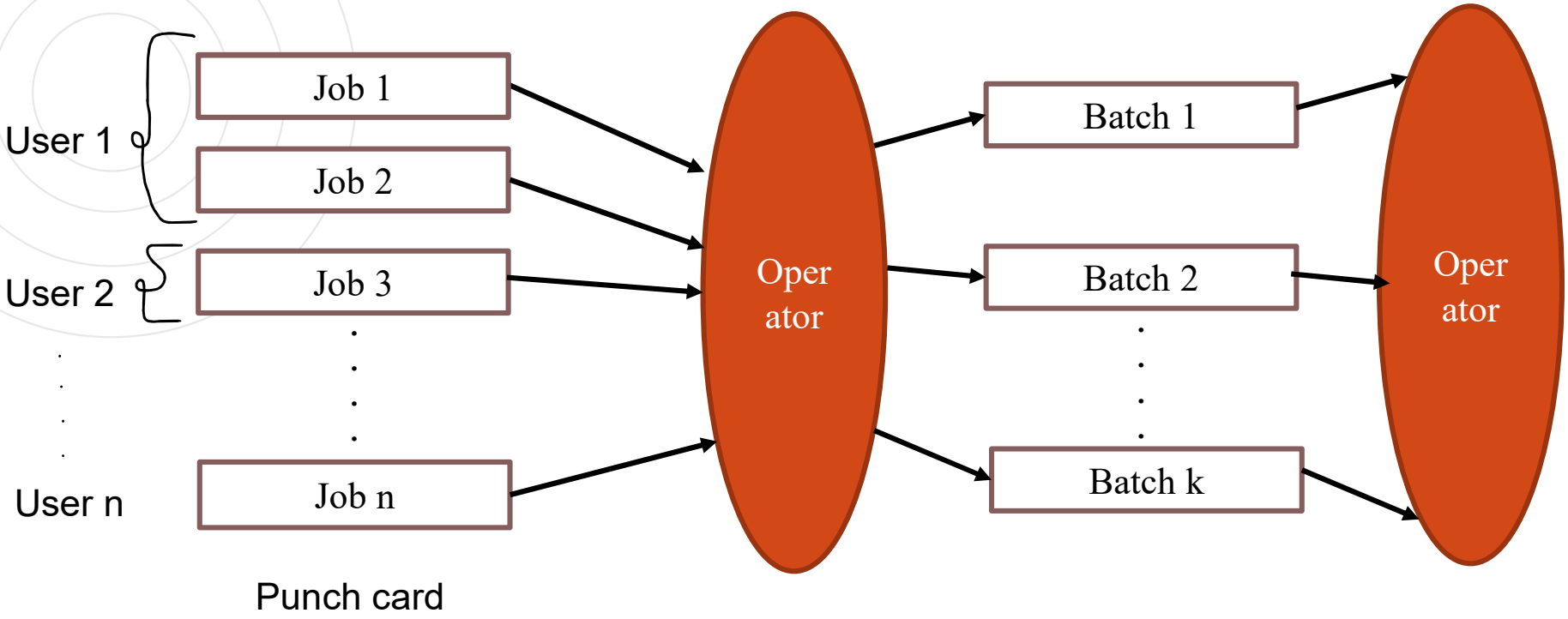
Types Of Operating Systems

Mainframe system:

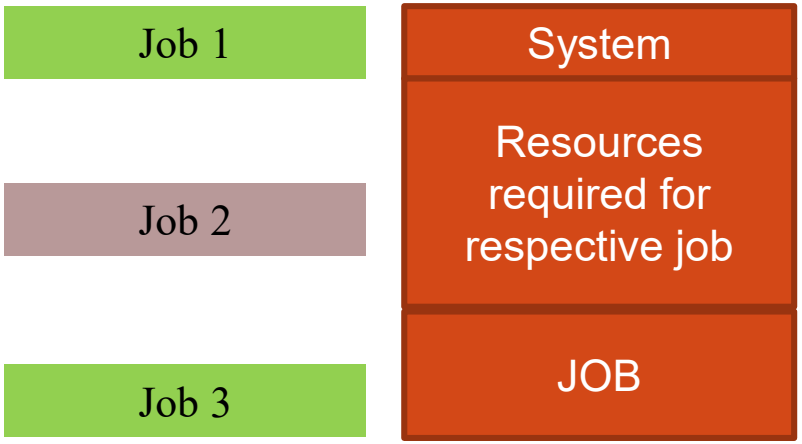
- Mainframe computer system were the first computers used to tackle many commercial and scientific applications.
- It was invented in 1930's by Harvard scholar Howard Aiken, who popularised the name mainframe.
- massive calculator for the solution of set of non-linear equation.
- weighted 5 tons and occupied the space of a whole room.
- Later on in 1950's it reduced by car garage size and now it decreased by **6ft closet.**
- It is being used in **banking, insurance, healthcare, government and public utilities have adapted mainframes since it is most stable, secure and compatible of all computing platforms.**
- Eg.: Universal automatic computers from UNIVAC, Z-series from IBM, Non-stop by Hewlett Packard

