Chapter 1: Introduction

(OS Structure, Modes and Services)

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Topics Covered

-- Zero Lecture

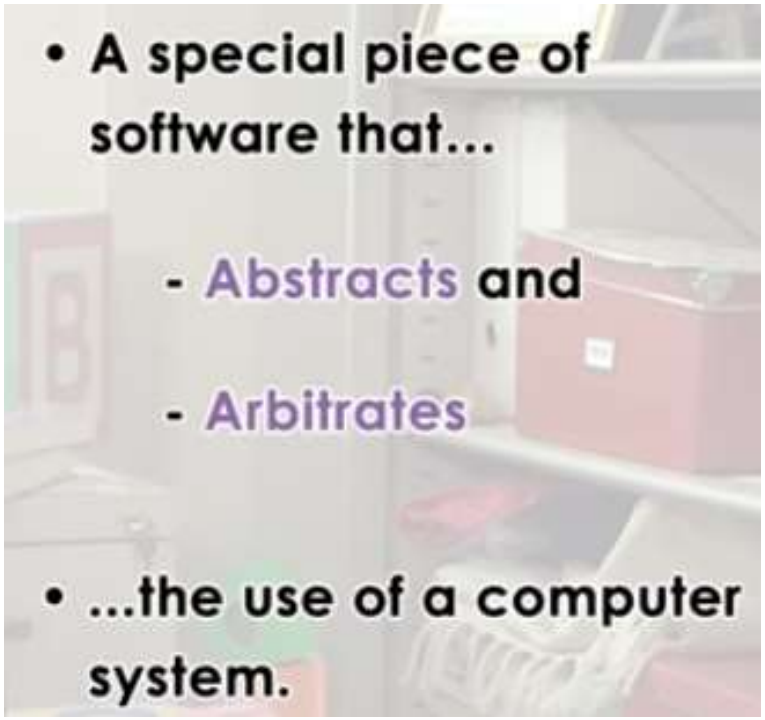
Topics to be Covered

-- Introduction
-- OS Structure
-- Type of OS

Learning Outcome:

Students will be able to understand OS Structure and types of OS

OPERATING SYSTEM?



- Abstract: To simplify how hardware actually looks like.
- Arbitrate: To manage , to oversee the hardware use

What is an Operating System?

- It is a layer of system software that:
  - directly has privileged access to hardware
  - hides hardware complexity
  - manages hardware on behalf of one or more applications according to policies.
  - acts as an intermediate/ interface between a user and the computer hardware.
  - **Resource allocator (Managing the resources efficiently)**
  - **Control Program**

