COS3023 Operating Systems and Concurrency

Topic 1- Operating System - Introduction

Lecturer : Ms Shafrah

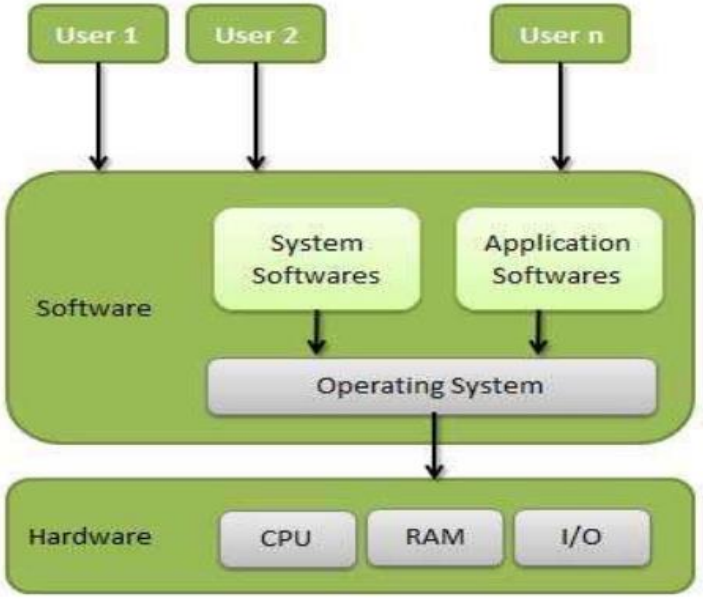
Learning Objectives

After completing this chapter, you should be able to describe:

- Innovations in operating system development
- The basic role of an operating system
- The major operating system software subsystem managers and their functions
- The types of machine hardware on which operating systems run
- The differences among batch, interactive, real-time, hybrid, and embedded operating systems

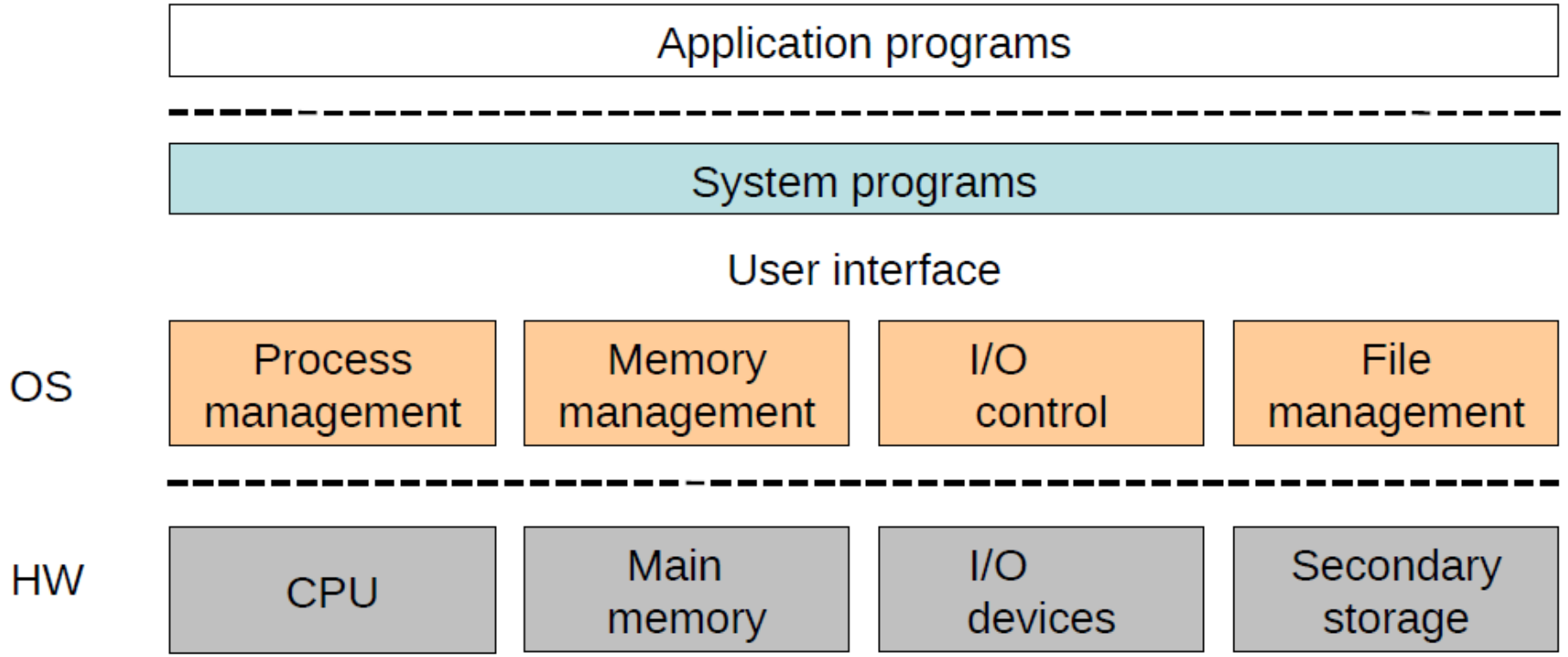
What Is an Operating System?

A computer system consists of **software** (programs) and **hardware** (the physical machine and its electronic components). The **operating system** software is the chief piece of software, the portion of the computing system that manages all of the hardware and all of the other software. To be specific, it controls every file, every device, every section of main memory, and every nanosecond of processing time. It controls who can use the system and how. In short, it's the boss.



