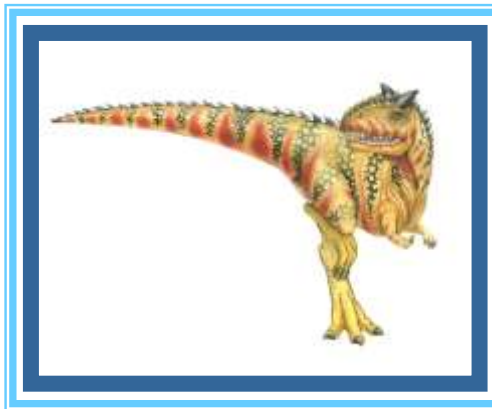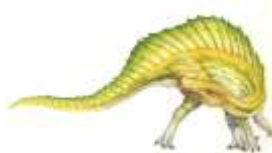# OS-1

What is an Operating System?

- 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

Types of OS

Different Types of Operating System:

- Batch OS

- Distributed OS

- Multi tasking OS / Time Sharing OS

- Network OS

- Cluster OS
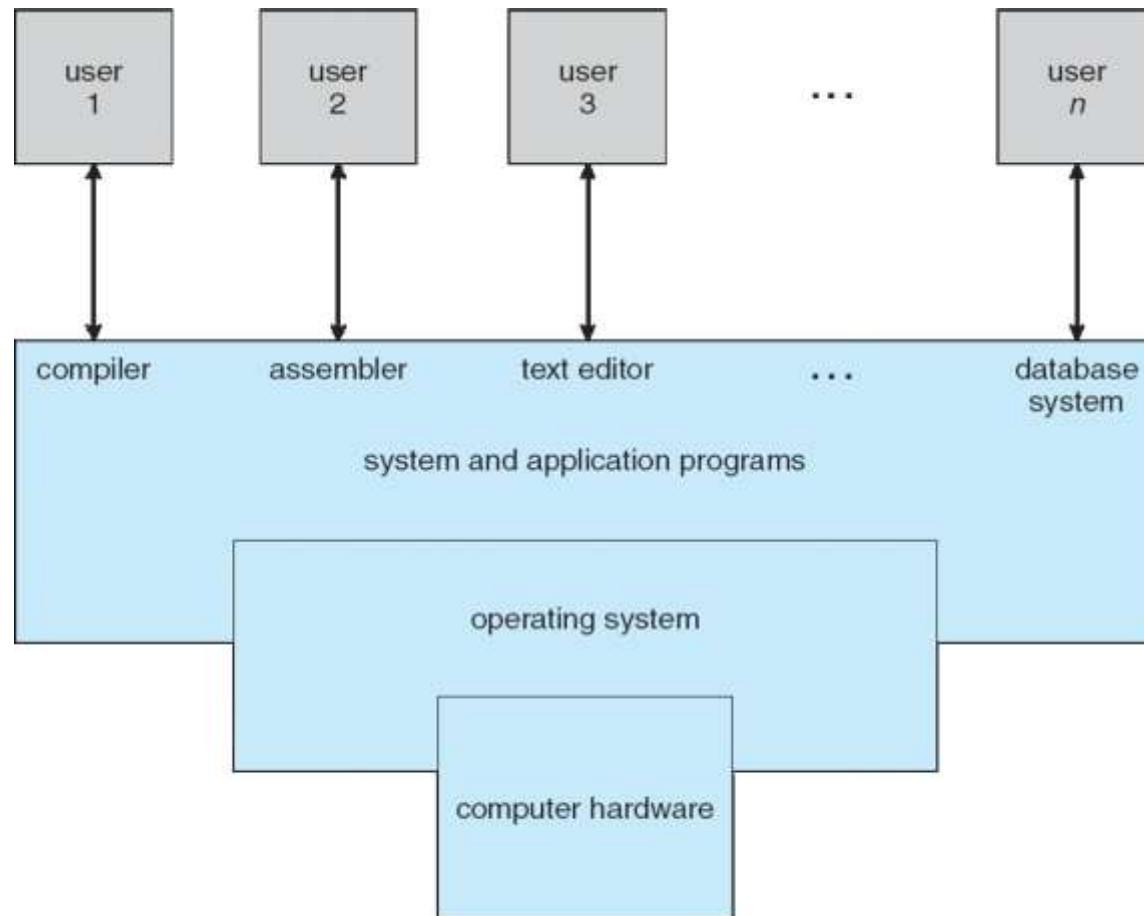
- Real Time OS

- Embedded OS

- Mobile OS etc.