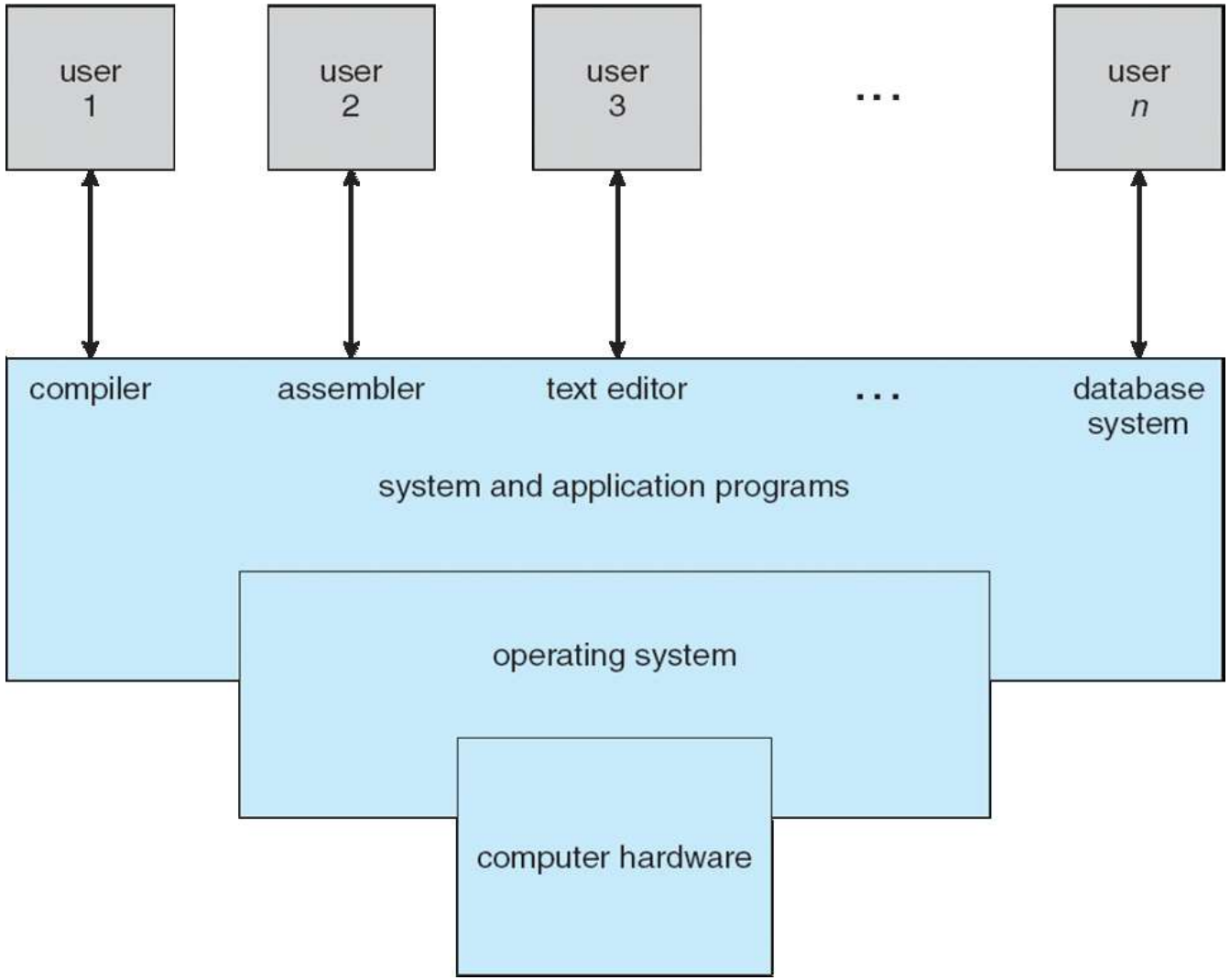
What is an Operating System?

- Operating system goals:
  - Execute user programs and make problem-solving easier.
  - Make the computer system convenient to use
  - Efficiently use available resources