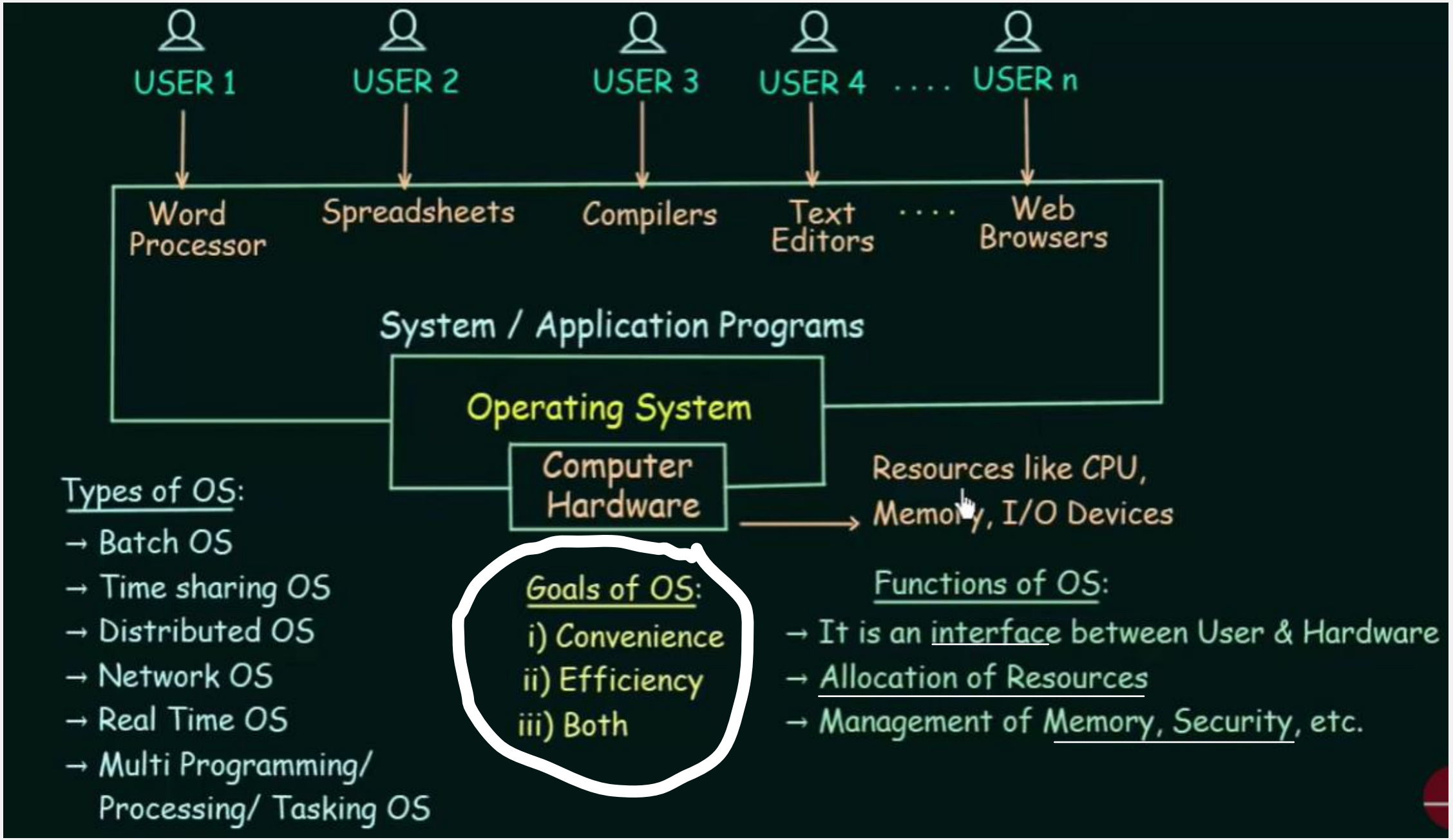
OS Overview

- An OS is a collection of system programs which manage the computer resources

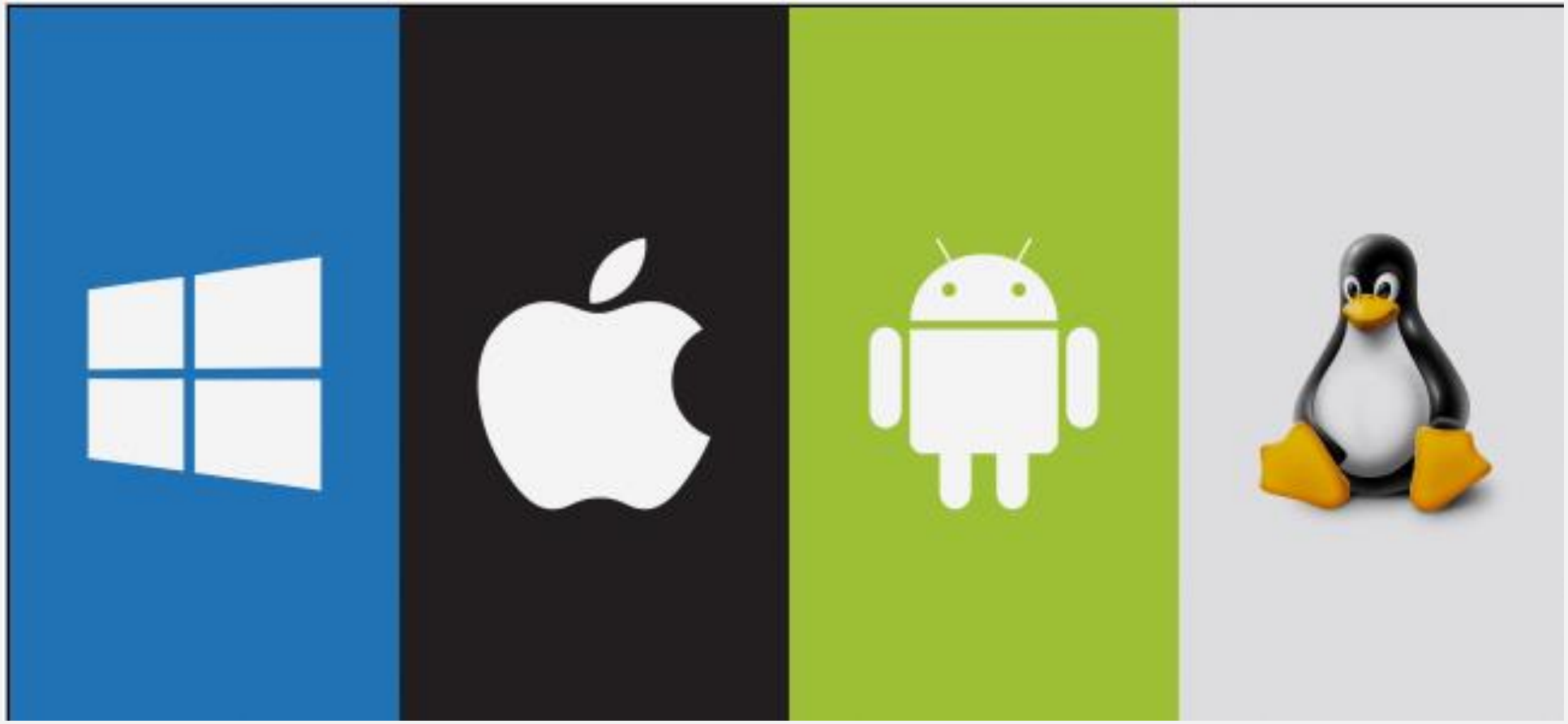


Operating system goals

- Execute user programs and make solving user problems easier
- Make the computer system convenient to use
- Use the computer hardware in an efficient manner


USER 1
USER 2
USER 3
USER 4
. . . .
USER n
Word Processor
Spreadsheets
Compilers
Text Editors
. . . .
Web Browsers
System / Application Programs
Operating System
Computer Hardware
Resources like CPU, Memory, I/O Devices
Types of OS:
→ Batch OS
→ Time sharing OS
→ Distributed OS
→ Network OS
→ Real Time OS
→ Multi Programming/ Processing/ Tasking OS
Goals of OS:
i) Convenience
