Chapter 1

Introduction

Operating Systems
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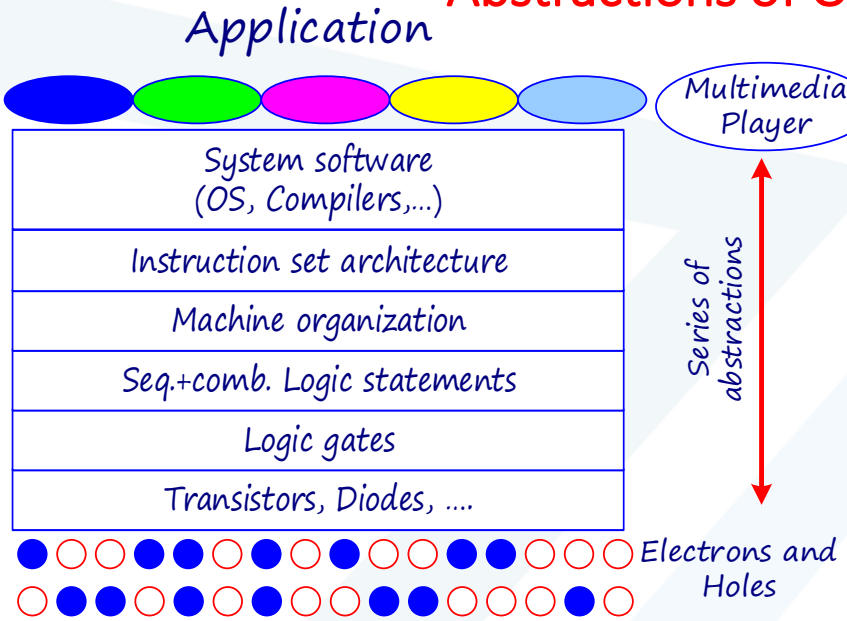
Objective

- To describe the basic organization of computer systems.
- To provide a grand tour of the major components of operating systems.
- To give an overview of the many types of computing environments.

Abstractions of OS



- A program that acts as an intermediary between a user of a computer and the computer hardware.
- Operating system goals:
  - Execute user programs and make solving user problems easier.
  - Make the computer system convenient to use
  - Use the computer hardware in an efficient manner.

Operating System Definitions

Resource allocator, Control program, Kernel

Resource allocator: manages and allocates resources.

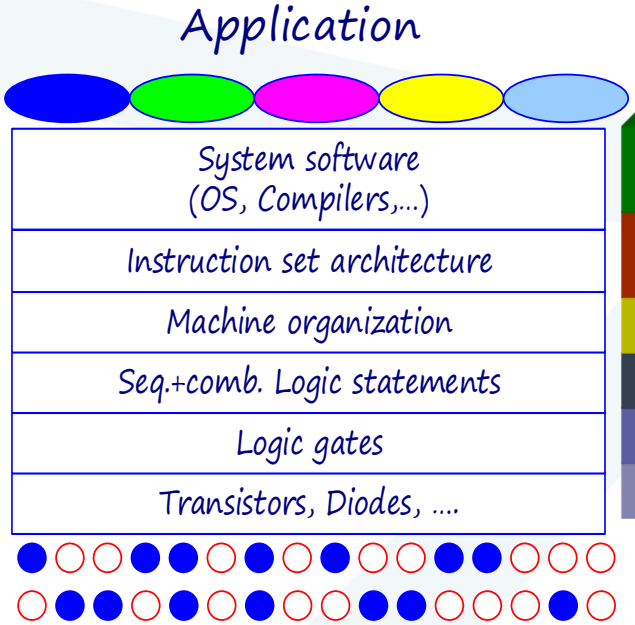
Control program: controls the execution of user programs and operations of I/O devices .

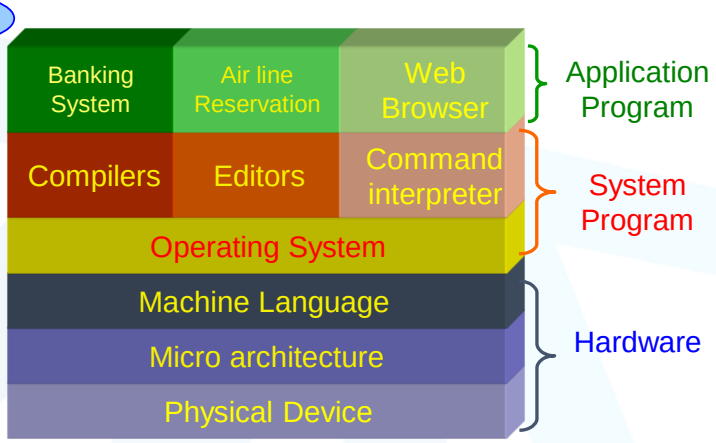
Kernel: the one program running at all times (all else being application programs).