Computer System Structure

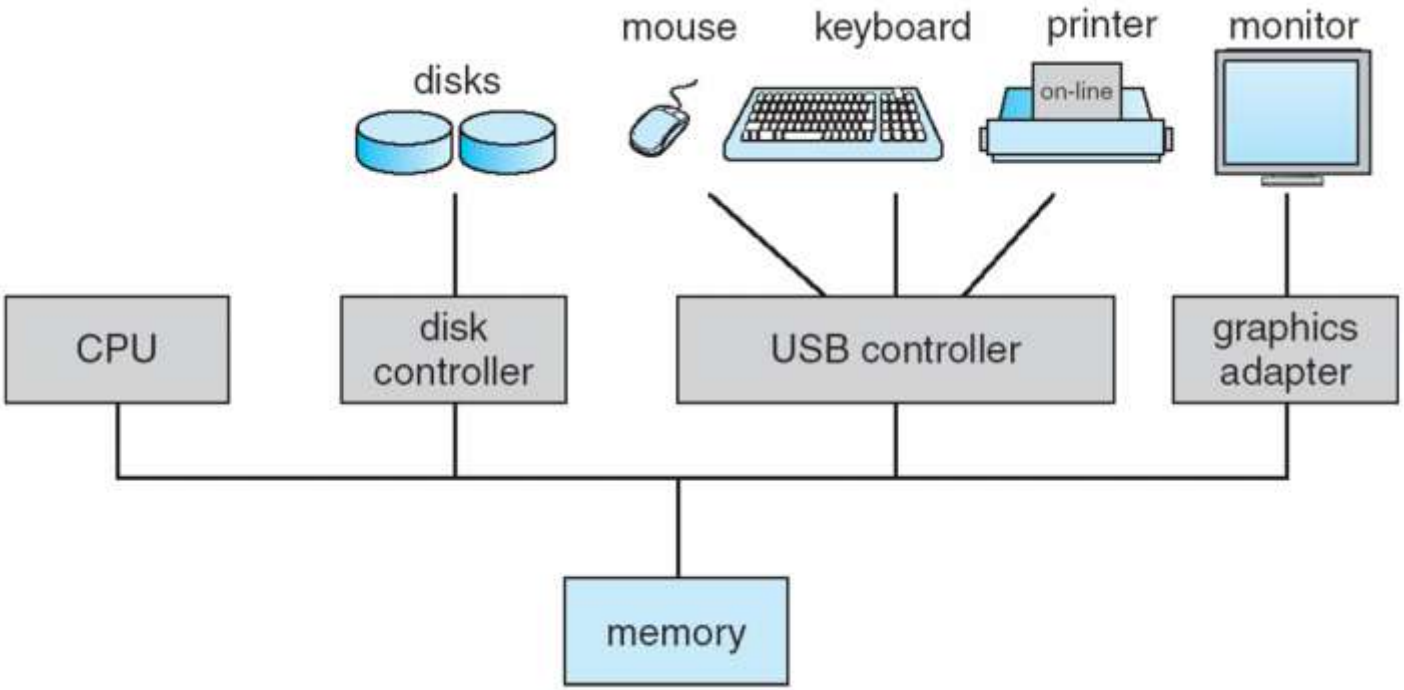
- **Computer system can be divided into four components:**
  - **Hardware** – provides **basic computing resources**
    - CPU, memory, I/O devices
  - **Operating system**
    - **Controls and coordinates use of resources** among various applications and users
  - **System/Application programs** – define the ways in which the system resources are used to solve user problems
    - Word processors, compilers, web browsers, database systems, video games
  - **Users**
    - People, machines, other computers

Four Components of a Computer System



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 competing for memory cycles



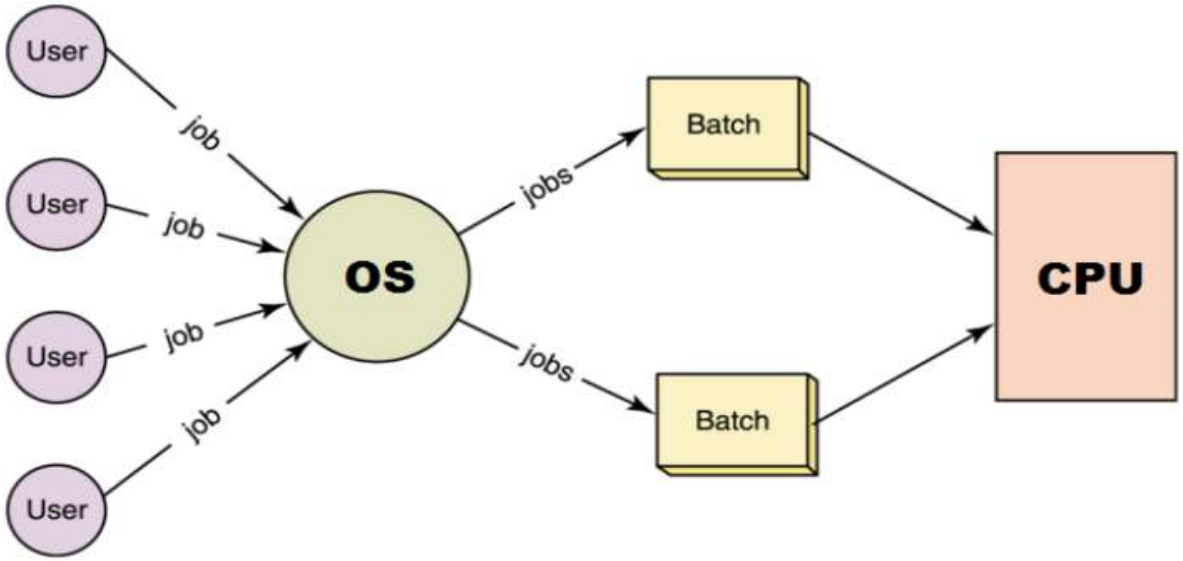
TYPES OF OS

Batch Systems

“Batch operating system. The users of a batch operating system do not interact with the computer directly.