ii) Efficiency
iii) Both
Functions of OS:
→ It is an interface between User & Hardware
→ Allocation of Resources
→ Management of Memory, Security, etc.

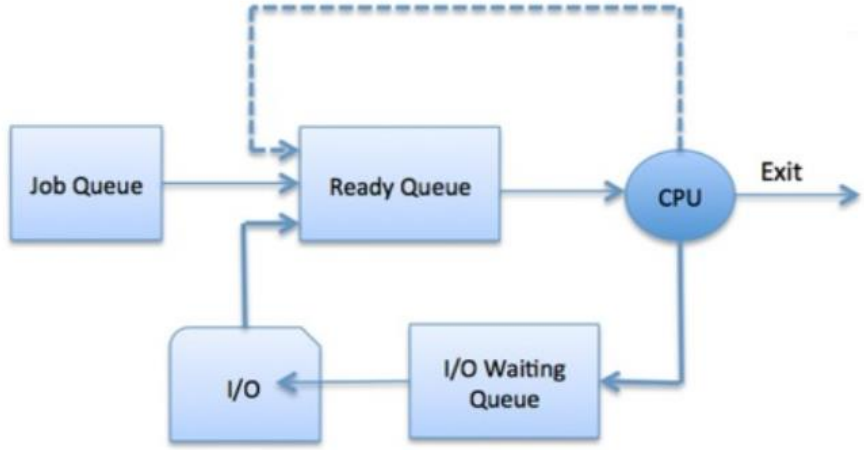
Example of OSs



Operating system functions

1. Job scheduling

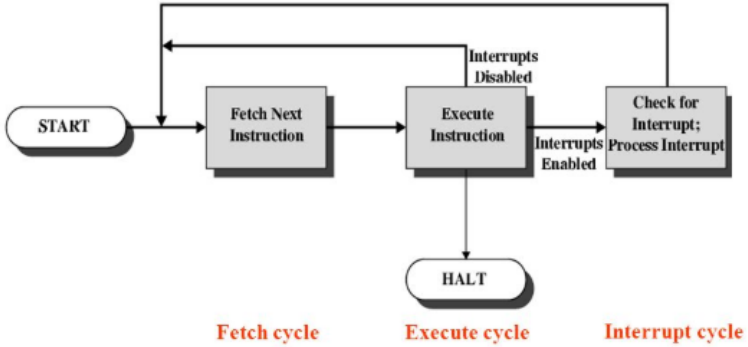
– it is the process of the operating system to keep list of jobs currently being run by the computer and clocking them in and out of the processor.



2. Interrupt handling

It is a break from the normal sequential processing

of instructions in a program



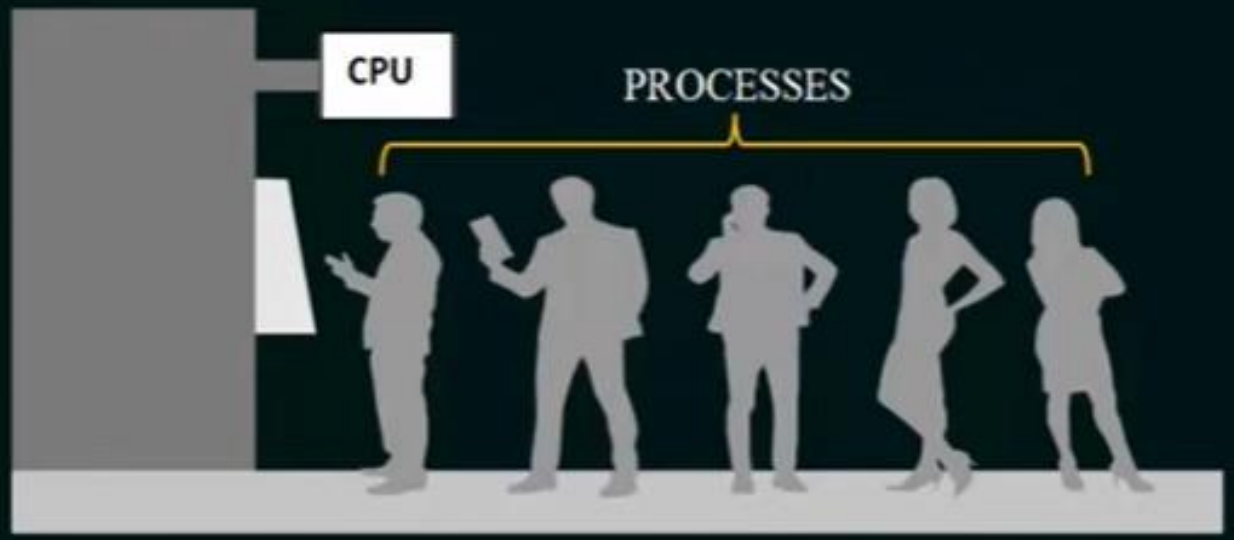
Scheduling Queues

JOB QUEUE

As processes enter the system, they are put into a **job queue,** which consists of all processes in the system.