Goals of OS

- **Primary:** convenience
  - make the computer system convenient to use
- **Secondary:** efficiency
  - use the computer hardware in an efficient manner
    - ✓ *The two goals are contradictory sometimes*

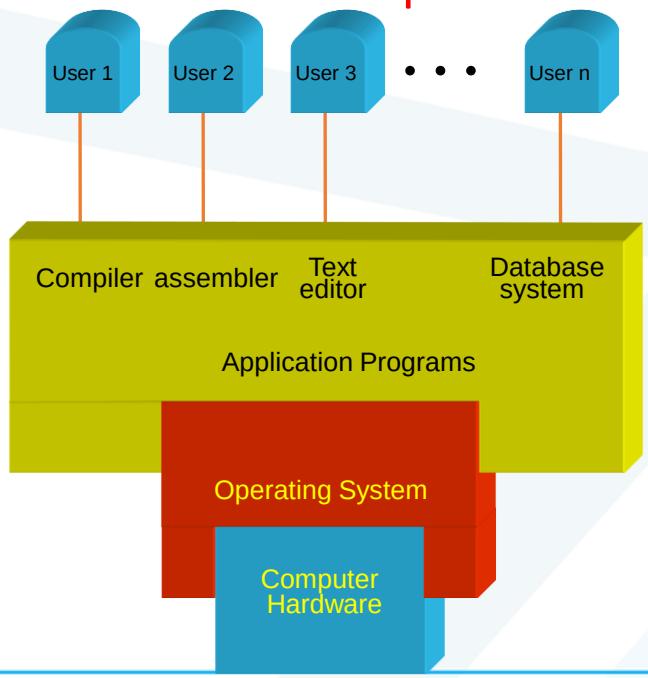
Computer System Components



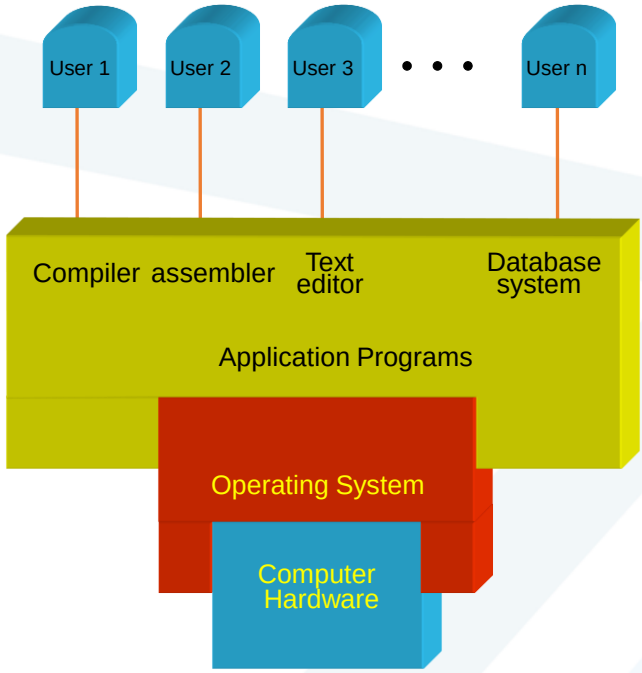


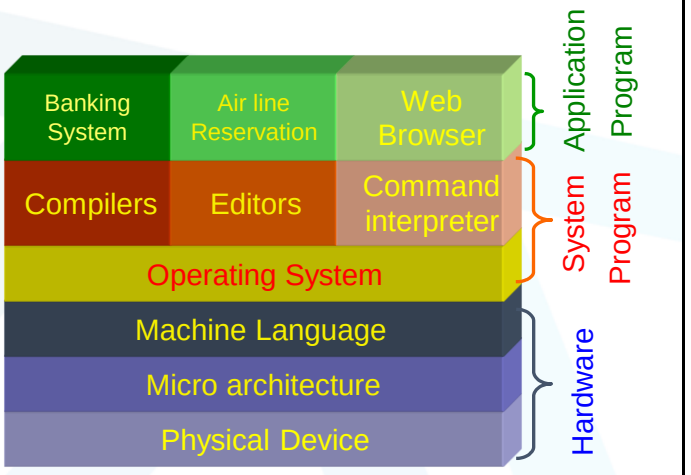
Computer system

Four Components of a Computer System



- Hardware (resource)
  - CPU, memory, I/O devices, ...
- Operating System (resource allocator)
- Applications (use resource to solve problems)
  - Compilers, database systems, games, business programs, ...
- Users
  - People, machines, other computers, ...





