CSE-309
Operating Systems

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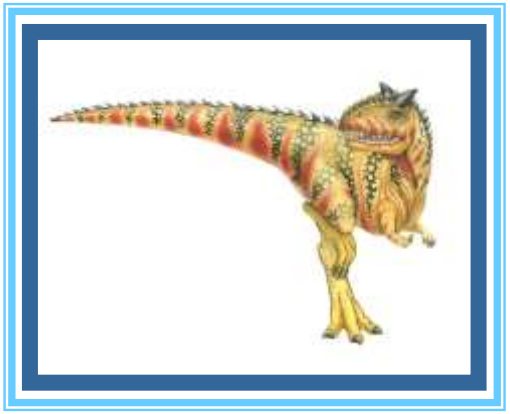
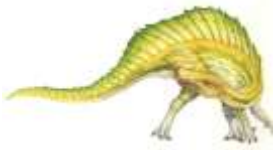
Chapter 1: Introduction



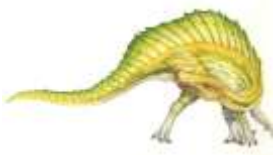
Chapter 1: Introduction

- What Operating Systems Do
- Computer-System Organization
- Computer-System Architecture
- Operating-System Structure
- Operating-System Operations
- Process Management
- Memory Management
- Storage Management
- Protection and Security
- Kernel Data Structures
- Computing Environments
- Open-Source Operating Systems



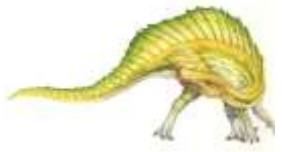
Objectives

- 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
- To explore several open-source operating systems



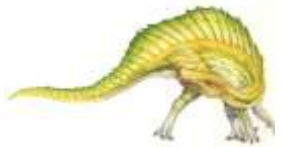
What is an Operating System?