Each user prepares his job on an off-line device like punch cards and submits it to the computer operator.

To speed up processing, jobs with similar needs are batched together and run as a group”.



TYPES OF OS: Batch Systems

Disadvantages:

- No interaction between user and computer.
- No mechanism to prioritize the processes

Multiprogrammed OS

Multiprogramming: When 2 or more processes reside in memory at the same time

- Single-user processes cannot keep CPU and I/O devices busy at all times
- **Multiprogramming organizes jobs (code and data) so the CPU always has one to execute**
- **Multiprogramming assumes a single shared processor.**
- Multiprogramming increases CPU utilization.
- **It is mixture of I/O bound and CPU bound processes**

Multiprogrammed OS

- If several jobs are ready to run at the same time, then the system chooses which one to run through the process of **CPU Scheduling**.

- In Non-multiprogrammed system, there are moments when CPU sits idle and does not do any work.

- **Note:: In Multiprogramming system, CPU will never be idle and keeps on processing.**

Revision

Q. What is the objective of multiprogramming operating systems?

a) Maximize CPU utilization

b) Switch the CPU among processes

c) Achieve multitasking

d) None of the above

MCQ

Which of the following features will characterize an OS as a multi-programmed OS?

1. More than one program may be loaded into the main memory at the same time.

2. If a program waits for a certain event, another program is immediately scheduled.

3. If the execution of a program terminates, another program is immediately scheduled.

(a) Only

(b) (1) and (2) only

(c) (1) and (3) only

(d) (1), (2) and (3) only

MCQ

Which of the following features will characterize an OS as a multi-programmed OS?

Ans. (d)

Q. Which program controls the execution of programs to prevent errors and improper use of computer?

a) Resource allocator

b) Control Program

c) Hardware

d) None of the above

Q. In which type of operating system users do not interact directly with the computer system?

a) Multiprogramming operating systems

b) Multiprocessing operating systems

c) Batch operating systems

d) Distributed operating systems

Multitasking/Timesharing OS

- **Timesharing (multitasking)** when multiple jobs are executed by the CPU simultaneously by switching between them.
  - There is at least one program executing in the 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
  - **Only one CPU is involved**, but **it switches** from one process to another **so quickly** that it gives the appearance of **executing all of the processes at the same time.**

Multiprocessing OS

- A multiprocessor system consists of several processing units that share a common physical memory.
- Multiprocessor system provides higher computing power and speed.
- In a multiprocessor system all processors operate under a single operating system.
- **Also known as parallel systems** or **tightly coupled systems**
- **Such systems have more than one processor/processing cores** in close communication, sharing the computer bus, the clock, and sometimes memory and peripheral devices.

Operating System Views

OS can be explored from 2 view points:

1. User view:

- **maximize the work and minimize the effort of the user.**
- **As if the processor is dealing only with the current task**,

but

in background processor is dealing with several processes.