What Operating Systems Do

- Depends on the point of view
- Users want convenience, ease of use and good performance
  - Don't care about resource utilization
- But shared computer such as mainframe or minicomputer must keep all users happy
- Users of dedicate systems such as workstations have dedicated resources but frequently use shared resources from servers
- Handheld computers are resource poor, optimized for usability and battery life
- Some computers have little or no user interface, such as embedded computers in devices and automobiles

Operating System Definition

- 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

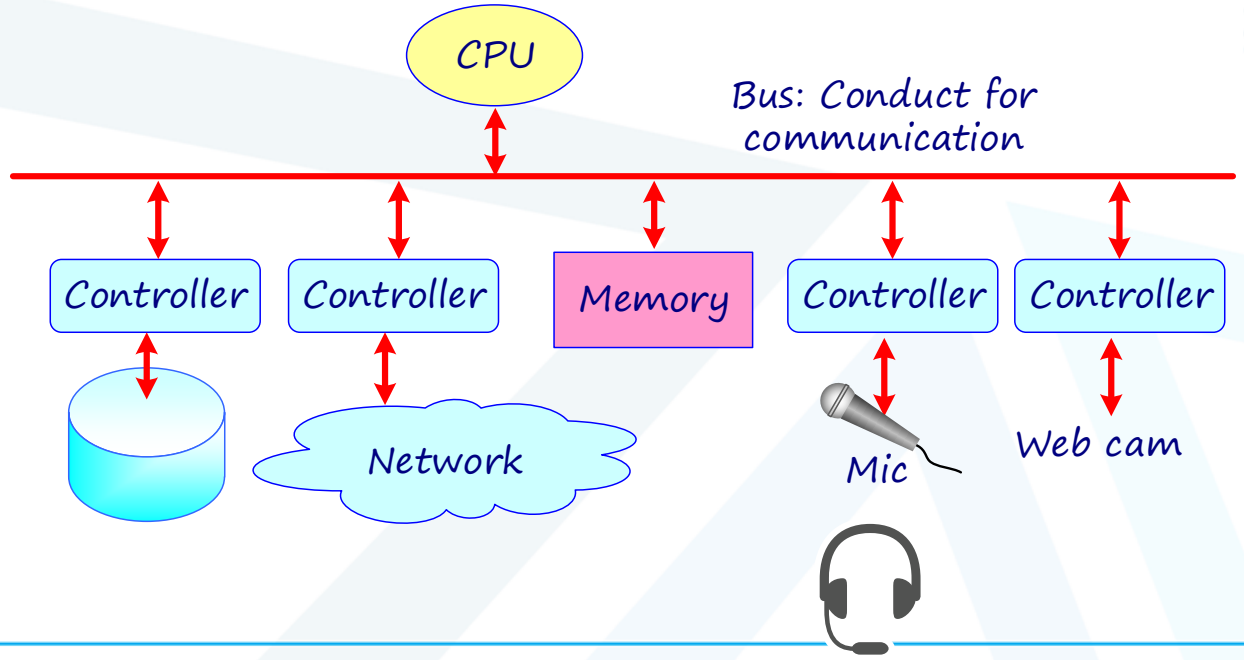
Operating System Definition (Cont.)

- No universally accepted definition
- "Everything a vendor ships when you order an operating system" is a good approximation
  - But varies wildly
- "The one program running at all times on the computer" is the **kernel**.
- Everything else is either
  - a system program (ships with the operating system) , or
  - an application program.