- 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

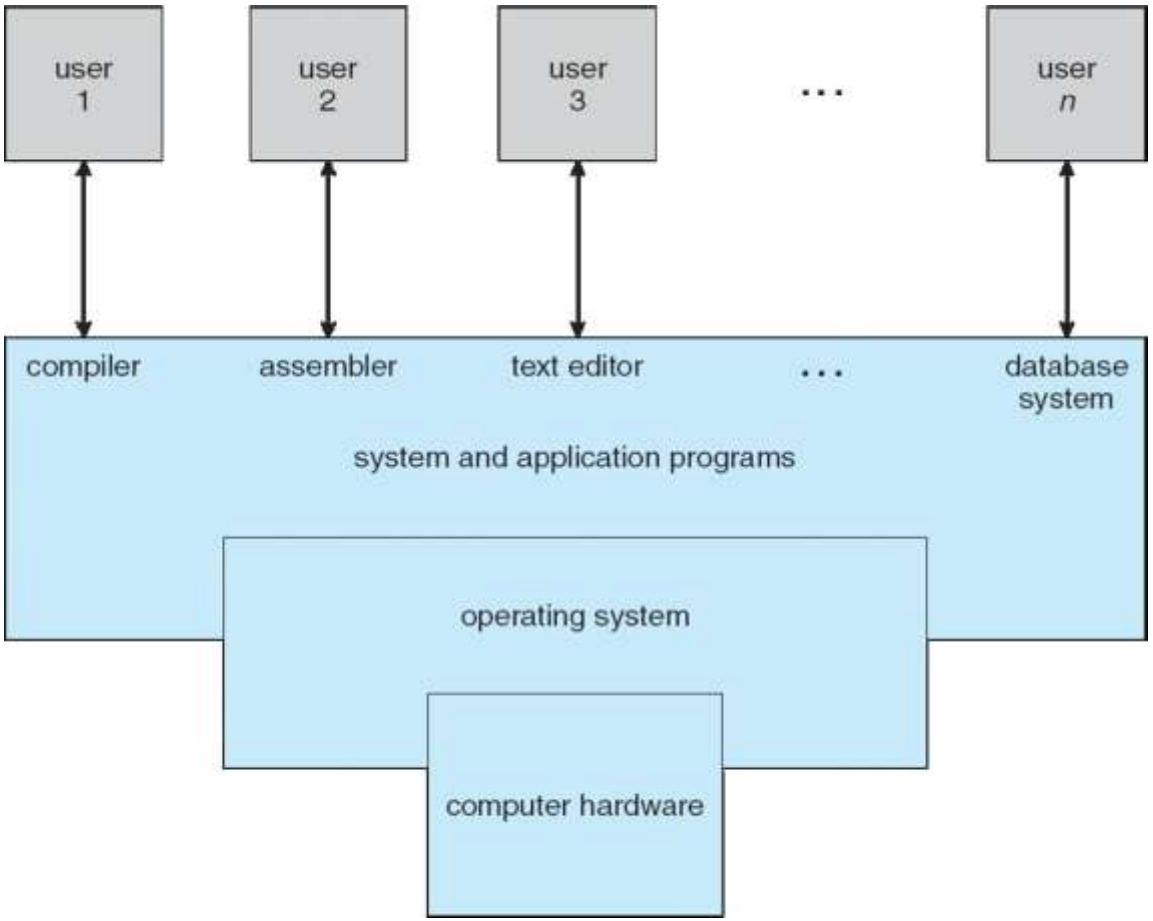


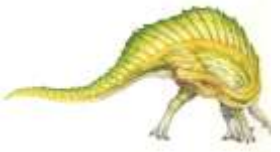
Computer System Components

- 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



Four Components of a Computer System





Functions of Operating System

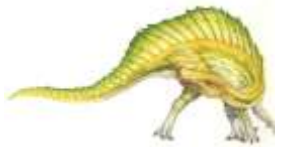
Main functions of Operating system

A separate module of operating system software performs each of the function:

(1). **Process management**:- Process management module takes care of creation and deletion of processes, and providing mechanisms for synchronization and communication among processes.

(2). **Memory management**:- Memory management module takes care of allocation and de-allocation of memory space to programs in need of this resources.

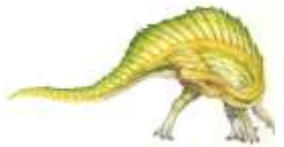
(3). **File management**:- It takes care of file-related activities such as organization storage, retrieval, naming, sharing, and protection of files.



Functions of Operating System

(4). **Security**:- Security module protects the resources and information of a computer system against destruction and unauthorized access.

(5). **Command interpretation**:- Command interpretation module takes care of interpreting user commands, and directing system resources to process the commands.



Classification of Operating System

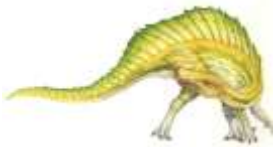
Operating System can also be classified as:-

(1). **Single User Systems**:-They are popularly associated with Desktop operating system which run on standalone systems where no user accounts are required.

Example: DOS.

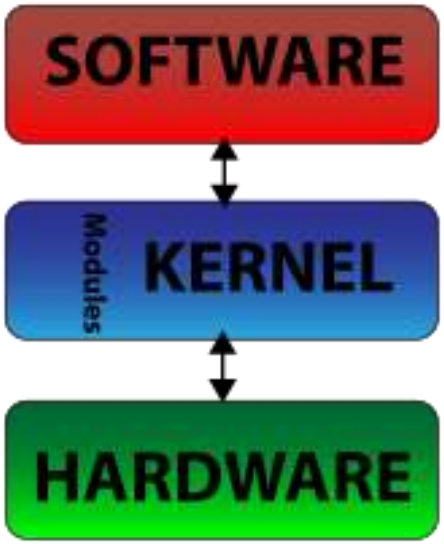
(2). **Multi User Systems**:-Provides regulated access for a number of users by maintaining a database of known users. Refers to computer systems that support two or more simultaneous users.

