

Operating System (ECSE204L)

(Core Subject, Credit:5)

By

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Lec-1: Introduction

- What is an operating system?
- What operating systems do?
- Simple Batch Systems
- Multiprogramming Batched Systems
- Time-Sharing Systems
- Personal-Computer Systems
- Parallel Systems/ Multiprocessing System
- Distributed Systems
- Real -Time Systems

What is an Operating System?

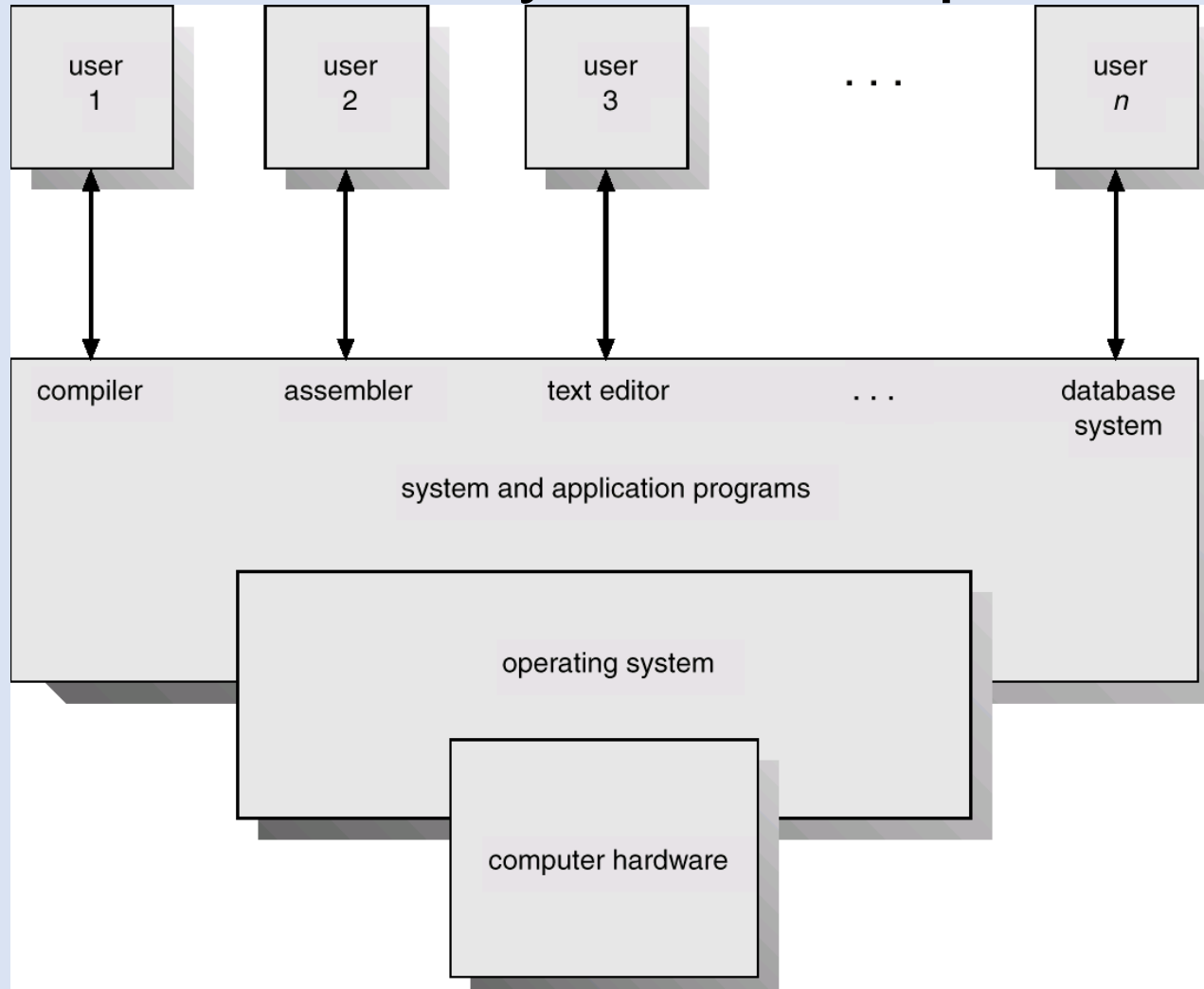
- Intermediary between a user of a computer and the computer hardware.
- A program that acts like a manager who efficiently manages computer resources.
- Operating system goals:
 - Execute user programs and make solving user problems easier.
 - Make the computer system convenient to use.