Operating System Views

OS can be explored from 2 view points:

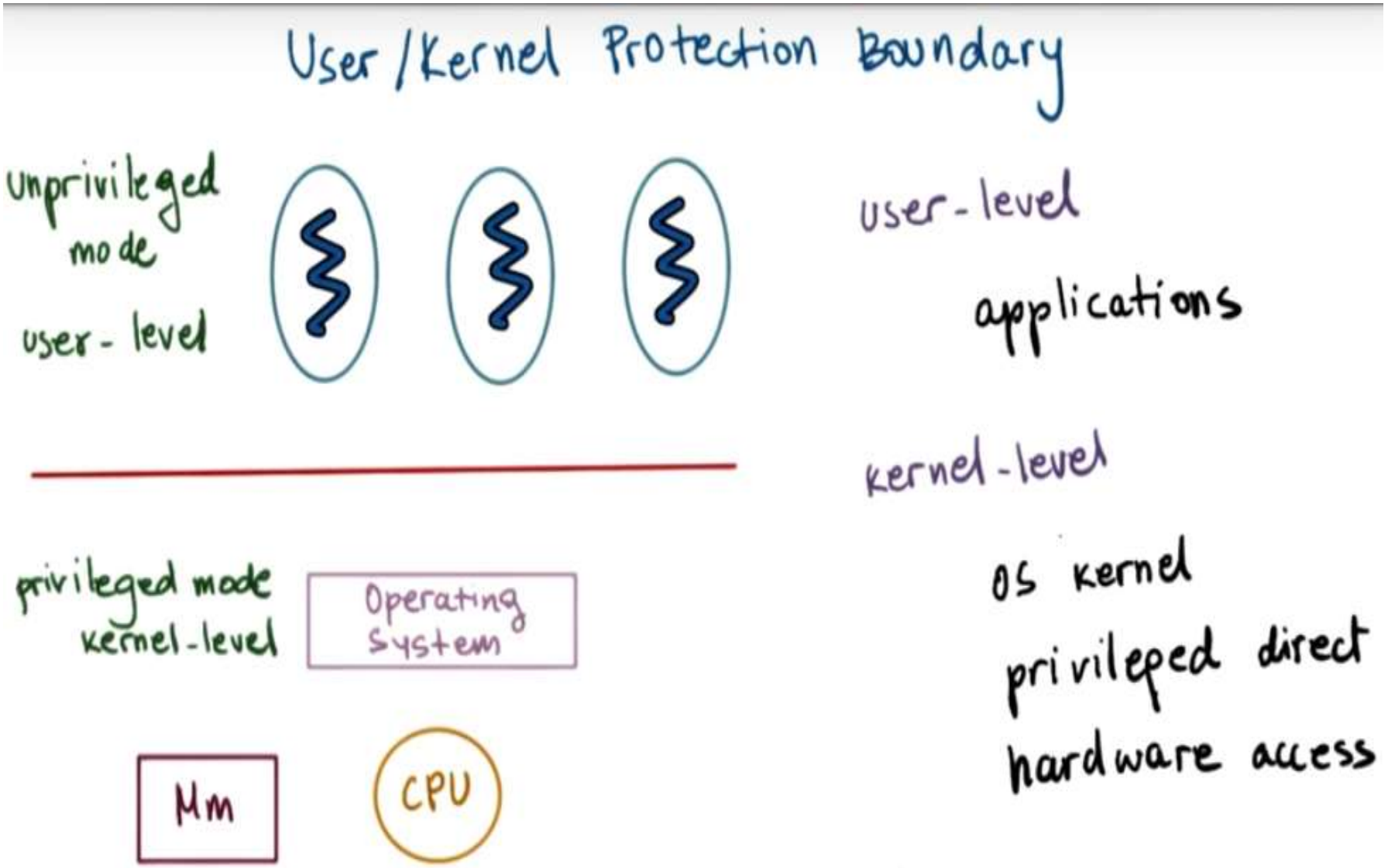
2. System View:

- OS is a **resource allocator**
- OS is a **control program**

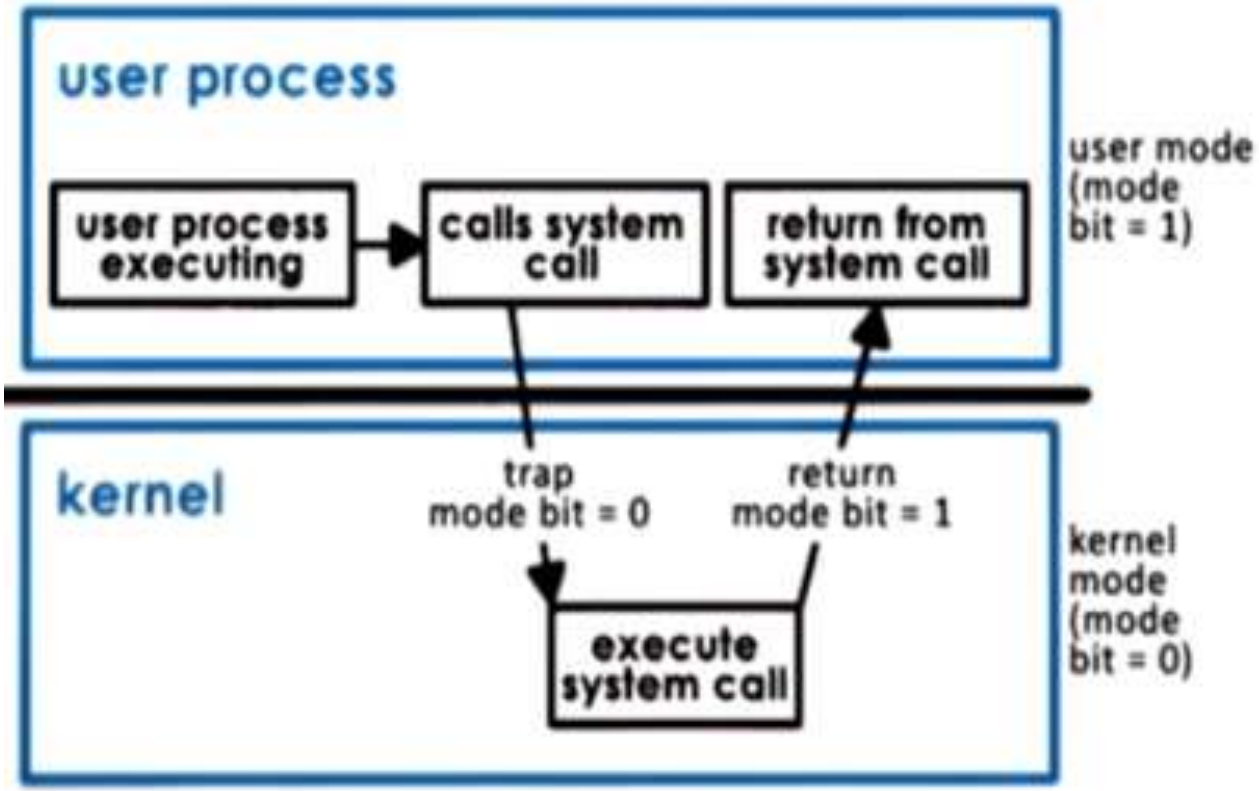
Operating-System Operations

- **To protect OS, Dual-mode** operations exist:
  - **User mode (1)** and **kernel mode (0)**
  - A **Mode bit is added to** the hardware to indicate mode
    - Provides the ability to distinguish when the system is running user mode or kernel mode
    - System call changes mode to the kernel, return from call resets it to user

User/Kernel Protection Boundary



Transition from User to Kernel Mode



To make a system call an application must

- write argoments
- save relevant data at well-defined location
- make system call

The operating system switches from user mode to kernel mode so the mode bit will change from?

a) 0 to 1

b) 1 to 0

c) Remain constant

d) None

Which program provides the interface between a process and the operating system?

a) Interrupt

b) System calls

c) CPU

d) Device Controller

Which one or more of the following options guarantee that a computer system will transition from user mode to kernel mode?