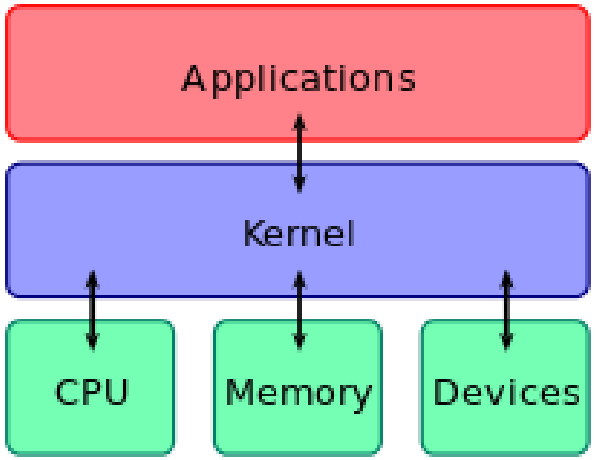
Example: Unix, Microsoft Windows NT.



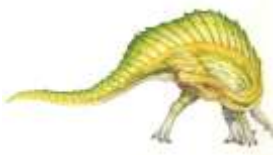
Computer Startup

- **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





A kernel connects the application software to the hardware of a computer.



Kernel

- "The one program running at all times on the computer" is the **kernel**.
- The **kernel** is a computer program which is the central module of an operating system (OS). It loads first (after the bootloader), and it remains in main memory.
- It handles the rest of start-up as well as input/output requests from software, translating them into data-processing instructions for the central processing unit.
- It handles memory and peripherals like keyboards, monitors, printers, and speakers.

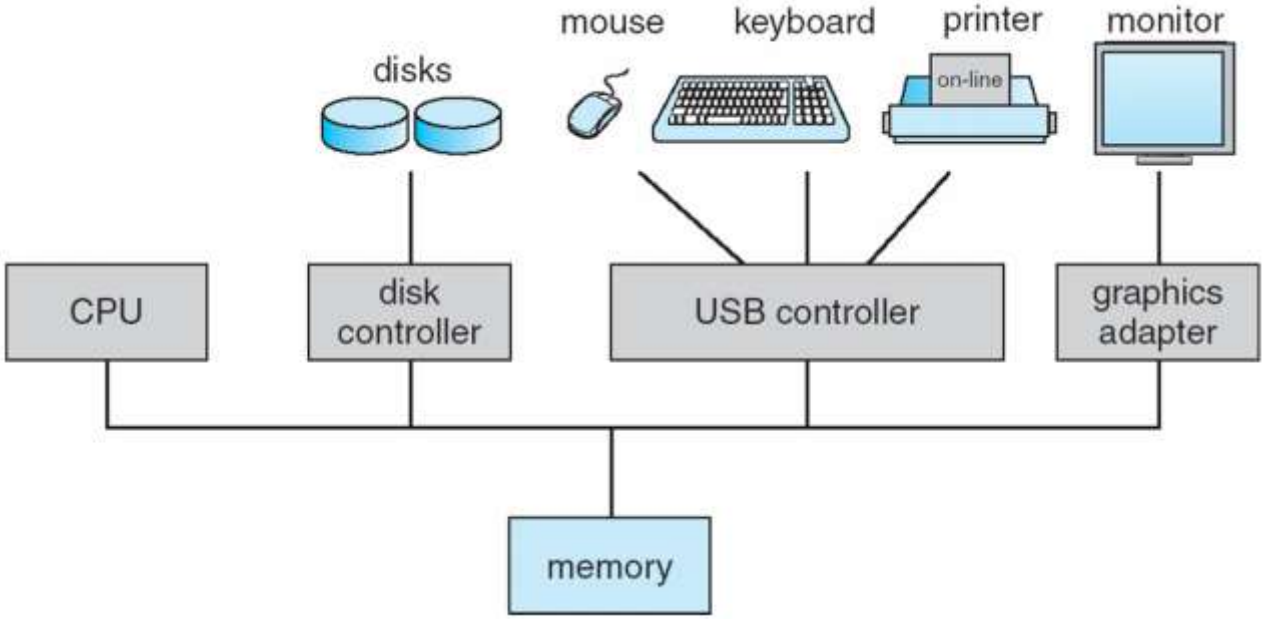
There are two types of kernels:

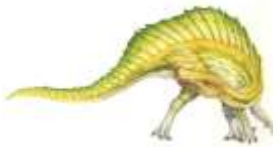
- A microkernel, which only contains basic functionality;
- A monolithic kernel, which contains many device drivers.

A computer user never interacts directly with the kernel. It runs behind the scenes and cannot be seen.

Computer System Organization

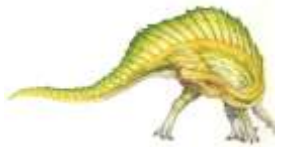
- Computer-system Organization
  - One or more CPUs, device controllers connect through common bus providing access to shared memory
  - Concurrent execution of CPUs and devices competing for memory cycles.





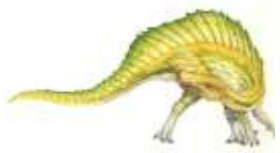
Computer-System Operation

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



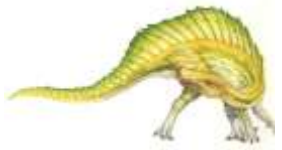
Storage Structure

- Main memory – only storage media that the CPU can access directly
  - **Random access**
  - Typically **volatile**
- Secondary storage – extension of main memory that provides large **nonvolatile** storage capacity
- Hard disks – rigid metal or glass platters covered with magnetic recording material
  - Disk surface is logically divided into **tracks**, which are subdivided into **sectors**
  - The **disk controller** determines the logical interaction between the device and the computer
- **Solid-state disks** – faster than hard disks, nonvolatile
  - Various technologies
  - Becoming more popular