READY QUEUE

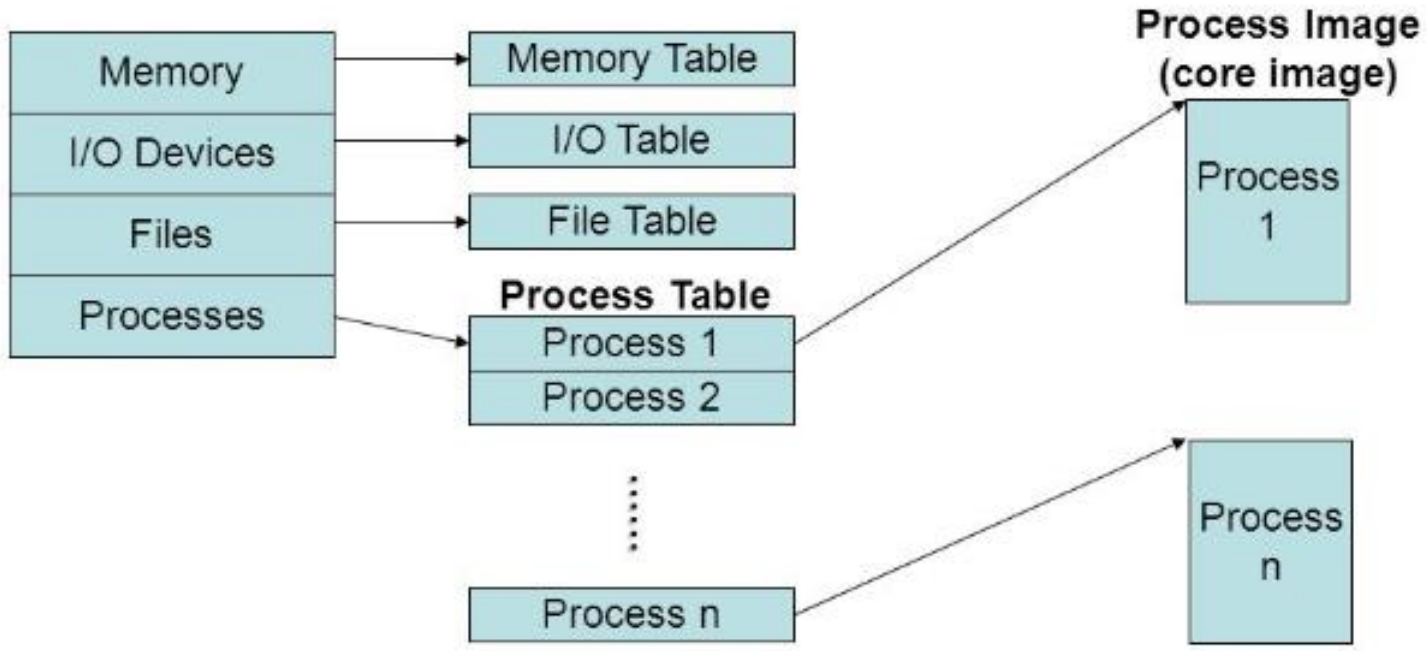
The processes that are residing in main memory and are ready and waiting to execute are kept on a list called the **ready queue.**



Operating system functions

3. Resource control and allocation

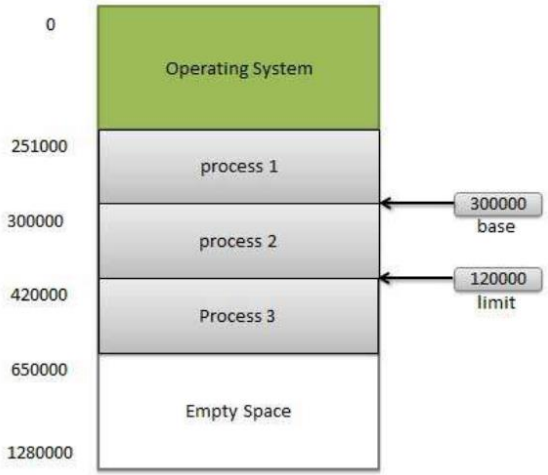
It is situation where the processor gives a computer resources a unique number called interrupt number so that it can be able to recognize and prioritize it.



Operating system functions

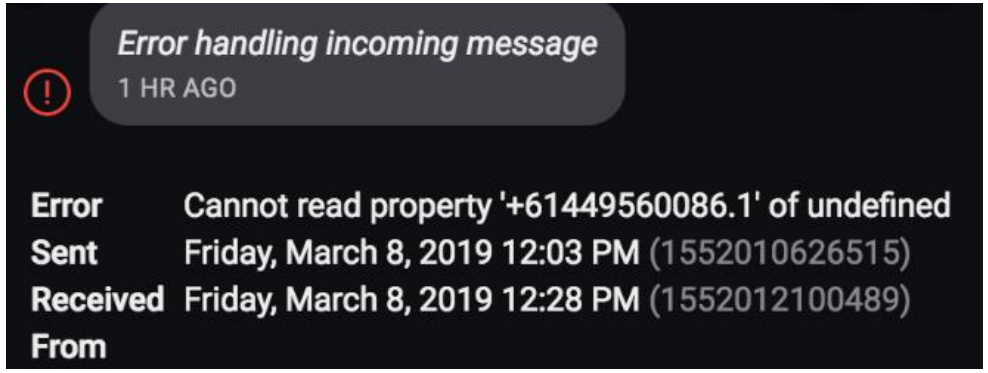
4. Memory Management

It is where the operating system constantly assigns main memory storage partitions to data and instructions



5. Error handling

It is a situation whereby an operating system alerts the user of errors that arises in ease of illegal operations, hardware or software failure.