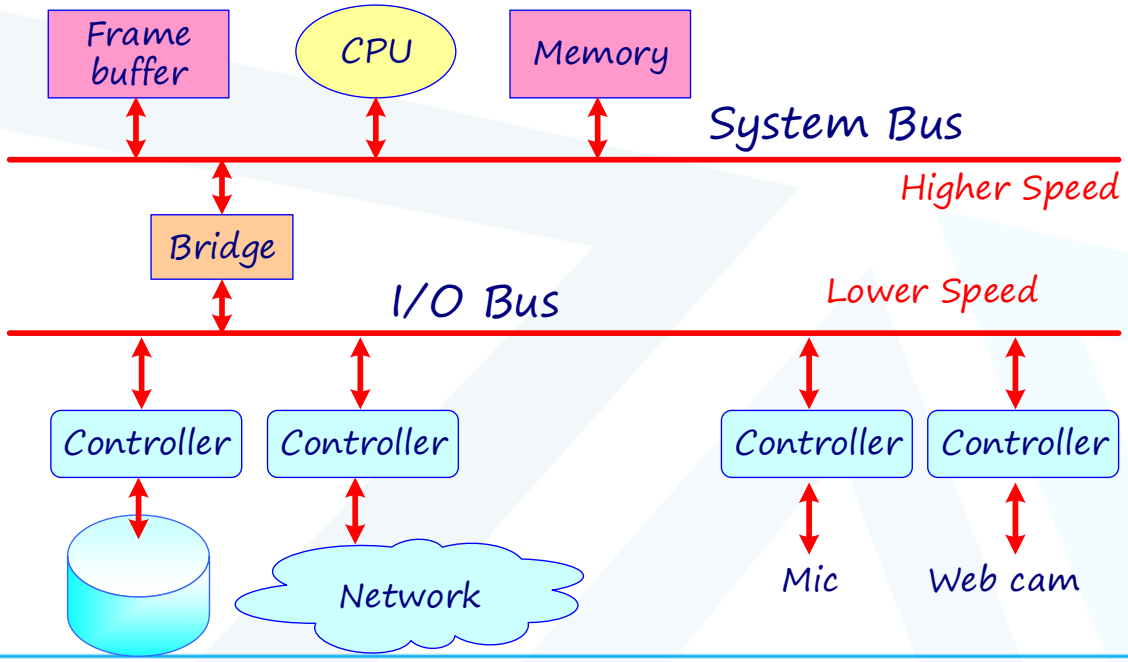
Computer Startup

- **bootstrap program** is loaded at power-up or reboot
  - Typically stored in ROM or EPROM, generally known as **firmware**
  - Initializes all aspects of system
  - Loads operating system kernel and starts execution

Components of a Computer System



Components of a Computer System



The Development of OS

First generation 1945 - 1955	Second generation 1955 - 1965	Third generation 1965 - 1980	Fourth generation 1980 - present
vacuum tubes, plug boards	transistors, batch systems	ICs and multiprogramming	Personal Computers
System operation was performed with the help of expert operators and without the benefit of an operating system	Single stream batch processing system, it collects all similar jobs in groups and then submits the jobs to the OS.	OS development continued with the introduction and widespread adoption of multiprogramming	Is characterised by the appearance of the PCs and the workstation. like Windows, Linux, MacOS etc.

Components of Operating System

Security Management

It refers to a mechanism for controlling the access of programs, processes, or users to the resources.

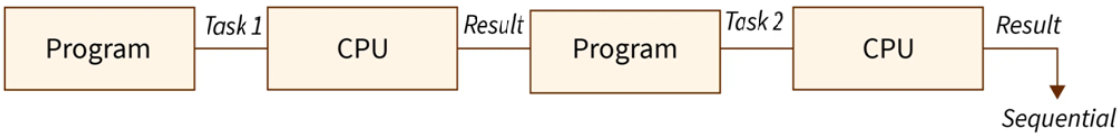
For example, memory addressing hardware ensure that a process can only execute within its own address space.

Finally, no process is allowed to do it's own I/O, to protect the integrity of the various peripheral devices.

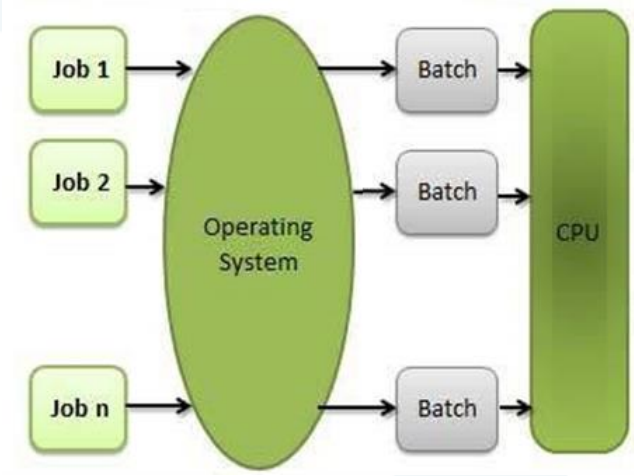
Types of Operating System

Serial Operating System

- Before the 1950 users used to give programs to the computer system itself as a **sequence of instructions** in the form of a punched card. These punched cards were first translated into a **card reader** and then it was submitted to the operating system.
- **The major drawbacks of the serial operating system were:**
  - No user and computer system interaction.
  - Very less memory.
  - It required a lot of time for program execution.
  - Only one program could be executed at a time.



