OPERATING SYSTEM

Lecture 1

CENTRAL UNIVERSITY

FAITH • INTEGRITY • EXCELLENCE

Presentation Content

- What is an Operating System (OS)?
- Examples of Operating Systems
- Functions of an Operating System
- Types of Operating Systems
- Advantages of an Operating System
- Services of an Operating System
- Properties of an Operating System
- Processes of an Operating System

Definition

- An operating system is a program that acts as an interface between the user and the computer hardware and controls the execution of all kinds of programs.
- It is a software which performs all the basic tasks like file management, memory management, process management, handling input and output, and controlling peripheral devices such as disk drives and printers.
- is a collection of software that manages computer hardware resources and provides common services for computer programs.
- The operating system is a vital component of the system software in a computer system.

Cont.

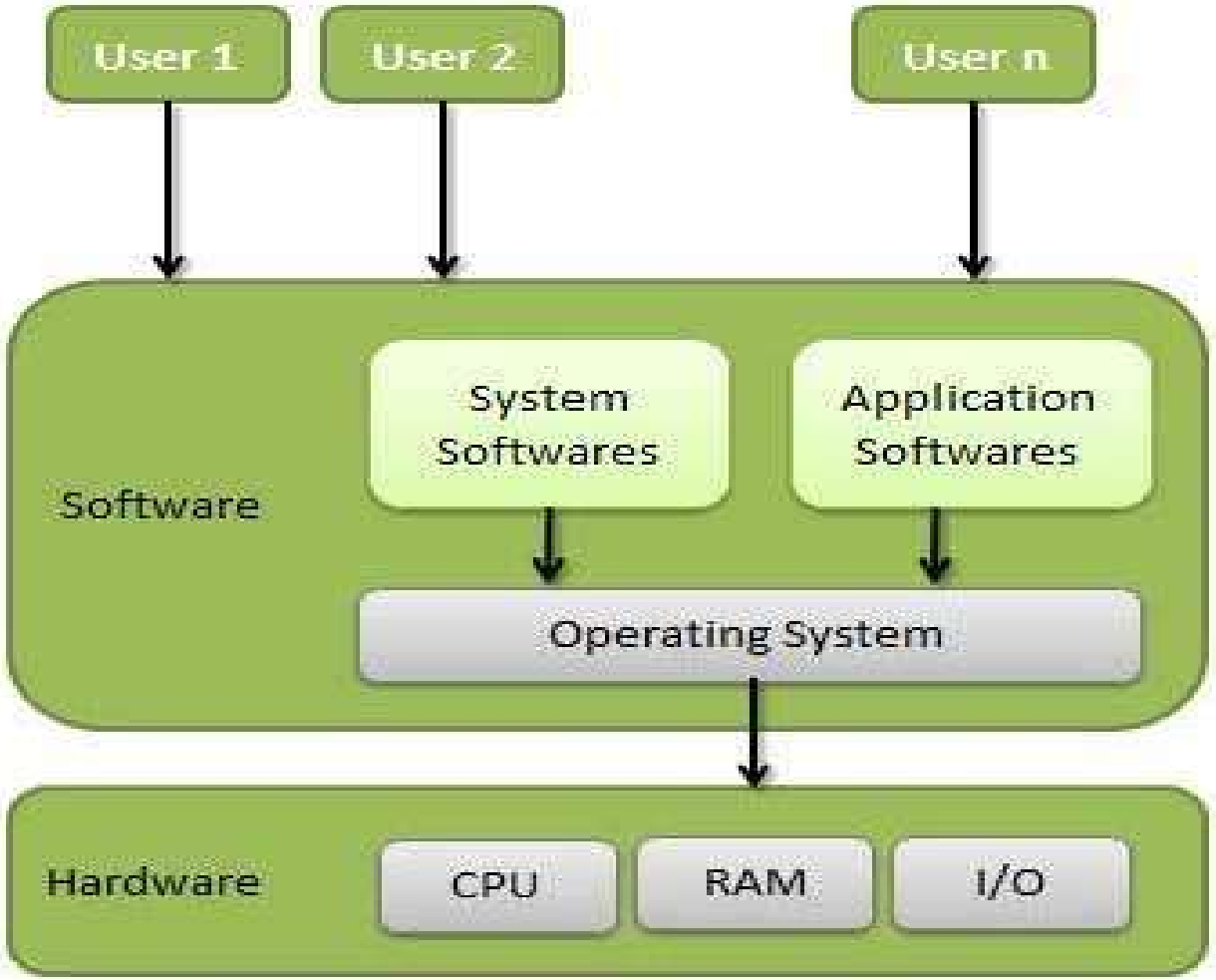

Figure 1 – Operating System bridging the gap between users and the hardware components

Examples of Operating Systems

- Windows (7, 8, 10, Sever)
- Mac OS
- Linux
- Solaris
- Android
- Chrome OS
- iOS
- Ubuntu, etc

History of OS

- Operating systems were first developed in the late 1950s to manage tape storage
- The General Motors Research Lab implemented the first OS in the early 1950s for their IBM 701
- In the mid-1960s, operating systems started to use disks
- In the late 1960s, the first version of the Unix OS was developed
- The first OS built by Microsoft was DOS. It was built in 1981 by purchasing the 86-DOS software from a Seattle company
- The present-day popular OS Windows first came to existence in 1985 when a GUI was created and paired with MS-DOS.

Functions of OS

- Memory Management
- Processor Management
- Device Management
- File Management
- Security
- Control over system performance
- Job accounting
- Error detecting aids
- Coordination between other software and users

- **Memory Management**:

refers to management of Primary Memory or Main Memory. It provides a fast storage that can be accessed directly by the CPU

- An Operating System does the following activities for memory management –
  - *Keeps tracks of primary memory, i.e., what part of it are in use by whom, what part are not in use.*
  - *In multiprogramming, the OS decides which process will get memory when and how much.*