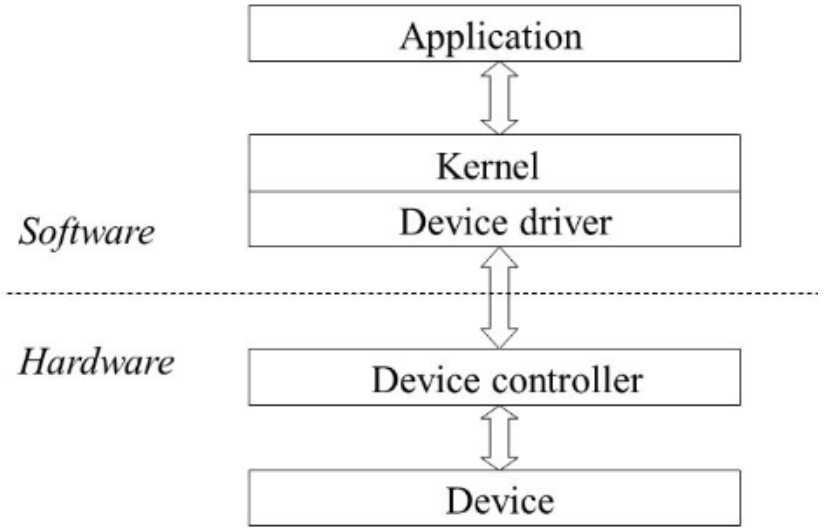


Operating system functions

6. Input/output handling

- Keep track of all devices. Program responsible for this task is known as the I/O controller.

-Decide which process get s the device when and for how much time.



Operating system definition

OS is a **resource allocator**

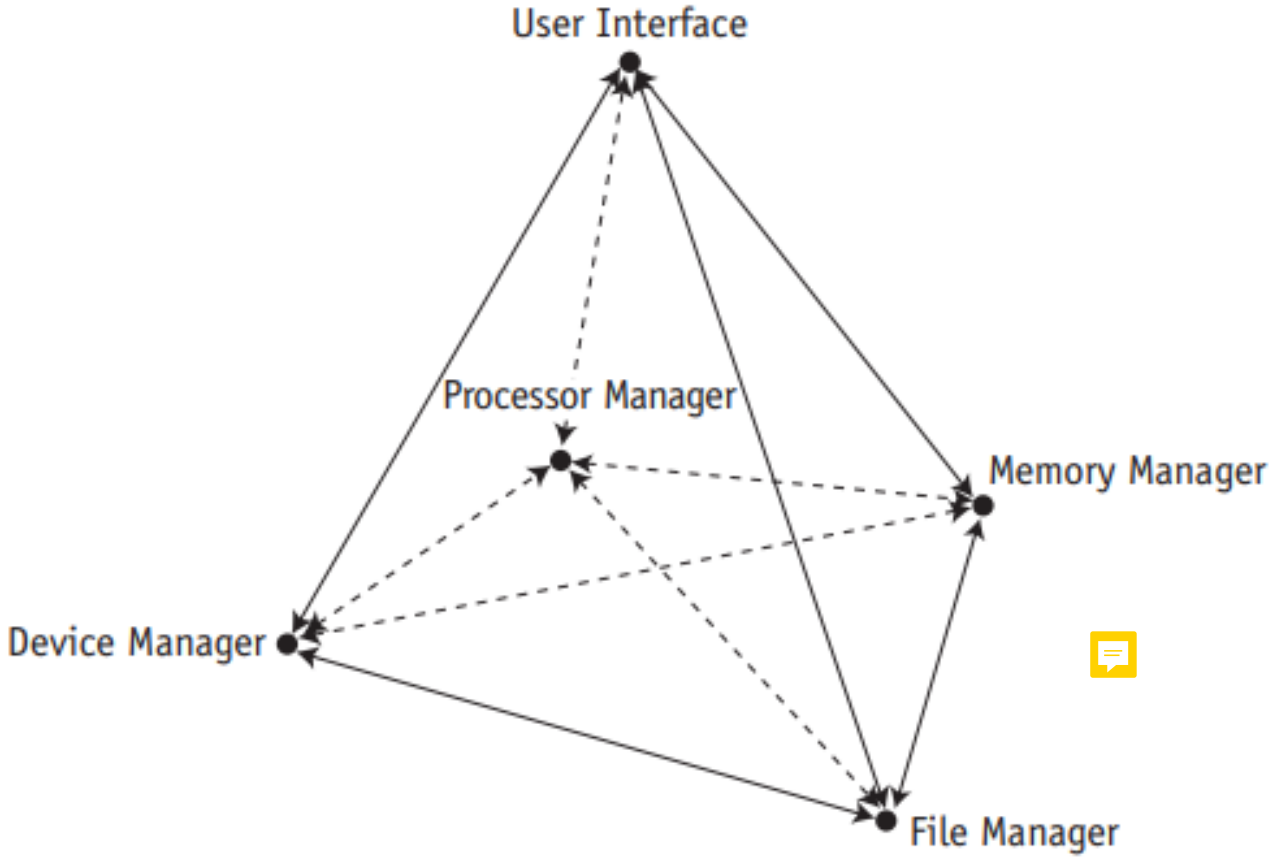
- Manages all resources
- Decides between conflicting requests for efficient and fair resource use

OS is a **control program**

- Controls execution of programs to prevent errors and improper use of the computer