What operating systems do?

Computer System Components

1. Hardware – provides basic computing resources (CPU, memory, I/O devices).
2. Operating system – controls and coordinates the use of the hardware among the various application programs for the various users.
3. Applications programs – define the ways in which the system resources are used to solve the computing problems of the users (compilers, database systems, video games, business programs).
4. Users (people, machines, other computers).

Abstract View of System Components



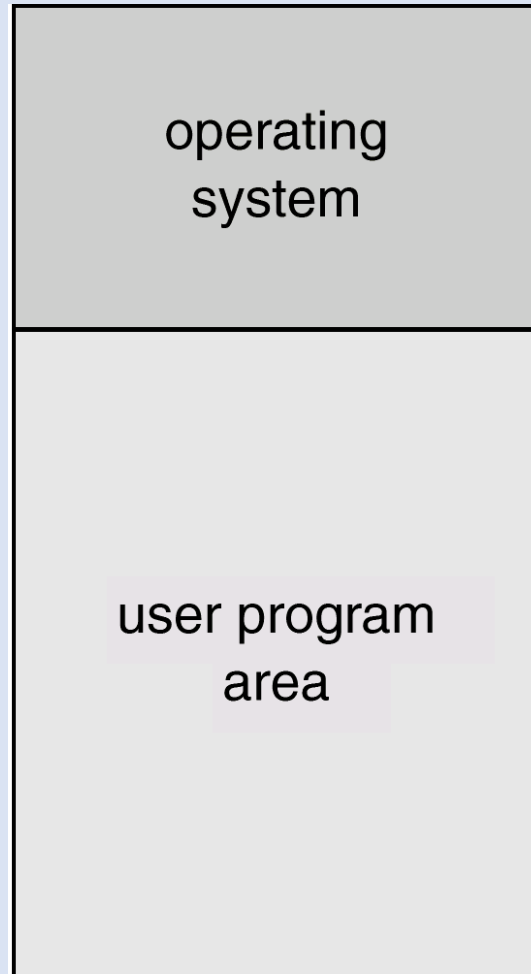
Some More Operating System Definitions May be:

- (System view) Resource allocator – manages and allocates resources.
- (User view) Easy to use, battery utilization, maximum performance; less priority to resources utilization;
- Control program – controls the execution of user programs and operations of I/O devices .
- A software that controls and allocates the resources.
- Kernel – the one program running at all times (all else being application programs).

Simple Batch Systems (1960)

- In this type of system, there is no direct interaction between user and the computer.
- 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.
- A special program (called monitor), manages the execution of each program in the batch.
- Monitor
 - initial control in monitor
 - control transfers to job
 - when job completes control transfers back to monitor
- Automatic job sequencing – automatically transfers control from one job to another. First rudimentary operating system.

Memory Layout for a Simple Batch System



Limitations:

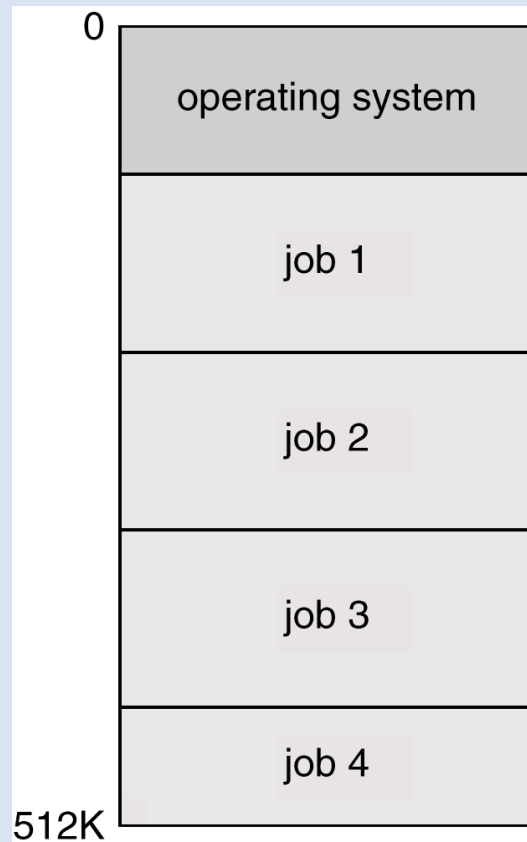
- Sequential Execution. Processor becomes ideal when processes do I/O operations.
- In this execution environment, the CPU is often idle because the speeds of the I/O devices are much slower than the speed of the CPU.
- User has no direct interaction with the system.
- Waiting time is more for a user/program.
- No mechanism to prioritize processes.