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

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.

KERNEL

■ **Kernel:** In computing, The Kernel is a computer program that manages I/O (Input/Output) requests from software, and translates them into data processing instructions for the central processing unit and other electronic components of a computer. The Kernel is a fundamental part of a modern computer's Operating System.
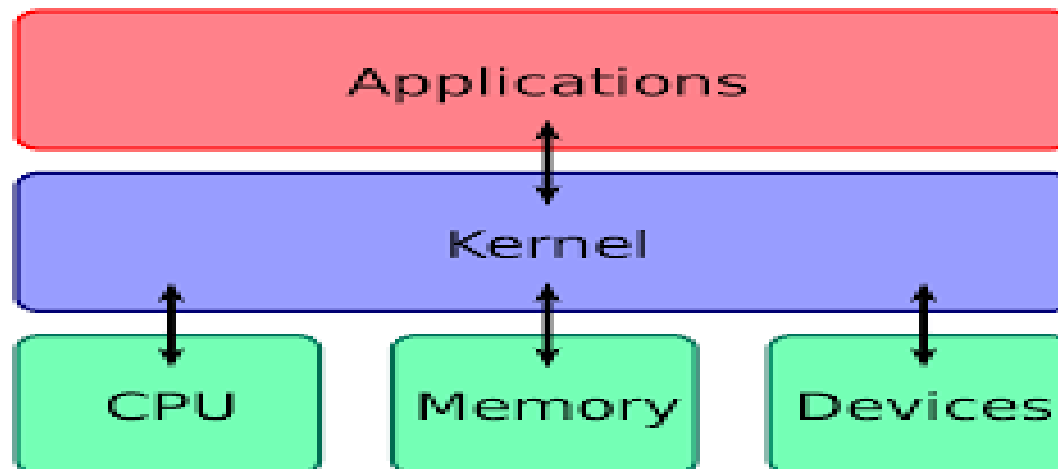
What is BIOS?

- **Boot Loader:** When turned on, a computer has a clear state. This means that there are no programs in its memory and that its components cannot be accessed.

   A **bootloader** helps to load the operating system (OS) or runtime environment   to add programs to memory and provide access for components. It is needed to run the startup process, initialize the hardware and pass control to the kernel, which initializes the operating system (OS).

<div align="center">

System Start → bootloader → Kernel

</div>

- **BIOS:** BIOS(Basic Input / Output System) is the program a computer's microprocessor uses to start the computer system after it is powered on. It also manages data flow between the computer's operating system (OS) and attached devices, such as the hard disk, video adapter, keyboard, mouse and printer.

Computer-System Architecture

- Most systems use a single general-purpose processor
  - Most systems have special-purpose processors as well

- **Multiprocessors** systems growing in use and importance
  - Also known as **parallel systems**, **tightly-coupled systems**
  - Advantages include:
    1. **Increased throughput**
    2. **Economy of scale**
    3. **Increased reliability** – graceful degradation or fault tolerance
  - Two types:
    1. **Asymmetric Multiprocessing** – each processor is assigned a specie task.
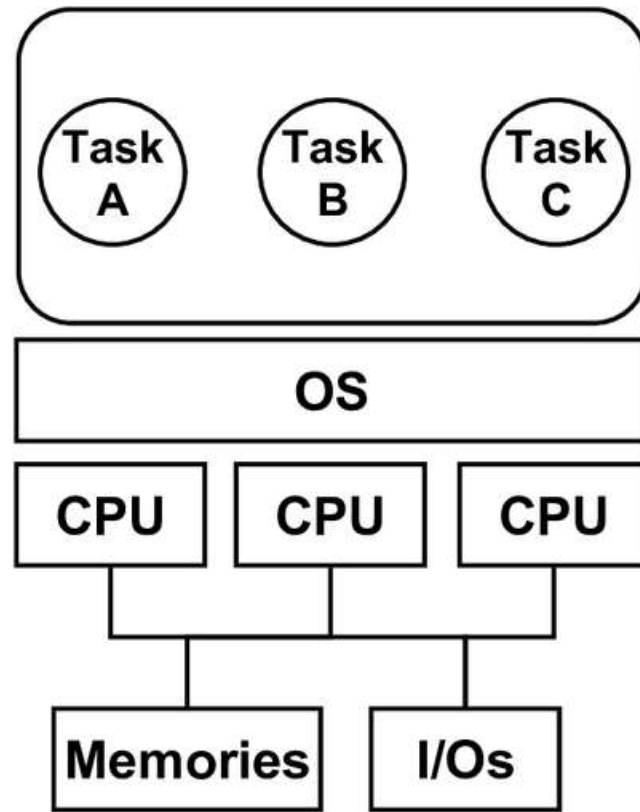   2. **Symmetric Multiprocessing** – each processor performs all tasks

