Chapter 1: Introduction

CS 231	Operating Systems	3-0-0-6

Syllabus : Process Management: process, thread, scheduling; Concurrency: mutual exclusion, synchronization, semaphores, deadlocks; Memory Management: allocation, protection, hardware support, paging, segmentation; Virtual Memory: demand paging, allocation, replacement, swapping, segmentation, TLBs; File Management: naming, file operations and their implementation; File Systems: allocation, free space management, directory management, mounting; I/O Management: device drivers, disk scheduling, Basics of Security
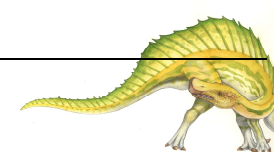
Text :

1. Silberschatz, A. and Galvin, P. B. Operating System Concepts. 8/e. Wiley, 2008.
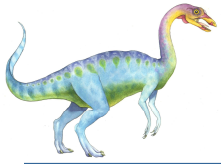
References :

1. Stalling, W. Operating Systems: Internals and Design Principles. 6/e. Pearson, 2008.

2. Tanenbaum, A. S. Modern Operating System. 3/e. Pearson, 2007.

3. Dhamdhere, D. M. Operating SystemsA Concept Based Approach, McGrawHill, 2008

Marking

- Tentative marking scheme

    - 30% Midsem

    - 50% Endsem

    - 20% Class test (2 tests)
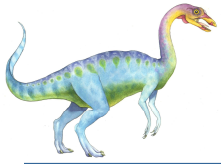
- Marking can slightly deviate from it

Main Contents

- Why we need Operating Systems

- Main components of computer system

- Storage Device Hierarchy

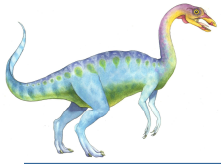- Main Functions of Operating Systems

Use of computer

- Web browsing -> Web browser

- Watching video -> Media player

- Text editing -> Office software

- Email -> Web browser
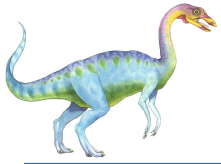

For each use, there is a program.

What is an Operating System?

- A program that acts as an intermediary between a user of a computer and the computer hardware.

- "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 System Structure

- Computer system can be divided into four components:

    - Hardware

        ▸ CPU, memory, I/O devices

    - Operating system

        ▸ Controls and coordinates use of hardware among various applications and users

    - Application programs

        ▸ Word processors, compilers, web browsers, database systems, video games

    - Users

        ▸ People, machines, other computers
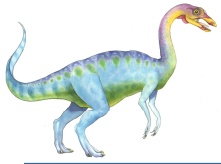
Four Components of a Computer System
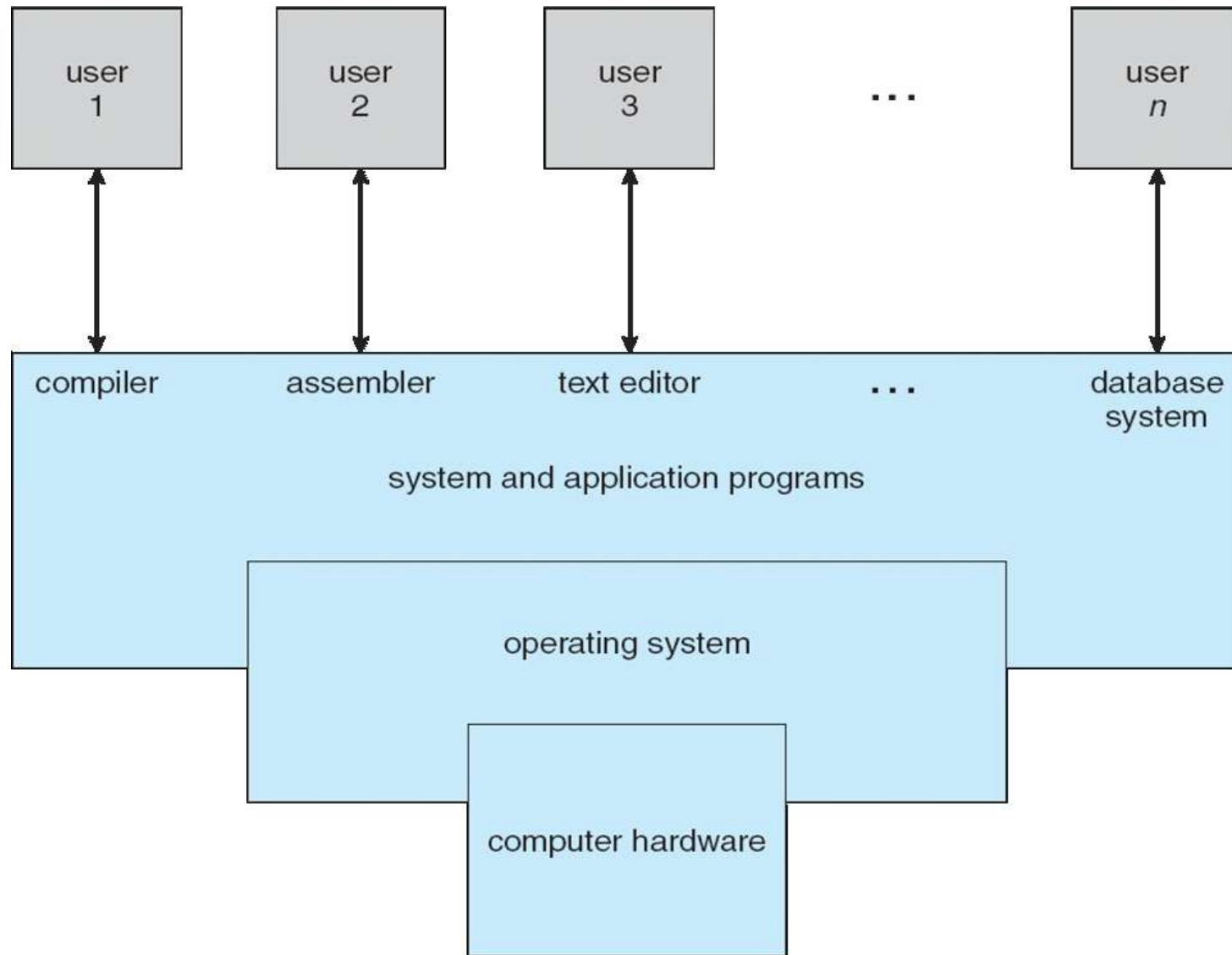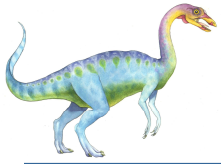
Operating System Functions