Batch operating system

Batch OS is a System in which group's job that performs similar types of functions.
These functions are called as batch and are executed at the same time.

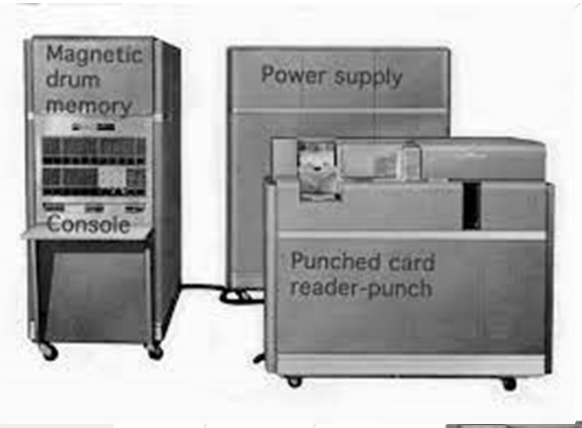


- The i/p device at that time used was punch card readers and punch card were storage device.
- Punch cards were stiff papers which could store digital data represented by presence or absence of holes in pre-defined position. The light was passed through the punch card.
- The light passes through the holes and get blocked where holes were not present
- Operator was the person who would operate the computer collect all the jobs from user.
- System provides required resources to the job to complete and after job completion it deallocates all the resources

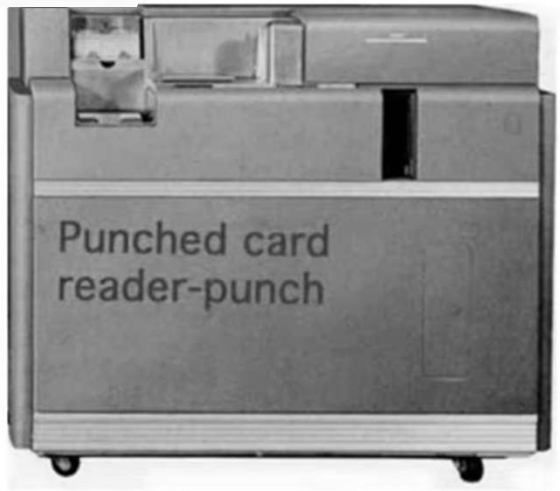


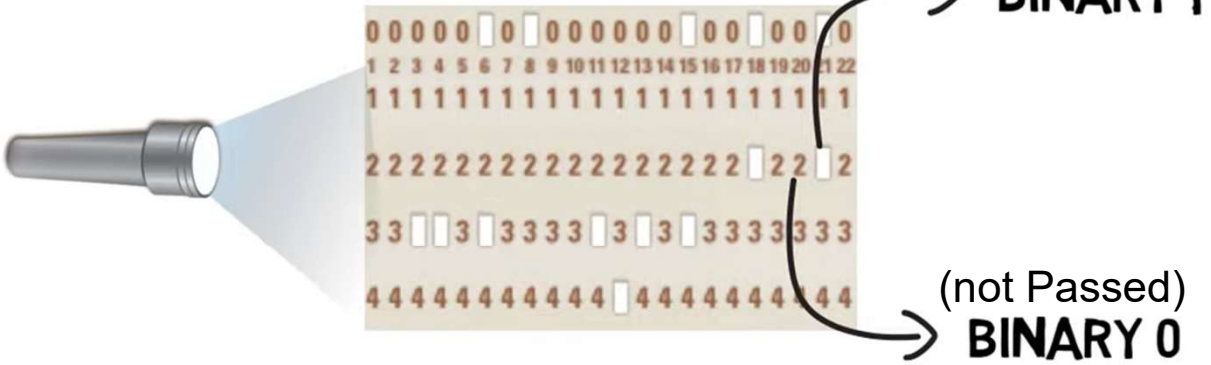
- Ex.: food, biotech, pharma, cosmetics and soaps etc... Manufacturing.