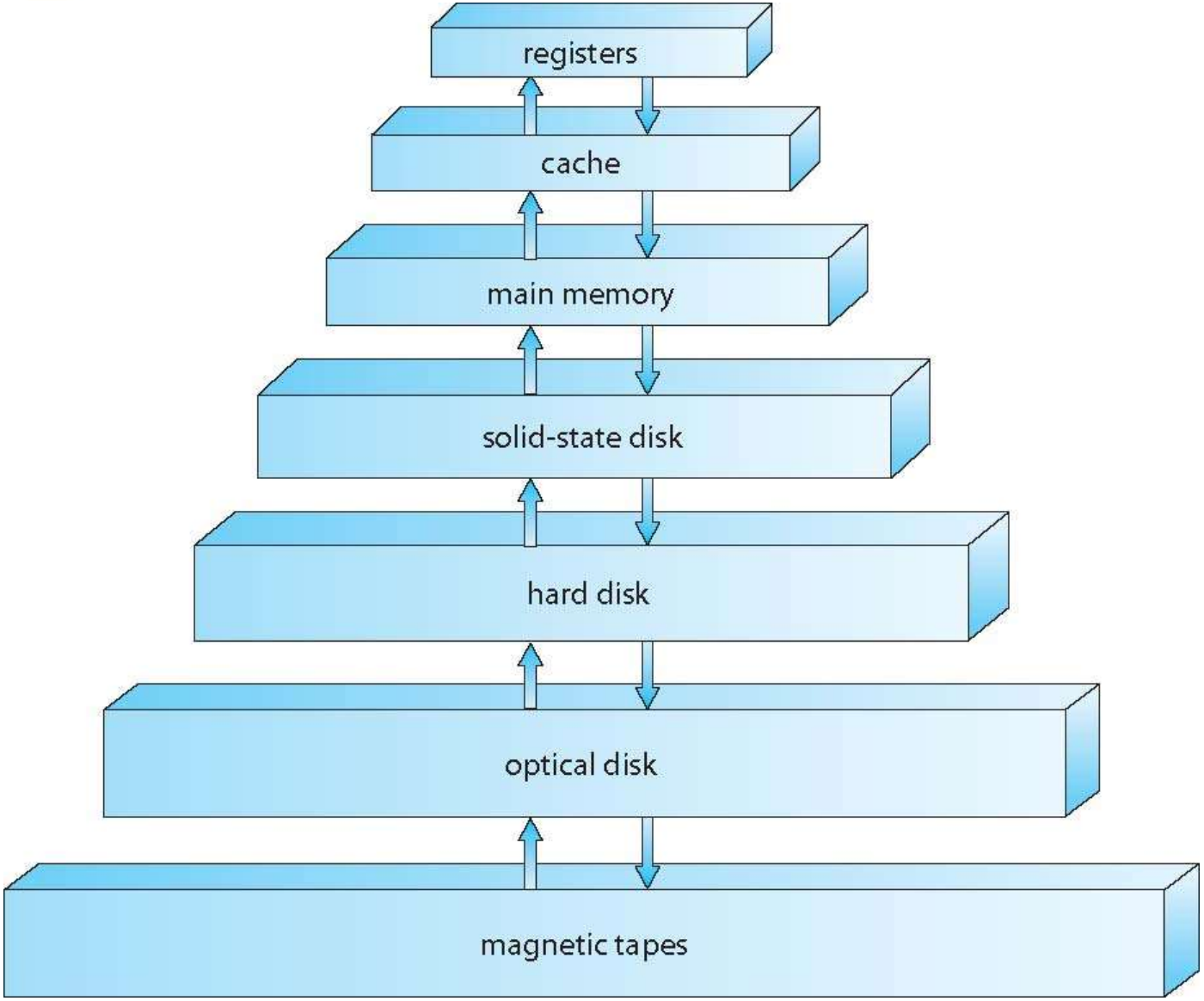


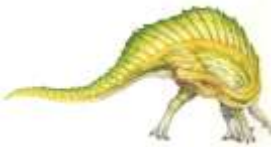
Storage Hierarchy

- Storage systems organized in hierarchy
  - Speed
  - Cost
  - Volatility
- **Caching** – copying information into faster storage system; main memory can be viewed as a cache for secondary storage
- **Device Driver** for each device controller to manage I/O
  - Provides uniform interface between controller and kernel



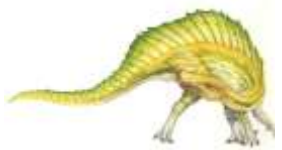
Storage-Device Hierarchy





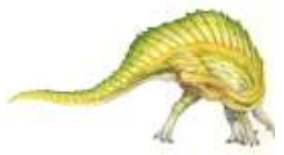
Caching

- Important principle, performed at many levels in a computer (in hardware, operating system, software)
- Information in use copied from slower to faster storage temporarily
- Faster storage (cache) checked first to determine if information is there
  - If it is, information used directly from the cache (fast)
  - If not, data copied to cache and used there
- Cache smaller than storage being cached
  - Cache management important design problem
  - Cache size and replacement policy



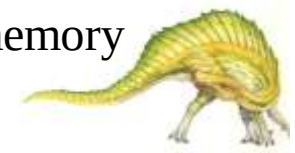
Direct Memory Access Structure

- Used for high-speed I/O devices able to transmit information at close to memory speeds
- Device controller transfers blocks of data from buffer storage directly to main memory without CPU intervention
- Only one interrupt is generated per block, rather than the one interrupt per byte