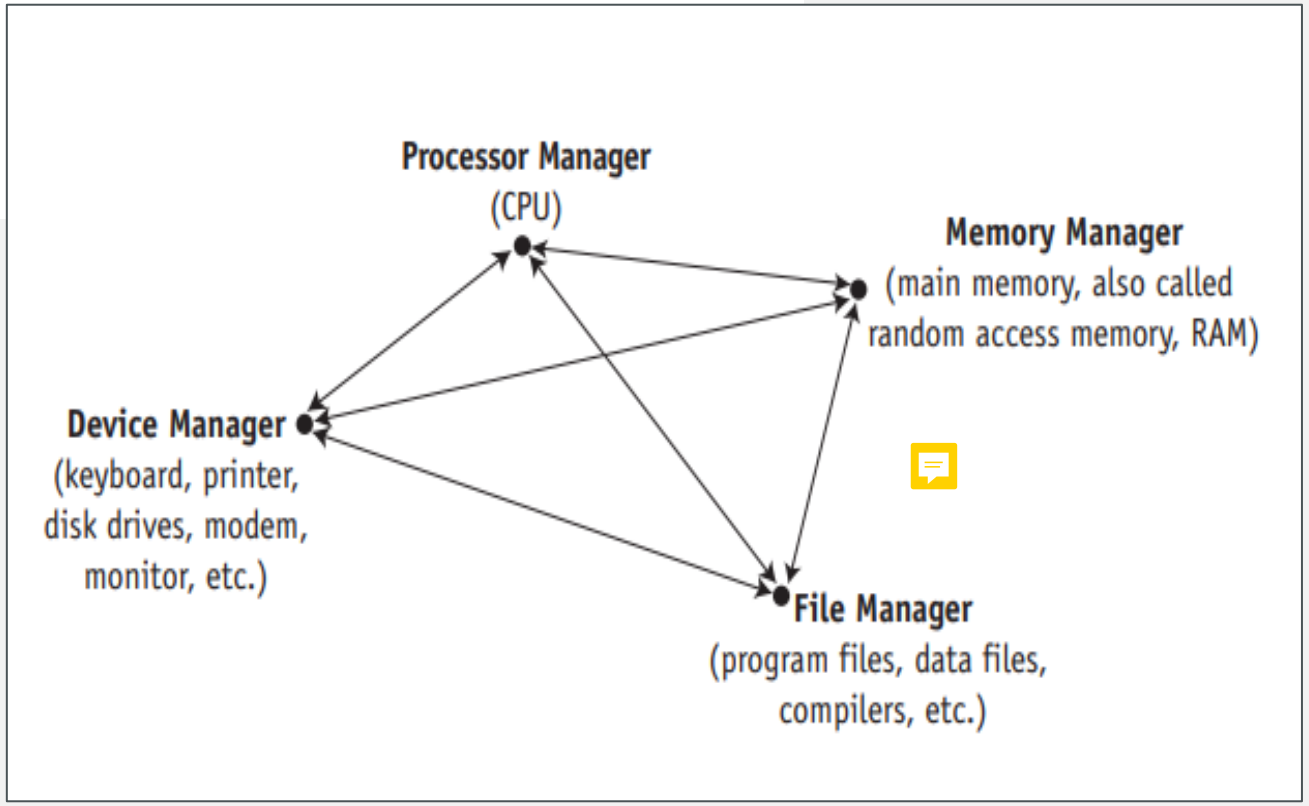
Operating System Software

This model of a non-networked operating system shows four subsystem managers supporting the User Interface.



Tasks/responsibilities of subsystem managers

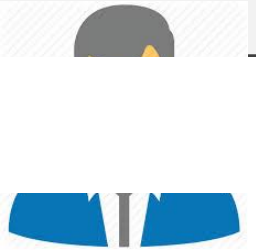
- Monitor its resources continuously
- Enforce the policies that determine who gets what, when, and how much
- Allocate the resource when appropriate
- Deallocate the resource when appropriate



Main Memory management (RAM)

- Checks the validity of each request for memory space.
- Allocates a portion of memory that isn’t already in use.
- Sets up a table to keep track of who is using which section of memory
- Deallocates memory

Processor management



- Decides how to allocate the CPU.
- Keep track of the status of each process.
- Monitors whether the CPU is executing a process or waiting for a READ/WRITE command to finish execution.
- Analogy: traffic controller

Processor management

- Two levels of responsibility:

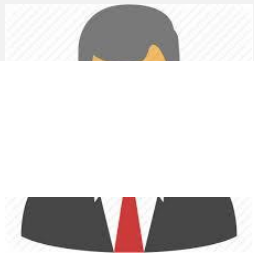
1. Handle jobs as they enter the system (handled by Job Scheduler)
   (which accepts or rejects the incoming jobs.)

2. Manage each process within those jobs(handled by Process Scheduler)
   (which is responsible for deciding which process gets the CPU and for how long)

Device management

- monitors every device, channel, and control unit.
- choose the most efficient way to allocate all of the system's devices, printers, ports, disk drives, and so forth, based on a scheduling policy chosen.
- allocating each resource, starting its operation, and, finally, deallocating the device, making it available to the next process or job.

File management



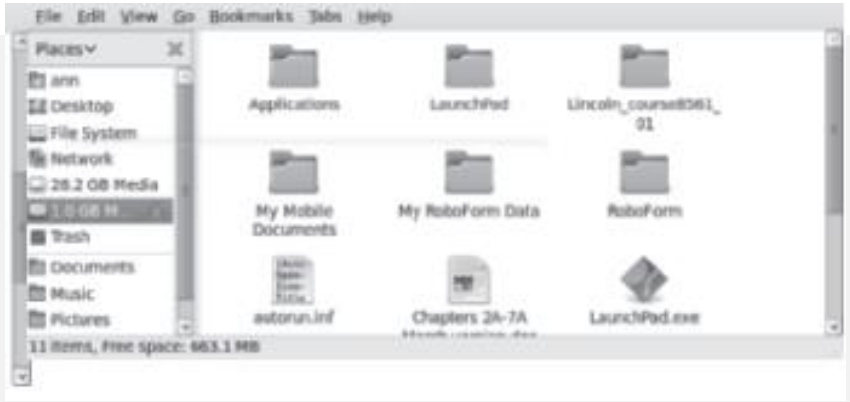
- keeps track of every file in the system, including data files, program files, compilers, and applications.
- also controls what users are allowed to do with files once they access them.
- allocates the necessary resources and later deallocates them.