Multiprogramming Batched Systems (1970)

- Overlap I/O of one job with computation of another job.
- *Job pool* – data structure that allows the OS to select which job to be run next in order to increase CPU utilization.

Multiprogrammed Batch Systems

Several jobs are kept in main memory at the same time, and the CPU is multiplexed among them.

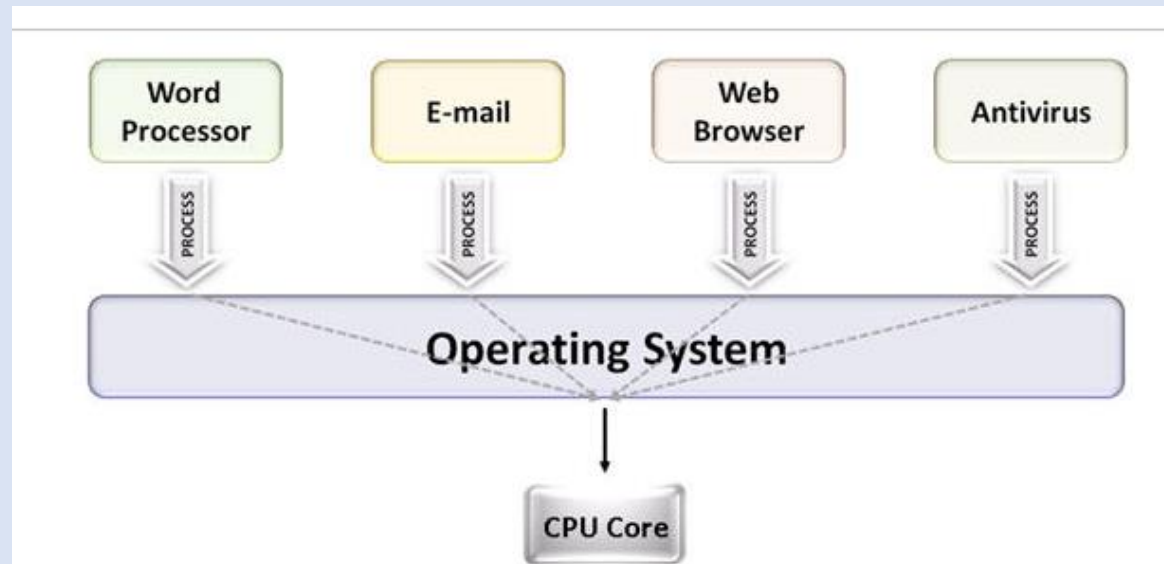


OS Features Needed for Multiprogramming

- Memory management – the system must allocate the memory to several jobs.
- CPU scheduling – the system must choose among several jobs ready to run.
- Allocation of devices.

Time-Sharing Systems–Interactive Computing (1970)

- Multiprogramming systems provide an environment in which various system resources like CPU, memory, I/O devices were utilized effectively.
- But it did not provide user interaction with the computer system.
- So, **time sharing or multitasking** is a logical extension of multiprogramming.
- In such system, more than one user can interact the system (or single user can run multiple applications) at the same time.