I/P Devices : Card Readers, Tape Drives, Punch Card readers.
O/P Devices: Line Printers, Tape Drives, Punch Cards

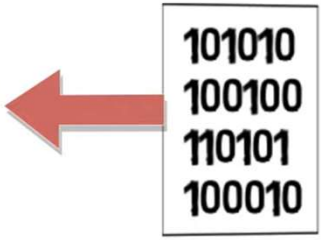

Magnetic drum memory
Power supply
Console
Punched card reader-punch

IBM 650


Punched card reader-punch


(Passed)
BINARY 1
(not Passed)
BINARY 0


HELLO, WORLD. THIS IS TWO-BIT HISTORY. ABCDEFGHIJKLMNOPQRSTUVWXYZ 123456 !@&%$@*


101010
100100
110101
100010

Advantages:

- Multiple users can **share** batch system.
- Repeated jobs are done **fast** in this system.
- Batch system could handle **large repeated jobs** easily.
- Less **context switching.**

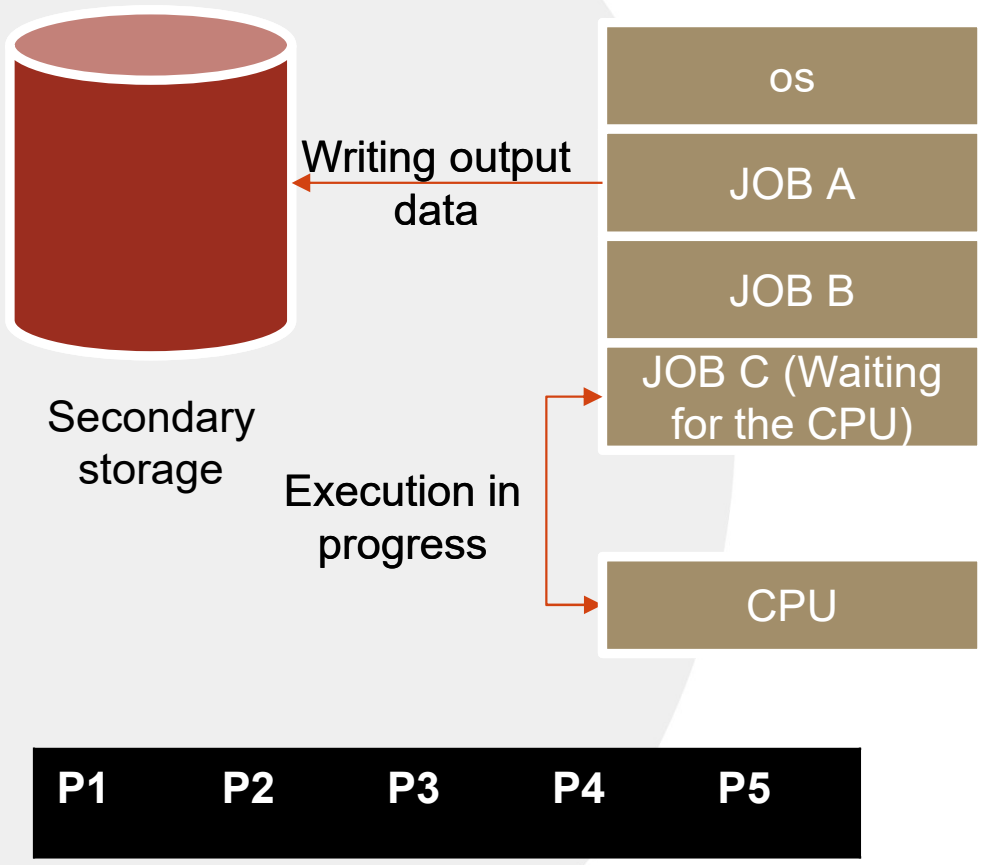
Disadvantages:

No context Switching

- When batch 1 is working Batch 2 hve to wait → **CPU Utilization**
- Loading and unloading of resources and jobs takes time → **CPU remains idle.**
- No priorities given to the job.
- Minimal or **no interaction** after the job is scheduled to be executed.
- If task is failed to complete, takes longer time to complete. → **lead to deadlock.**
- **Operator** must be fully knowledgeable and skilled person.