- 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

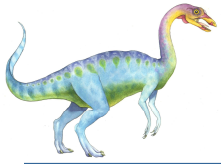 - Error in one program should not affect other programs

Computer Startup

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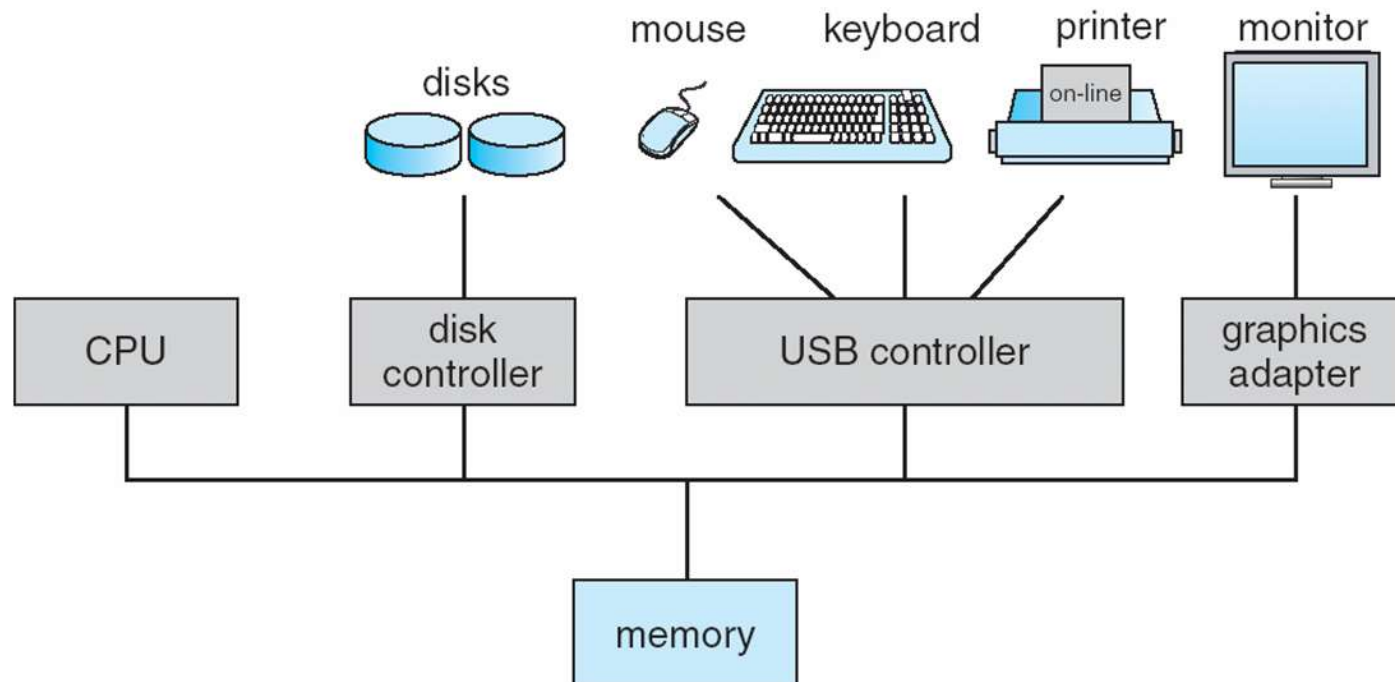   - Typically stored in ROM or EPROM, generally known as **firmware**
    - Initializes all aspects of system
    - Loads operating system kernel and starts execution