Time-Sharing Systems–Interactive Computing

- Multiple jobs are executed by switching the CPU between them but the **switches occur so frequently** that users can interact with each program while it is running and user can assume that he is only working on the system, but actually CPU is shared among different users.
- Here CPU time is shared by different processes. So this system is called as time sharing system.
- The CPU scheduler selects a job from the ready queue and switches the CPU to that job. When the time slot expired, the CPU switches from current job to another job.
- The time slice is given by the OS for sharing CPU time between processes.
- Time sharing system uses
 - CPU scheduling
 - Multiprogramming
 - Memory management scheme
- **UNIX is a time shared system.**

Advantages:

- The main advantage of time sharing system over the batch system is, the user can interact with the job while it is executing, but it is not possible in batch system.
- Efficient CPU utilization

Disadvantages:

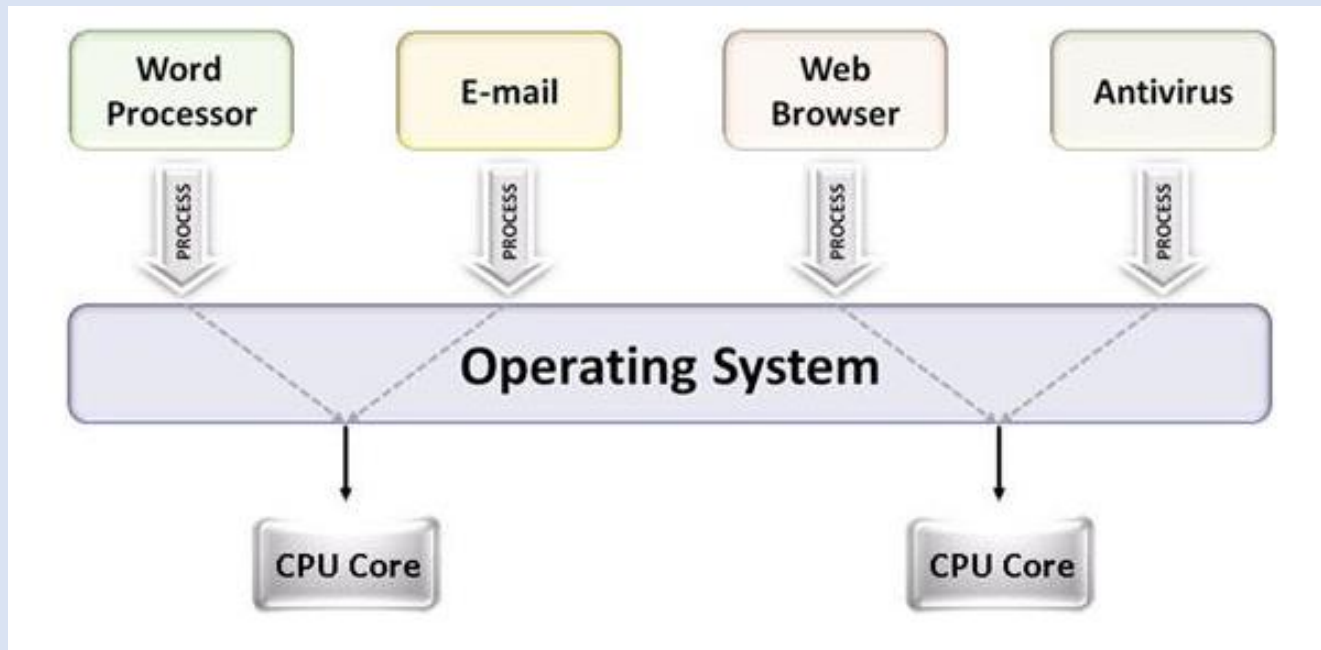
- As numbers of users are interacting with the processor at the same time, it is complex than multiprogrammed OS.
- System must have memory management and protection, since several jobs are kept in memory at the same time.
- Disk management is also required.
- It provides mechanism for concurrent execution which requires complex CPU scheduling scheme.

Personal-Computer Systems (1980)

- *Personal computers* – computer system dedicated to a single user.
- I/O devices – keyboards, mice, display screens, printer.
- User convenience and responsiveness.
- Personal computer operating system provides a good interface to a single user.

Parallel Systems/Multiprocessing System (1980)

- Multiprocessing is the ability of an operating system to execute more than one process simultaneously on a multi processor machine. In this, a computer uses more than one CPU at a time



- Multiprocessor systems with more than one CPU in close communication.
- *Tightly coupled system* – processors share memory and a clock; communication usually takes place through the shared memory.
- Advantages of parallel system:
 - Increased *throughput*
 - Increased reliability

Multithreading: Multithreading is the ability of an operating system to execute the different parts of a program called threads at the same time

Parallel Systems (Cont.)