Multi-programming operating system

- execute multiple programs efficiently.
- In multi programming os two or more users programms can be **in memory** and are executed one after another.
- OS maintains **job pools**(list of jobs) from which it selects the job
- If process or a job required i/o operation, access resources/files or any other operation then it will be move out of the CPU for that perticular operation so when that would happen **CPU remained idle** and **CPU utilization was very low**.



- suppose any process p3 requires i/o operation or it is being interrupted by external factor during cpu time then it will be taken out from the memory for fullfiling its requirements.
- Now in this duration cpu will be given to the another process which is in queue(because we wanted to utilize the cpu maximum) and complete it and during that if previous process arrives again cpu will be allocated to that process and complete it.

Advantages:

- Faster response time
- Resources are wisely allocated
- Better cpu utilization
- Can be used by multiple people at the same time

Disadvantages:

- Cpu scheduling is necessary
- Since all tasks are stroed in main memory, memory management is also required.

Multi-tasking / time sharing

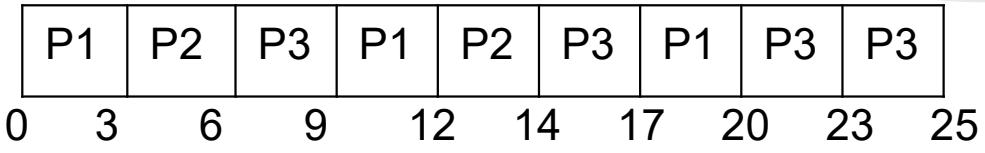
- Logical extension of multiprogramming.
- Today we work on a laptop or a pc and we work on multiple programs at a time.
- We work on a world document at the same time we can play music and surf through intrernet. This is all because of multitasking.
- Multi tasking is the system which allows user to perform more than one task (process,thread,program) at the same time.
- It is also known as time sharing system.(**Time quantam is used**)
- A time quantum is a period of time in which process is allowed to run in multi- tasking enviornment.

Multi-tasking os does the switching so fast that it feels like all the processes are having parellel execution.

Ex:

PId	BT
P1	9ns
P2	5ns
P3	11ns

Time quantum = 3ns



- Here in given example we can see that all the processes gets CPU for 3 ns of time for an execution. If any process still needs CPU for an execution it will get rescheduled in ready queue(round robin).
- This system is **interactive** hence it provides communication b/w user and the system.
- User gives the information to os or program directly.
- It is so fast that each process is given the impression that the entire computer system is dedicated to their use, even though. It is being shared.
- It is **complex** so need **memory management and protection**.
- To obtain the reasonable response time jobs may have to be **swapped** in and out from main memory to the disk and disk to the main memory.
- That's where the **virtual memory** came to a picture.
- The main advantage of virtual memory is that program can be larger than the physical memory.

Advantages:

- Each task get equal opportunity.
- Less chances of duplication of S/W
- CPU idle time is reduced.
- Time sharing provide concurrent execution → **CPU Scheduling, Job Synchronization, communication & Deadlock avoidance.**

Disadvantages:

- Reliability
- Data Communicaation
- Security
- Integrity of user prog and data.

Desktop system

- Personal computers PCs→ **where User controls PC**
- Supports fundamental festures such as task scheduling , Peripheral control Printing , I/O, Memory allocation.
- Ex: windows, Linux, Mac OS.
- **Low Cost**
- CPU Utilization is not Prime Concern instead **User convenience & responsiveness** is Prime Concern.
- Initially file Protection was not necessary.
- Now PCs are connected to other computers via internet where other computer can access files, so file protection became important.
- Malicious programs can destroy data.