Computer System Organization

- Computer-system operation

  - One or more CPUs, device controllers connect through common bus providing access to shared memory

  - Concurrent execution of CPUs and devices

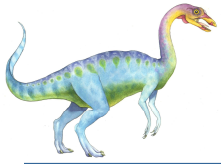# Computer-System Operation

- 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
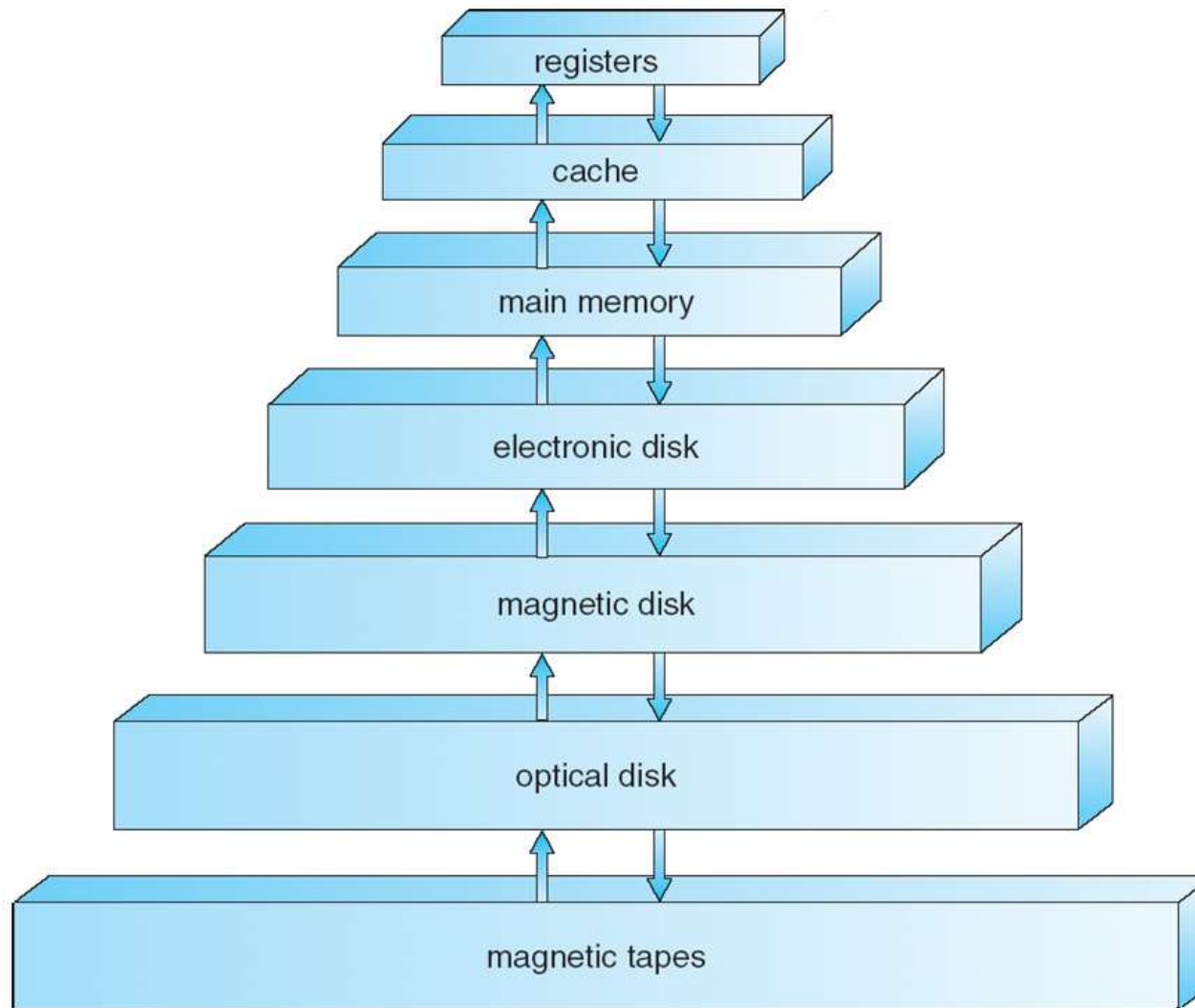
Storage Hierarchy