- *Symmetric multiprocessing (SMP)*

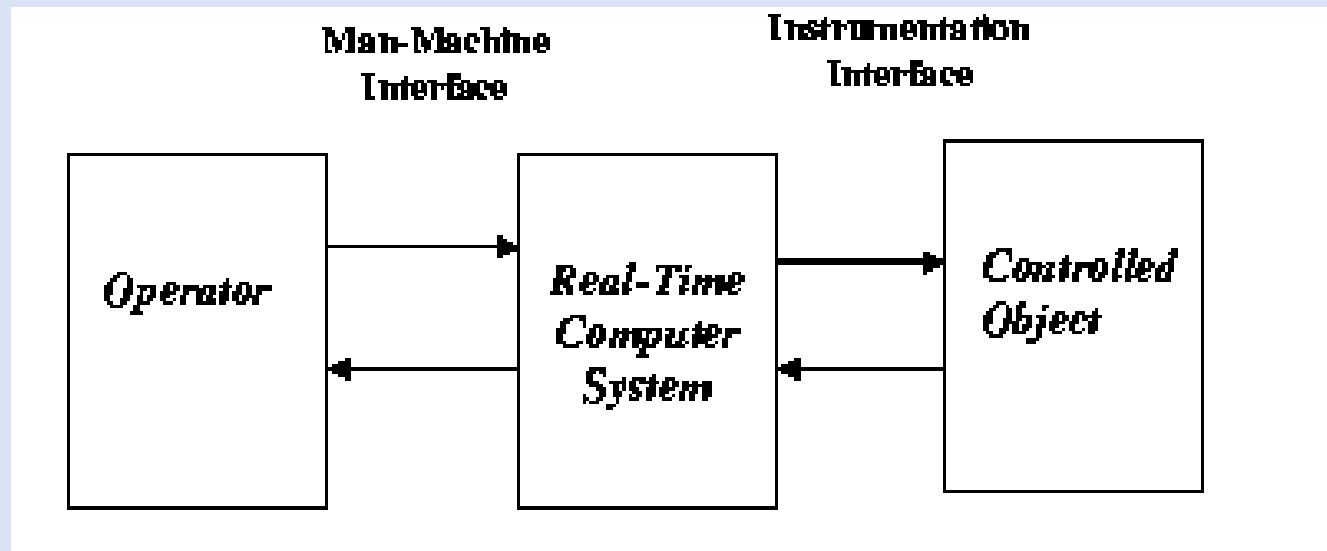
- Each processor runs an identical copy of the operating system.
- Many processes can run at once without performance deterioration.
- Most modern operating systems support SMP

- *Asymmetric multiprocessing*

- Each processor is assigned a specific task; master processor schedules and allocates work to slave processors.
- More common in extremely large systems

Real-Time Systems

- Real time system means that the system is subjected to real time, i.e., response should be guaranteed within a specified timing constraint or system should meet the specified deadline.
- Often used as a control device in a dedicated application such as controlling scientific experiments, medical imaging systems, flight control system, real time monitors, industrial control systems.



Real-Time Systems

- *Hard real-time system.*

- This type of system can never miss its deadline. Example: Flight controller system.
- Secondary storage limited or absent, data stored in short-term memory, or read-only memory (ROM)
- Not supported by general-purpose operating systems.

- *Soft real-time system*

- This type of system can miss its deadline occasionally with some acceptably low probability. Example: Telephone switches.
- Limited utility in industrial control or robotics
- Useful in applications (multimedia, virtual reality) requiring advanced operating-system features.

Distributed Systems

- Distribute the computation among several physical processors.
- *Loosely coupled system* – each processor has its own local memory; processors communicate with one another through various communications lines, such as high-speed buses or telephone lines.
- Advantages of distributed systems.
 - Resources Sharing
 - Computation speed up – load sharing
 - Reliability
 - Communications

Distributed Systems (Cont.)

- Network Operating System
 - Nodes can have different operating system.
 - Runs independently from other computers on the network
 - Communication through file sharing
 - Network Operating System is more scalable than Distributed Operating System.
- Distributed Operating System
 - less autonomy between computers
 - gives the impression there is a single operating system controlling the network.