Batch Processing Systems



Advantages

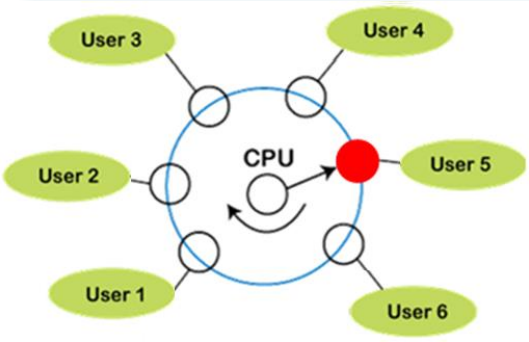
- Takes much of the work of the operator to the computer.
- Increased performance.

Disadvantages

- Difficult to debug program.
- A job could enter an infinite loop.
- One batch job can affect pending jobs.

Jobs are processed in a first come first served fashion.

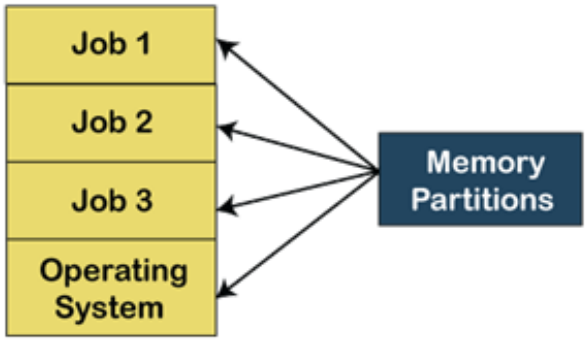
Multi-Tasking (Time-sharing) Processing System



Allows us to connect many people to share and use a specific system at a single time. It is the logical extension of the multiprogramming through which users can run multiple tasks concurrently.

It provides each user his terminal for input or output that impacts the program or processor currently running on the system. It represents the CPU's time is shared between many user processes. Or, the processor's time that is shared between multiple users simultaneously termed as time-sharing.

Multiprogramming Processing Systems



It keeps several jobs in memory at a

Advantages

High and efficient CPU utilization.

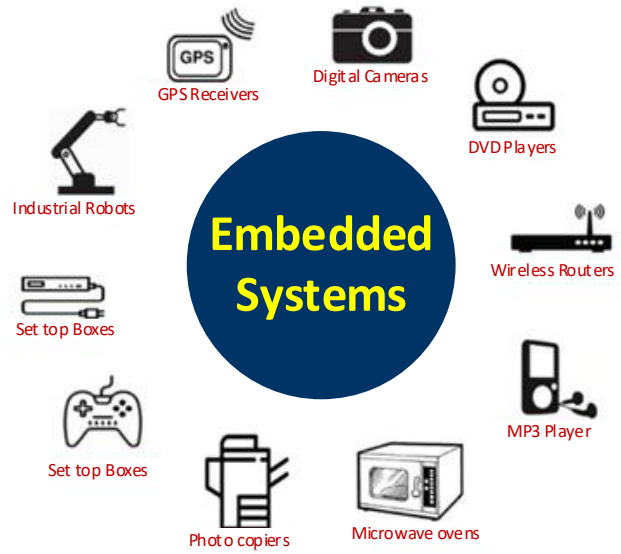
User feels that many programs are allotted CPU almost simultaneously.

Disadvantages

CPU scheduling is required.

memory management is required.

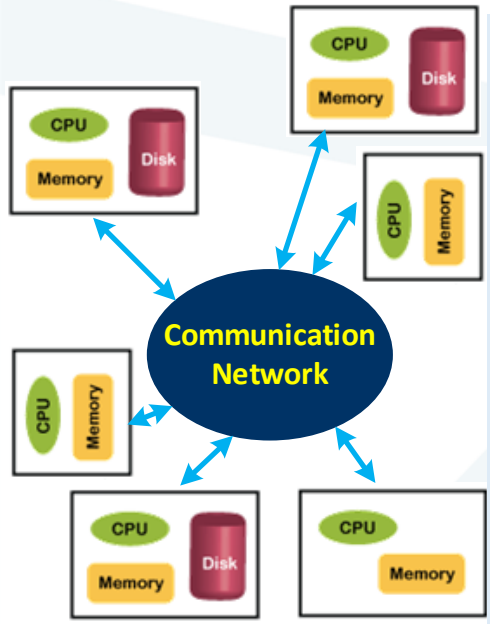
Embedded Processing Systems



These operating systems are designed to work on dedicated devices like automated teller machines (ATMs), airplane systems, digital home assistants, and the internet of things (IoT) devices.

general purpose computers or devices.

Distributed Processing Systems



Features of Distributed Operating System

Resource Sharing: The data is shared for the exchange of information, whereas the hardware resources are shared for convenience and reduction in cost.