- Storage systems organized in hierarchy
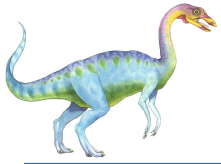 - Speed
  - Cost
  - Volatility

- **Caching** – copying information into faster storage system; main memory can be viewed as a *cache* for secondary storage

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

Operating System Structure

- **Multiprogramming** 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
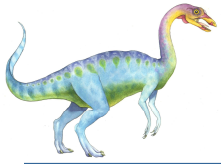
Memory Layout for Multiprogrammed System
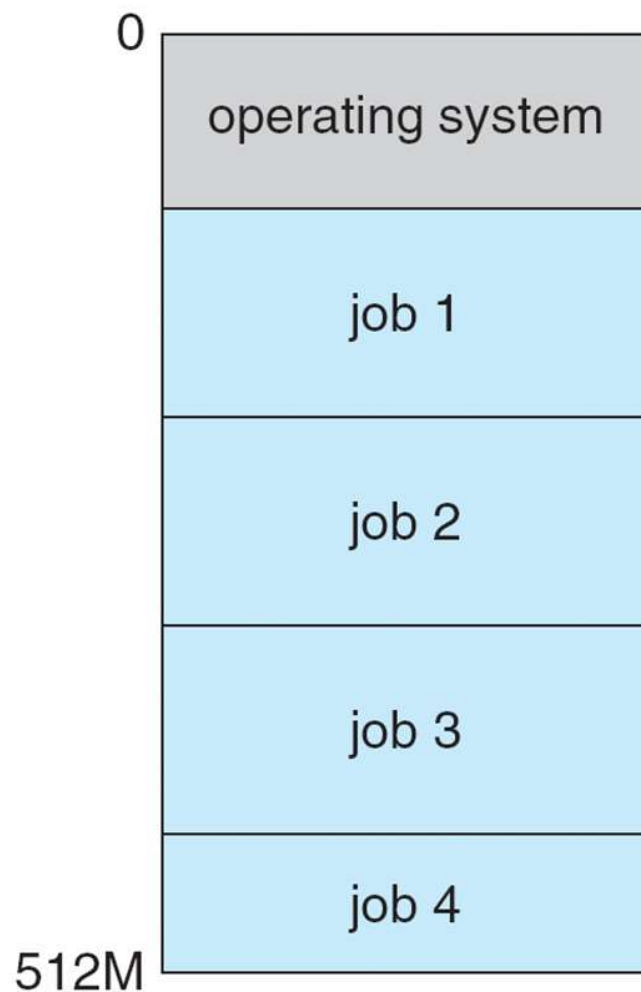
Process Management

- A process is a program in execution. It is a unit of work within the system. Program is a *passive entity*, process is an *active entity*.

- Process needs resources to accomplish its task
    - CPU, memory, I/O, files
    - Initialization data

- Process termination requires reclaim of any reusable resources

- Single-threaded process has one **program counter** specifying location of next instruction to execute
    - Process executes instructions sequentially, one at a time, until completion

- Multi-threaded process has one program counter per thread

Process Management Activities

The operating system is responsible for the following activities in connection with process management:

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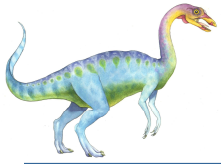- Providing mechanisms for deadlock handling

Memory Management

- All data in memory before and after processing

- All instructions in memory in order to execute

- Memory management determines what is in memory when

  - Optimizing CPU utilization and computer response to users

- Memory management activities

  - Keeping track of which parts of memory are currently being used and by whom

  - Deciding which processes (or parts thereof) and data to move into and out of memory

  - Allocating and deallocating memory space as needed

Storage Management

- OS provides uniform, logical view of information storage
  - Abstracts physical properties to logical storage unit - **file**
  - Each medium is controlled by device (i.e., disk drive, tape drive)
    - Varying properties include access speed, capacity, data-transfer rate, access method (sequential or random)

- File-System management
  - Files usually organized into directories
  - Access control on most systems to determine who can access what
  - OS activities include
    - Creating and deleting files and directories
    - Primitives to manipulate files and dirs
    - Mapping files onto secondary storage
    - Backup files onto stable (non-volatile) storage media

Protection and Security

- **Protection** – any mechanism for controlling access of processes or users to resources defined by the OS

- **Security** – defense of the system against internal and external attacks
  - Huge range, including denial-of-service, worms, viruses, identity theft, theft of service

End of Chapter 1