User Interface

- is the portion of the operating system that users interact with directly.
- the user interface consisted of :
  - commands typed on a keyboard and displayed on a monitor

    or

  - a menu option from a list.



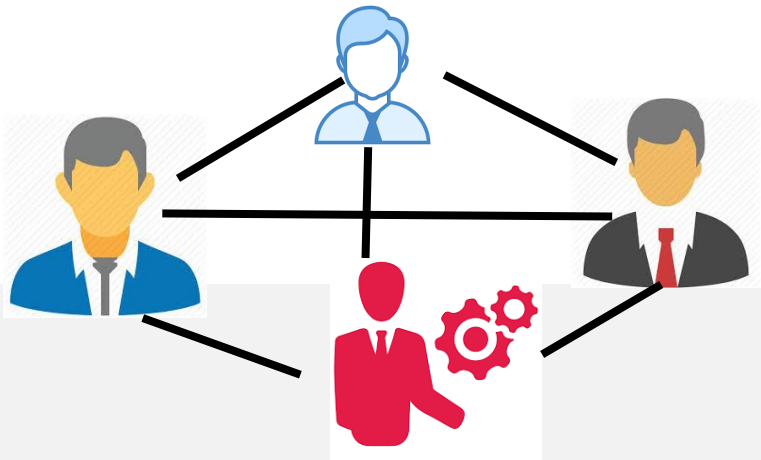
Cooperation Issues

Each manager must be able to work harmoniously with every other manager.

1. The Device Manager must receive the electrical impulses from the mouse or keyboard, form the command, and send the command to the User Interface, where the Processor Manager validates the command.

2. The Processor Manager then sends an acknowledgment message to be displayed on the monitor so the user realizes the command has been sent.

3. When the Processor Manager receives the command, it determines whether the program must be retrieved from storage or is already in memory, and then notifies the appropriate manager.



Cooperation Issues (cont.)

Each manager must be able to work harmoniously with every other manager.

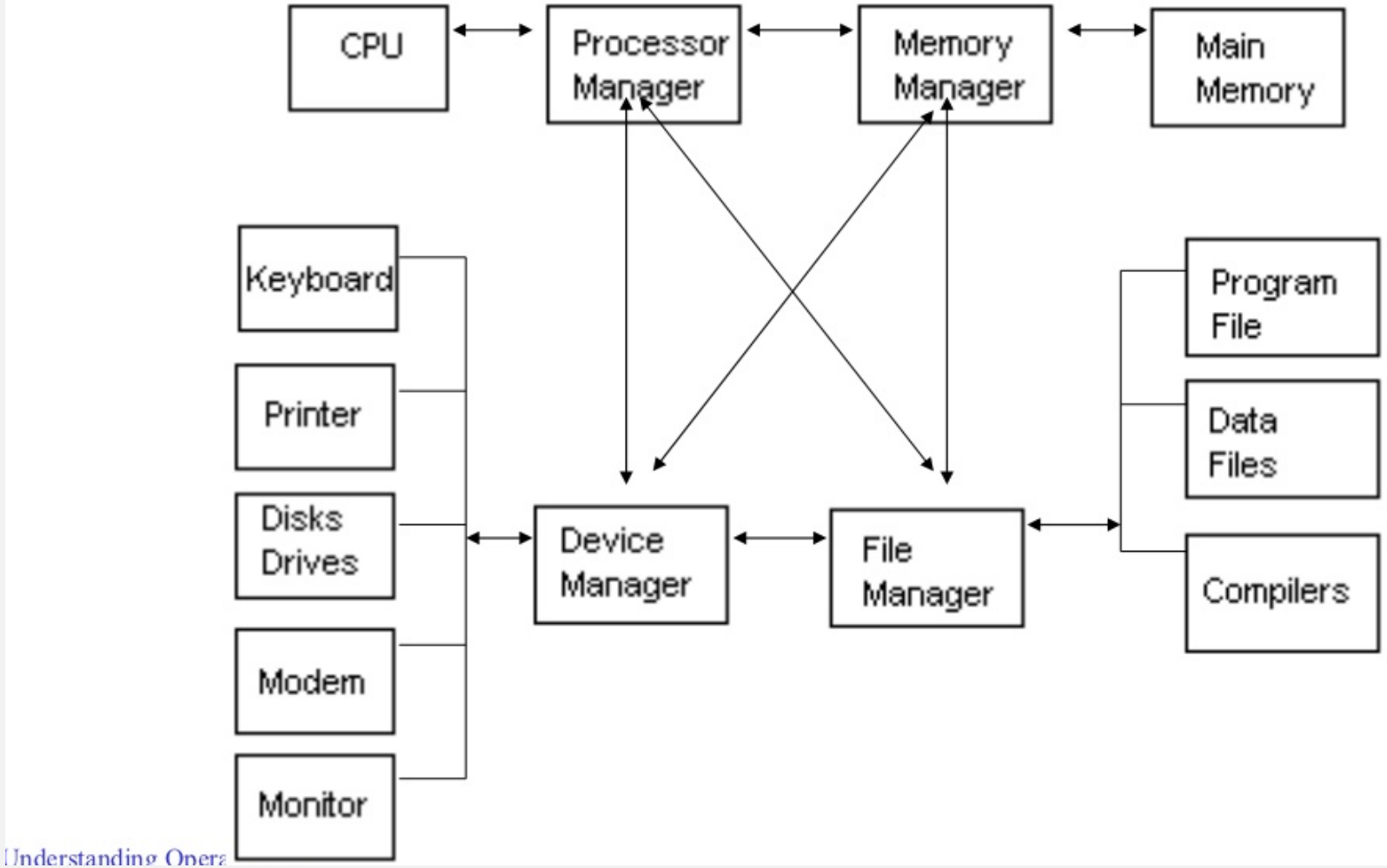
4. If the program is in storage, the File Manager must calculate its exact location on the disk and pass this information to the Device Manager, which retrieves the program and sends it to the Memory Manager.