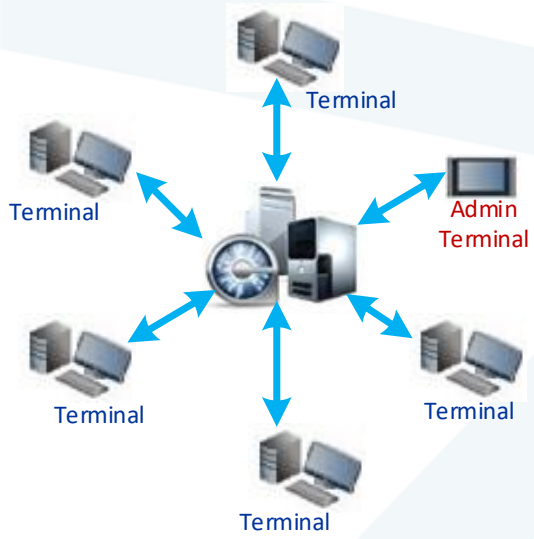
Concurrency: different tasks are handled by different concurrently interacting machines or computers.

Scalability: new computers or units can be added to the feature if needed.

Security: must Ensures transparency and security between users.

Heterogeneity: several programming languages, operating systems , software, hardware, networks implemented by different developers.

Network Processing Systems

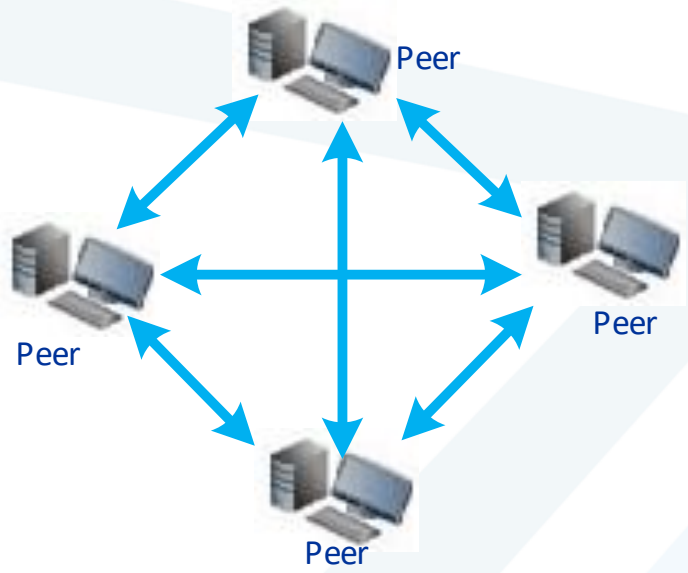


It operates on terminals using network devices like a switch, router, or firewall to handle data, applications and other network resources.

It provides connectivity among the autonomous operating system.

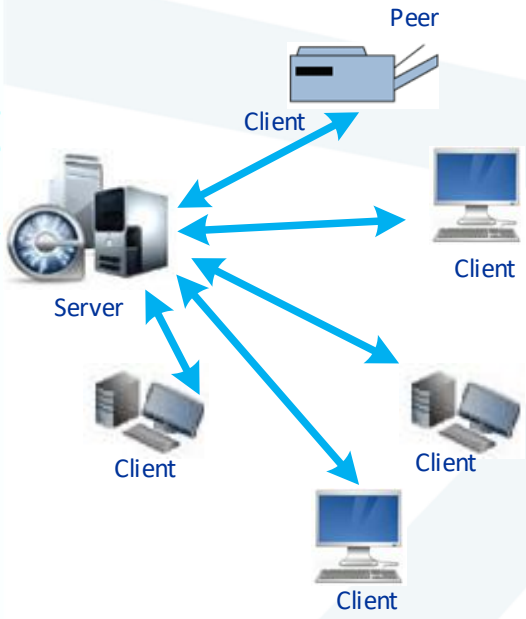
It is also useful to share data, files, hardware devices and printer resources among multiple computers to communicate with each other.

Type of Network Processing Systems



Peer-to-peer network operating system: The type of network operating system allows users to share files, resources between two or more computer machines using a LAN.

Type of Network Processing Systems

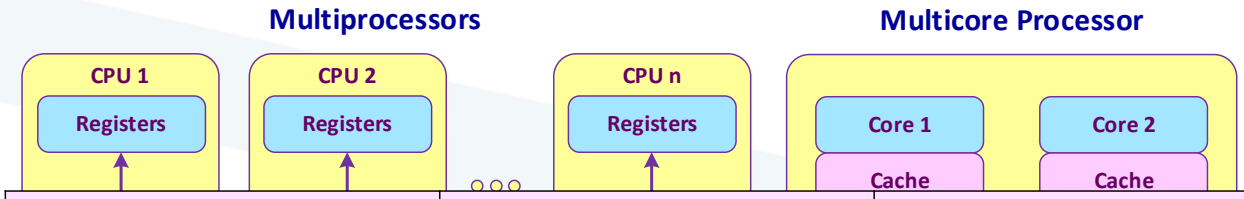


Client-Server network operating system:
It allows the users to access resources, functions, and applications through a common server or center hub of the resources.
The client workstation can access all resources that exist in the central hub of the network.
Multiple clients can access and share different types of the resource over the network from different locations.