a) Function Call

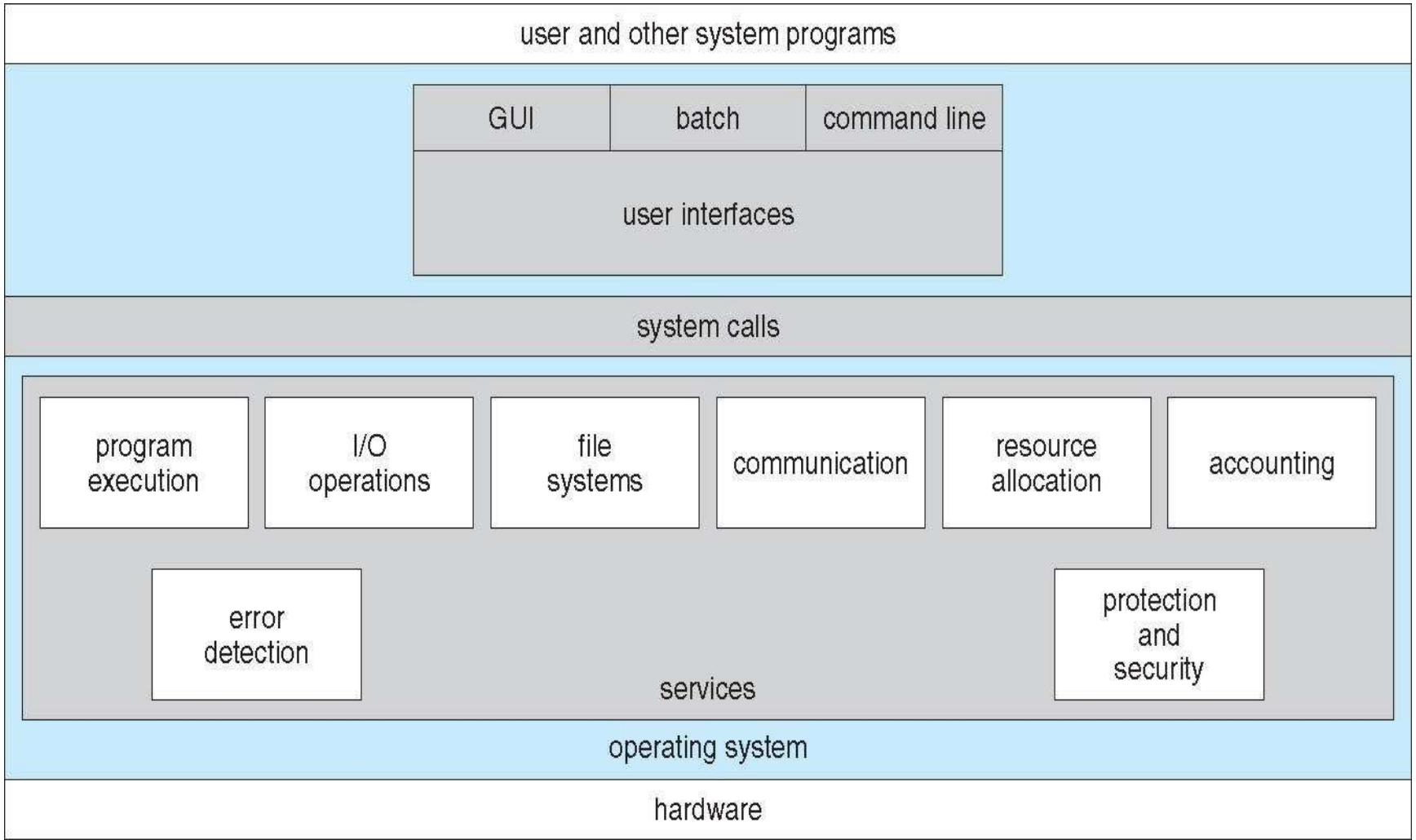
b) malloc Call

c) Page Fault

d) System Call

Operating System Functions/Services

- An operating system provides an **environment for the programs to run.**
- It provides certain services to programs



Operating System Services

- 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.
  - **File-system manipulation** - read and write files and directories, create and delete them, search them, list file Information, permission management.

Operating System Services

- **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.

- **Resource allocation –** OS must ensure allocation of resources to all programs running.
  - **Many types of resources** - such as **CPU cycle time, main memory, and file storage**, **I/O devices**

Operating System Services

- **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
  - If a system is to be protected and secure, precautions must be instituted throughout it.
  - **A chain is only as strong as its weakest link.**