Advantages:

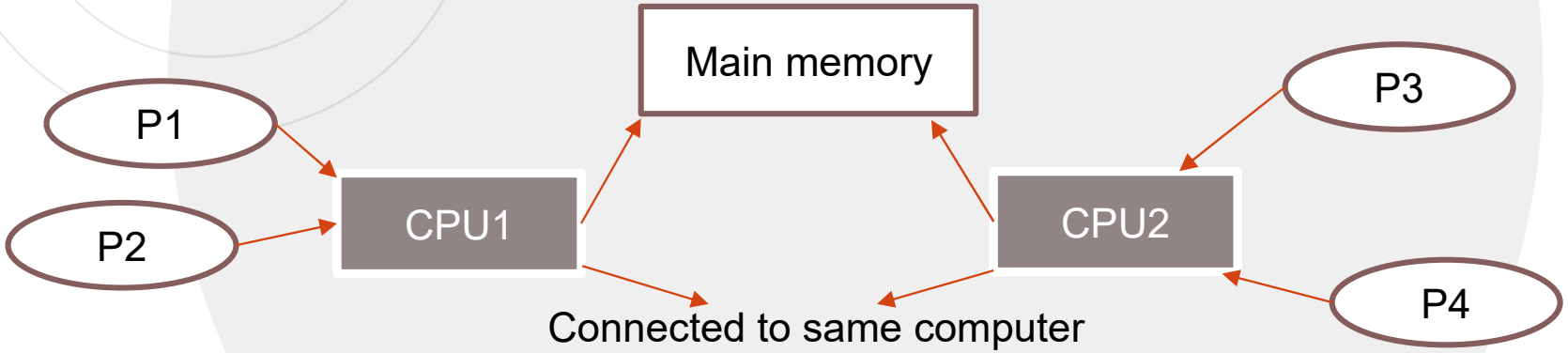
- User friendly GUI.
- Can be updated regularly.
- Can manage several tasks.
- Can Store large amount of data.

Disadvantages:

- Some OS are expensive
- Highly complicated
- Fragmentation
- If central OS fails whole system fails.

Multiprocessor systems

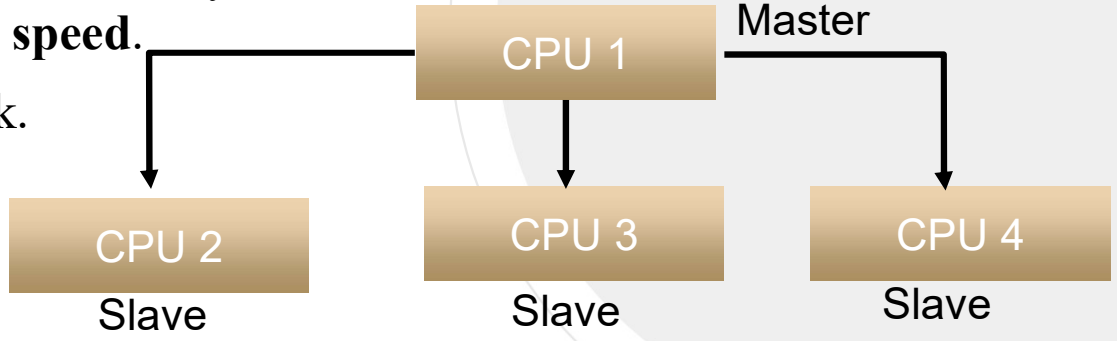
- Multi processing/ Parallel system refers to the use of more CPUs within the single compute system.
- These multiple CPUs are in close communication and **shares the computer bus, memory and other peripheral devices.** (You might have heard of dual core…quad core etc.)
- All the processes are loaded into the memory. → **share main memory**



There are two types of multiprocessor system:

1) Asymmetric multiprocessor system:

- There is a **master slave** architecture present in this.
- Instead of giving all rights to all the processor, we can make one processor a master and then it can decide which CPU can perform which task.
- Many **time if all processors access I/O devices or memory or any other hardware** the designing of such connections gets difficult and production cost for circuit design also gets high. So to prevent this one processor is assigned for all interaction with i/o or memory or other hardware devices and all other processors are used **to improve the processing speed**.
- Ex: MMX Processor for multimedia related task.



- Advantage: I/O operation or application software is faster.
- Disadvantage: some Processors may get burdened for specific type of task and some may be idle.
- If one CPU fails the entire system will go down

2) Symmetric multiprocessor system:

- In symmetric multiprocessing(SMP) each **CPU have equal rights**.
- SMP means that all processors are **peers**. There is no master slave hierarchy.
- Implements same copy of OS
- Task will be allotted to least burdened CPU.
- All can initiate I/O.

Advantages:

- Fault tolerant system.
- Few processor failure does not bring the whole system down.

Disadvantages:

- Difficult to balance workload
- Special synchronization algo requires for handling many processors.