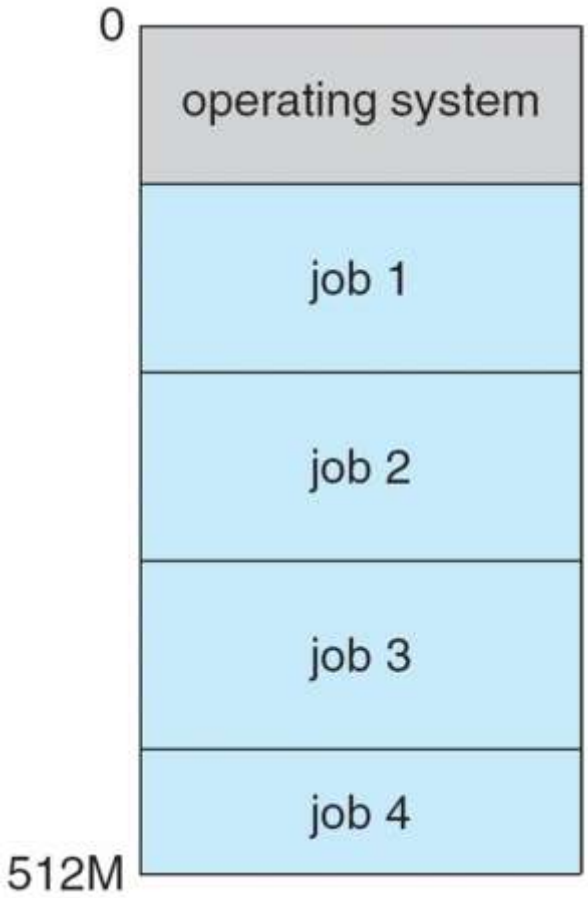


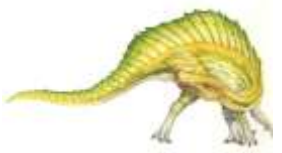
Operating System Structure

- **Multiprogramming** (**Batch system**) needed for efficiency
  - Single user cannot keep CPU and I/O devices busy at all times
  - Multiprogramming organizes jobs (code and data) so CPU always has one to execute
  - A subset of total jobs in system is kept in memory
  - One job selected and run via **job scheduling**
  - When it has to wait (for I/O for example), OS switches to another job
- **Timesharing** (**multitasking**) is logical extension in which CPU switches jobs so frequently that users can interact with each job while it is running, creating **interactive** computing
  - **Response time** should be < 1 second
  - Each user has at least one program executing in memory ⇨**process**
  - If several jobs ready to run at the same time ⇨ **CPU scheduling**
  - If processes don't fit in memory, **swapping** moves them in and out to run
  - **Virtual memory** allows execution of processes not completely in memory



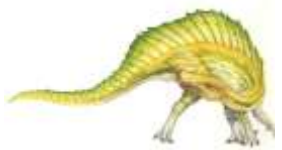
Memory Layout for Multiprogrammed System





Open-Source Operating Systems

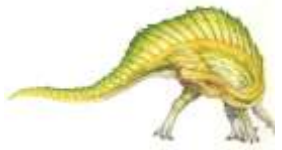
- Operating systems made available in source-code format rather than just binary **closed-source**
- Counter to the **copy protection** and **Digital Rights Management (DRM)** movement
- Started by **Free Software Foundation (FSF)**, which has "copyleft" **GNU Public License (GPL)**
- Examples include **GNU/Linux** and **BSD UNIX** (including core of **Mac OS X**), and many more
- Can use VMM like VMware Player (Free on Windows), Virtualbox (open source and free on many platforms - http://www.virtualbox.com)
  - Use to run guest operating systems for exploration



Memory

Questions?

- What is an Operating System?
- What are the goals of an operating system?
- Why OS is required in computer system?
- Describe Computer System Components.
- What are the functions of Operating System?
- Classify of Operating System based on user.
- Define Kernel with types.
- Describe computer system organization and operation.
- Write short note on timesharing and multiprogramming



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