5. The Memory Manager then finds space for it and records its exact location in memory. Once the program is in memory, the Memory Manager must track its location in memory (even if it's moved) as well as its progress as it's executed by the Processor Manager.

6. When the program has finished executing, it must send a finished message to the Processor Manager so that the processor can be assigned to the next program waiting in line.

7. Finally, the Processor Manager must forward the finished message to the Device Manager, so that it can notify the user and refresh the screen.

Subsystems Must Work With Each Other



SECTION CHECKPOINT

1. What is an OS?
2. List 5 functions of OS.
3. List 3 example of OS.
4. List 4 subsystem managers

Types of OS

- **Batch**

Relied on stacks of punched cards or reels of magnetic tape for input. Jobs were entered by assembling the cards into a deck and running the entire deck of cards through a card reader as a group—a batch.

- **Interactive**

Faster turnaround than batch systems but are slower than the real-time systems real-time.

Allow each user to interact directly with the computer system via commands entered

Types of OS (cont.)

- **Real-time system**

Used in time-critical environments where reliability is key and data must be processed within a strict time limit.

For example, real-time systems are used for space flights , airport traffic control, critical industrial processes, certain medical equipment

- **Hybrid**

A combination of batch and interactive. They appear to be interactive because individual users can access the system and get fast responses, but a system actually accepts and runs batch programs in the background when the interactive load is light.

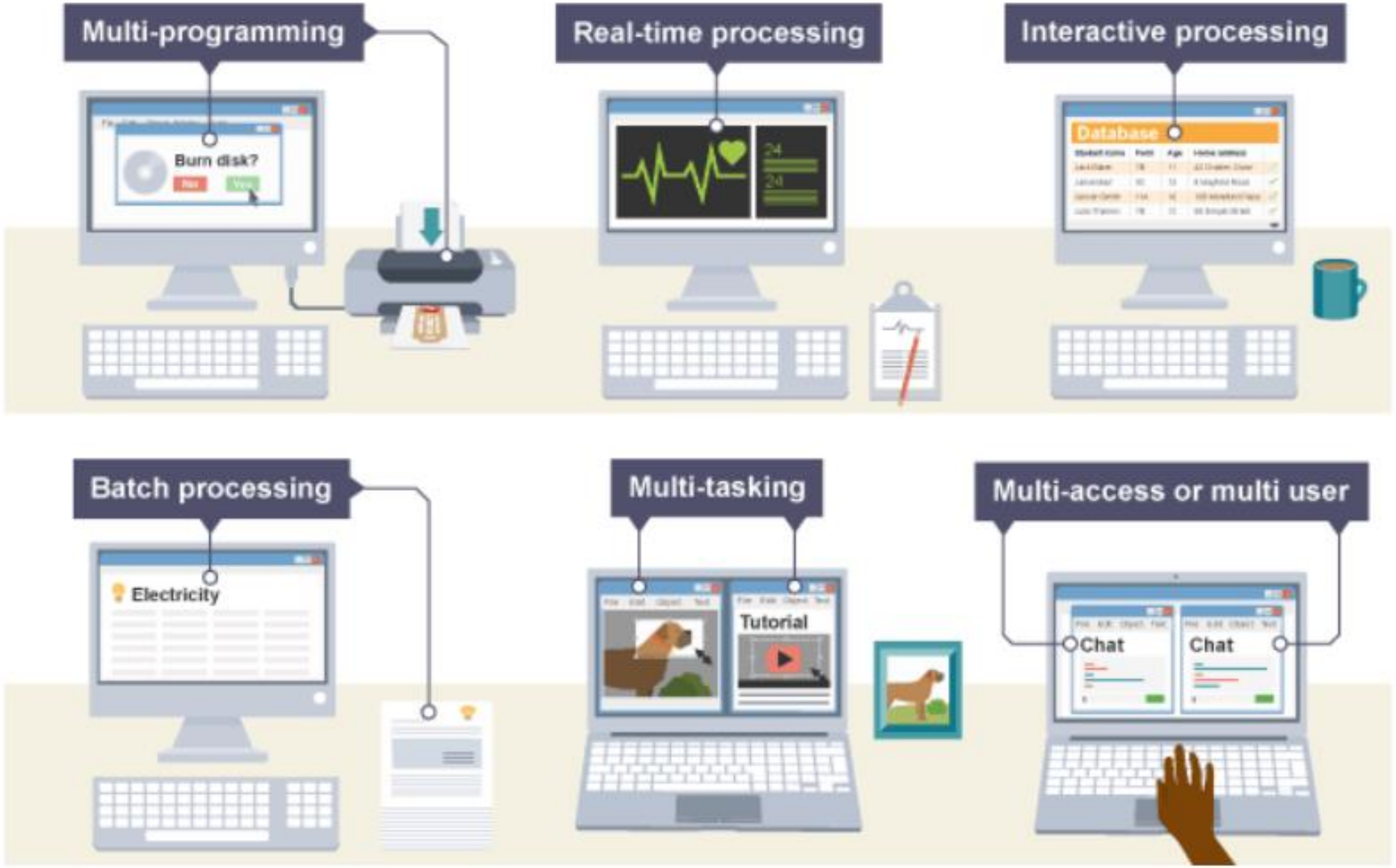
Types of OS (cont.)

- **Embedded systems**

Computers placed inside other products to add features and capabilities.

For example, embedded computers in household appliances,automobiles, digital music players, elevators, and pacemakers. In the case of automobiles, embedded computers can help with engine performance, braking, and navigation.

Operating system functions



Key Terms

- Batch system
- CPU
- Device Manager
- embedded system
- File manager
- Hybrid system
- interactive system
- main memory
- Memory manager

Key Terms

- Multiprocessing
- Multiprogramimg
- Operating system
- Processor manager
- Real-time system
- Throughput

Exercises:

1. Explain the responsibilities of each subsystem manager.

2. Windows 10 is often referred to as a "Desktop Operating System" or "Personal Computer Operating System" whilst Windows Server 2016 is described as a "Server Operating System". Identify the main differences between a desktop operating system, such as Windows 10, and a server operating system such as Windows Server 2019.


THANK YOU