Advantages of multiprocessor system:

1. **Increased throughput.**
2. **Economy of scale**.
3. **Increased reliability**
4. **It allows parallel processing.**

Other Multiprocessor systems:

1. **Shared Memory Multiprocessor:** each CPU contains distributable common memory.
2. **Uniform Memory Multiprocessor:** All Processors access all memory at consistent speed.
3. **Distributed Memory MultiProcessor:** All CPUs will have their private memory.
4. **NUMA (Non Uniform memory access) Multiprocessor :** some areas of memory for approaching at swift rate and remaining memory for other tasks.

Distributed systems.

- Loosely coupled system. In a loosely coupled system, there is a low degree of interaction between tasks, and memory conflicts do not take place.
- Jobs are distributed to different processors. →thery share same computational tasks.
- Networked systems →communication path between two or more systems(Network adapters and device drivers).
    - Network varies by → Protocol Used.
      →Distance between nodes.
      →transport media
    - Network can be → LAN, MAN, WAN
    - Media : Copper wires, Fiber optica, wireless transmission, microwave dishes , radio, infrared network.

Client-Server systems :

- Centralized system work as server system to satisfy request generated by client systems.
- Server→ Computer Server Systems : Provides an interface to which client requests and receives the response.
  →File Server Systems: Provides file system interface where clients can create update and delete files.

Advantages:

- Centralized : Resources and data security are controlled through server.
- Scalability: Any or all elements can be replaced individually as needs increase.
- Interoperability: all components (Client/server) work together.
- Accessibility: servers can be accessed remotely.

Disadvantages:

- Expense and Maintanence of large network
- Dependance

Distributed systems.

Peer to Peer systems :

- Donot share memory or clocks. Every pc has local memory but do not share main memory
- Computers communicate via a veraity of communication methods like telephone lines or high speed buses.

Advantages:

- **Less initial expense : No dedicated server**
- Setup: an installed os just needs to be reconfigured for peer to peer tasks.

Disadvantages:

- Decentralized : No central repository for files and applications.
- Security : Less secured as compared to client server systems.

Clustered system

- Two or more independent systems linked together and shared storage media.
- All systems work together to complete all tasks and all will have cluster software.
- Systems interact with each other using Message passing interface (MPI) / Parallel Virtual Machine(PVM).

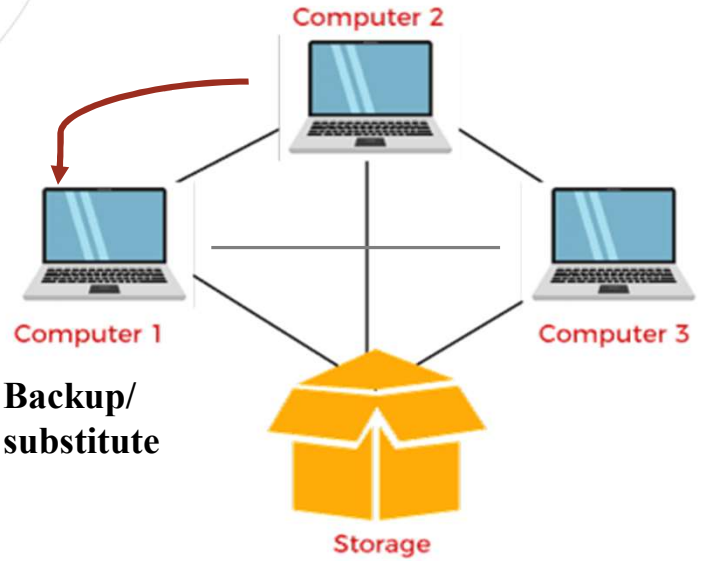
- Clustered os is combination of S/W cluster and H/W Cluster:
- S/W Cluster: gives environment for all to operate.
- H/W Cluster : Helps in sharing high performance disks among all computers.
- If one cluster node fails, immediately other node take over its storage and resources , and try to restart.
- Whether forecasting , Scientific computing, Super computer systems.

There are primarily 3 types of clustered systems.