Continued…
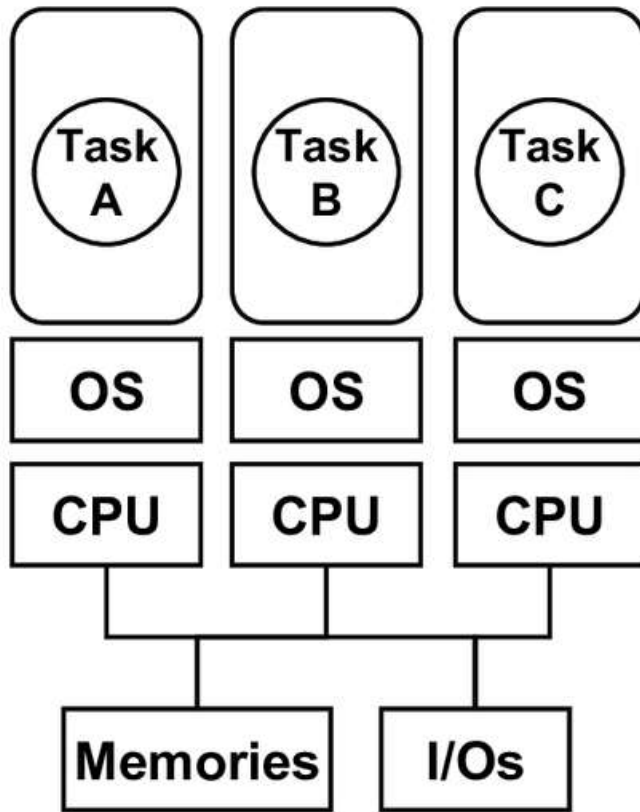
(a) Asymmetric Multi-Processing (AMP)

(b) Symmetric Multi-Processing (SMP)

Operating System Services

■ Operating systems provide an environment for execution of programs and services to programs and users

■ One set of operating-system services provides functions that are helpful to the user:

- **User interface** - Almost all operating systems have a user interface (**UI**).

  ▸ Varies between **Command-Line (CLI)**, **Graphics User Interface (GUI)**,

- **Program execution** - The system must be able to load a program into memory and to run that program, end execution, either normally or abnormally (indicating error)

- **I/O operations** - A running program may require I/O, which may involve a file or an I/O device

Operating System Services (Cont.)

- One set of operating-system services provides functions that are helpful to the user (Cont.):

  - **File-system manipulation** - The file system is of particular interest. Programs need to read and write files and directories, create and delete them, search them, list file Information, permission management.

  - **Communications** – Processes may exchange information, on the same computer or between computers over a network
    - Communications may be via shared memory or through message passing (packets moved by the OS)

  - **Error detection** – OS needs to be constantly aware of possible errors
    - May occur in the CPU and memory hardware, in I/O devices, in user program
    - For each type of error, OS should take the appropriate action to ensure correct and consistent computing
    - Debugging facilities can greatly enhance the user's and programmer's abilities to efficiently use the system

Operating System Services (Cont.)

- Another set of OS functions exists for ensuring the efficient operation of the system itself via resource sharing
  - **Resource allocation -** When multiple users or multiple jobs running concurrently, resources must be allocated to each of them
    - ‣ Many types of resources - CPU cycles, main memory, file storage, I/O devices.
  - **Accounting -** To keep track of which users use how much and what kinds of computer resources
  - **Protection and security -** The owners of information stored in a multiuser or networked computer system may want to control use of that information, concurrent processes should not interfere with each other
    - ‣ **Protection** involves ensuring that all access to system resources is controlled
    - ‣ **Security** of the system from outsiders requires user authentication, extends to defending external I/O devices from invalid access attempts

A View of Operating System Services