Multiprocessing Operating System

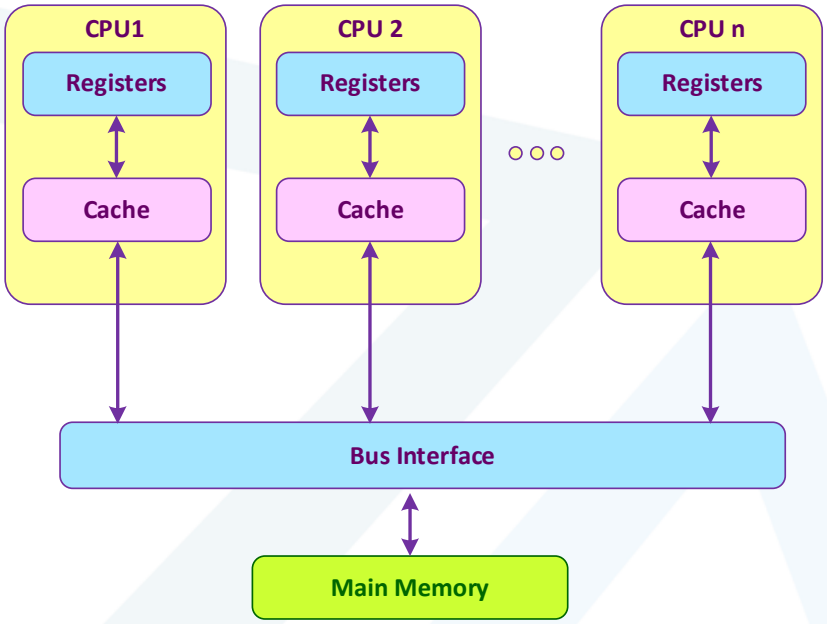
❖It is the type of operating system that refers to using two or more central processing units (CPU) in a single computer system. However, these multiprocessor systems or parallel operating systems are used to increase the computer system's efficiency. With the use of a multiprocessor system, they share computer bus, clock, memory and input or output device for concurrent execution of process or program and resource management in the CPU.

Multiprocessing and Multicore Operating System

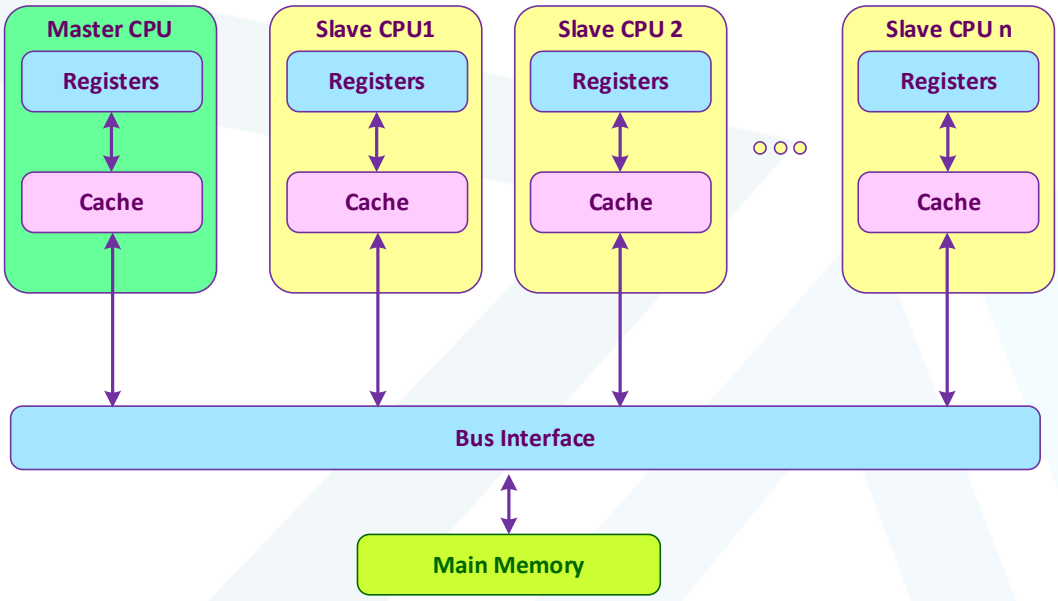


		A multicore processor
	It is more reliable than the multicore system. If one of any	It is not much reliable
Cost	It is more expensive as	These are cheaper than the
Configuration	It requires complex configuration.	It doesn't need to be configured.