Asymmetric clustering system:

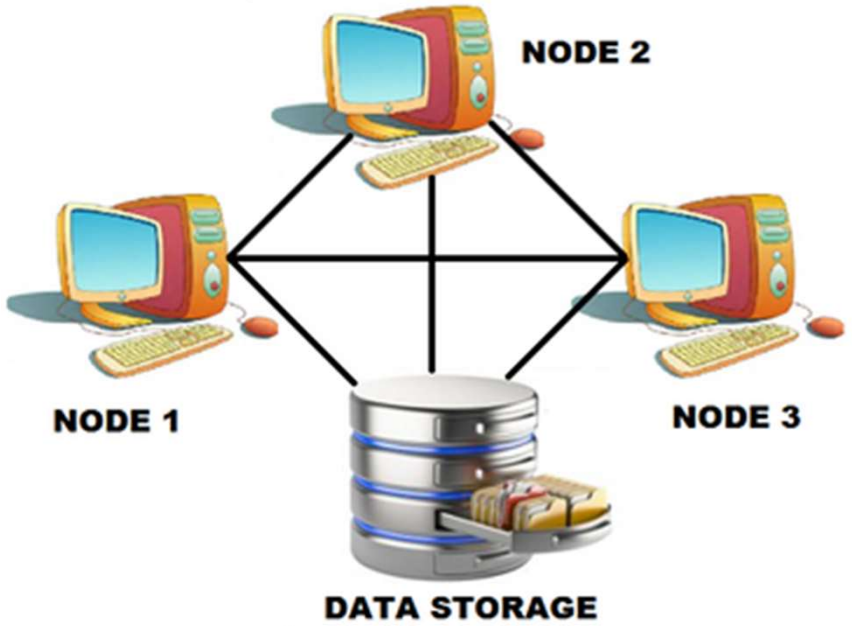
- In asymmetric clustering one notice on **hot standby** mode. And all others were on the applications.
- The node which is on hot standby some with like a backup or substitute. That means it monitors all the nodes in the network. It keeps track of every node. If any of the node fails, it take overs.

Hot standby mode



Symmetric clustering system:

- In symmetric system no node is on standby mode.
- All the nodes are doing the computation and all nodes monitor each other.
- In case of failure the work will be maintained by the node which is free or work accomplished.



Parallel Clustering System:

Several users access similar data on same shared storage.

Real-time system

- real-time system is used **when rigid time requirements** have been placed on the operation of a processor or the flow of data; thus, it is often used as a control device in a dedicated application. Sensors bring data to the computer.
- The computer must analyze the data and possibly adjust controls to modify the sensor inputs.
- Systems that control **scientific experiments, medical imaging** systems, **industrial control systems**, and certain display systems are real-time systems.
- Some **automobile-engine fuel-injection systems**, **home-appliance controllers**, and **weapon systems** are also real-time systems.
- A real-time system has well-defined, fixed time constraints. Processing must be done within the defined constraints, or the system will fail.
- For instance, it would not do for a robot arm to be instructed to halt after it had smashed into the car it was building.

Real-time systems come in two types:

Hard real time :

- A hard real-time system guarantees that critical tasks be **completed on time**.
- This goal requires that all delays in the system be bounded, from the retrieval of stored data to the time that it takes the operating system to finish any request made of it. Such time constraints dictate the facilities that are available in hard real-time systems.
- In Secondary **storage of any sort is usually limited or missing,** with data instead being stored in **short-term memory or in read-only memory (ROM)**. ROM is located on nonvolatile storage devices that retain their contents even in the case of electric outage; most other types of memory are volatile.
- That's why **virtual memory is almost never found** on real-time systems.

Soft real time:

- A less restrictive type of real-time system is a soft real-time system, where a critical real-time task gets priority over other tasks, and retains that priority until it completes.
- As in hard real-time systems, the operating-system kernel delays need to be bounded: A real-time task cannot be kept waiting indefinitely for the kernel to run it.
- Soft real time is an achievable goal that can be mixed with other types of systems. Soft real-time systems, however, have more limited utility than hard real-time systems.
- Given their lack of deadline support, they are risky to use for industrial control and robotics. They are useful, however in several areas, **including multimedia, virtual reality, and advanced scientific projects-such as undersea exploration and planetary rovers**.

Handheld systems

- Hand held devices like smart phones , tablets (PDA)
- Features :

1. It works to provide realtime operations.
2. Input/Output device flexibility.
3. Configurability.

- Types of hand held OS:
- Palm OS
- Symbian OS
- Linux OS
- Windows OS
- Android OS

Advantages:

- Low Cost
- Less heat generation
- Stability

Disadvantages:

I/p, O/P memory issues.

Thank you