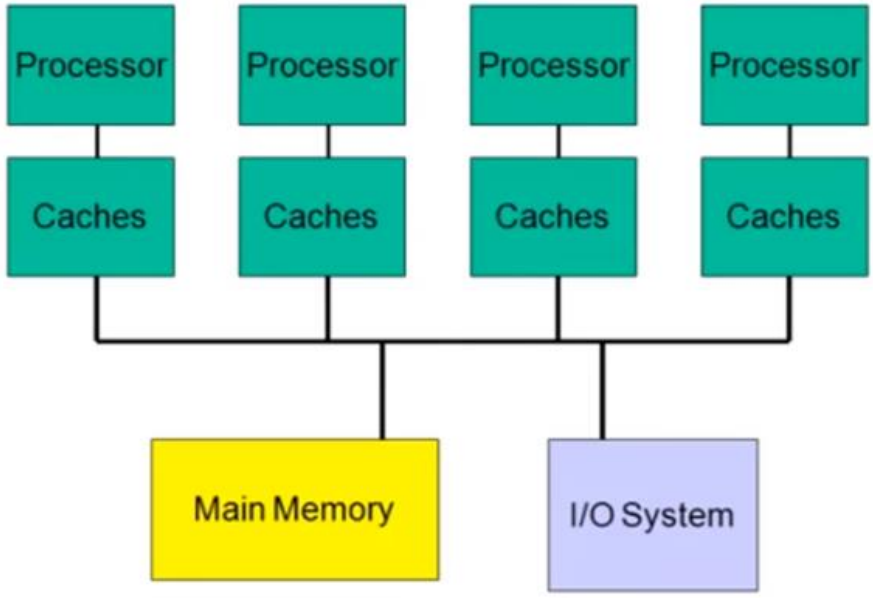
Symmetric Multiprocessing Architecture



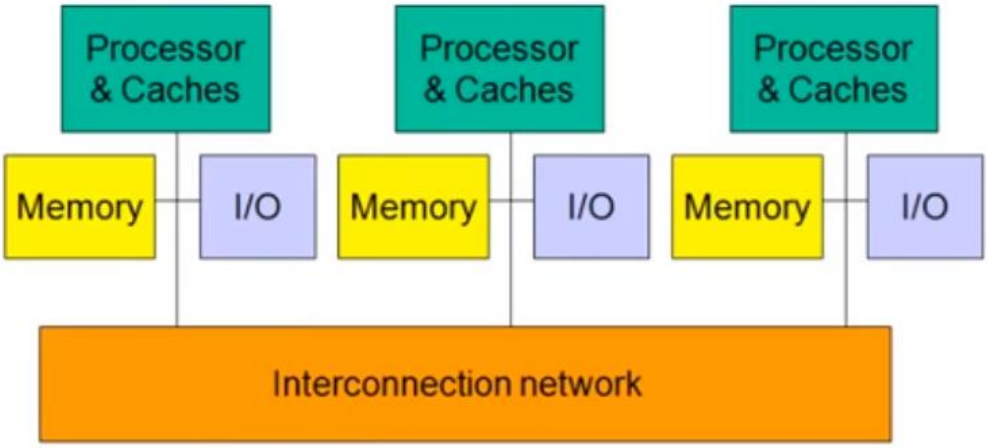
Asymmetric Multiprocessing Architecture



Centralized Shared-Memory Multiprocessing Architecture



Distributed Memory Multiprocessors



Real-Time Operating System

❖A real-time operating system is an important type of operating system used to provide services and data processing resources for applications in which the time interval required to process & respond to input/output should be so small without any delay real-time system. For example, real-life situations governing an automatic car, traffic signal, nuclear reactor or an aircraft require an immediate response to complete tasks within a specified time delay. Hence, a real-time operating system must be fast and responsive for an embedded system, weapon system, robots, scientific research & experiments and various real-time objects.

Hard Real-Time System

These types of OS are used with those required to complete critical tasks within the defined time limit. If the response time is high, it is not accepted by the system or may face serious issues like a system failure. In a hard real-time system, the secondary storage is either limited or missing, so these system stored data in the ROM.

Soft Real-Time System

A soft real-time system is a less restrictive system that can accept software and hardware resources delays by the operating system. In a soft real-time system, a critical task prioritizes less important tasks, and that priority retains active until completion of the task. Also, a time limit is set for a specific job, which enables short time delays for further tasks that are acceptable. For example, computer audio or video, virtual reality, reservation system, projects like undersea, etc.