  - *Allocates the memory when a process requests it to do so.*
  - *De-allocates the memory when a process no longer needs it or has been terminated.*

- **Processor Management**:

Also called process scheduling, decides which activity is processed and for how long.

- OS uses PM for the following activities–
  - *It controls traffic*
  - *Allocates and de-allocates the processor when a process requests it to do so and when a process has been terminated respectively.*

- **Device Management:**

OS manages device communication via their respective drivers by

  - *Keeping tracks of all devices by the **I/O controller.***
  - *Allocate and de-allocate processes to the device in an efficient way*

- **File Management:**

A file system organizes files into directories by

  - *Keeps track of information, location, uses, status etc. The collective facilities are often known as **file system***
  - *Allocates and de-allocates the resources*
  - *Decides who gets the resources*

Other functions are:

- **Providing Security** by means of password and similar other techniques, to prevents unauthorized access to programs and data.
- **Controlling system performance by** recording delays between request for a service and response from the system.
- **Job accounting** − Keeping track of time and resources used by various jobs and users.
- **Error detecting aids** − Production of dumps, traces, error messages, and other debugging and error detecting aids.
- **Coordination between other software and users** − Coordination and assignment of compilers, interpreters, assemblers and other software to the various users of the computer systems.

Types of OS

- **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. The programmers leave their programs with the operator and the operator then sorts the programs with similar requirements into batches.
- Disadvantages
- Lack of interaction between the user and the job.
- CPU is often idle, because the speed of the mechanical I/O devices is slower than the CPU.
- Difficult to provide the desired priority.

- **Time-sharing OS**

This is a technique which enables many people, to use a particular computer system at the same time, from various terminals. Time-sharing or multitasking is a logical extension of multiprogramming. Processor's time which is shared among multiple users simultaneously is termed as time-sharing.

- Advantages−
  - *Provides the advantage of quick response.*
  - *Avoids duplication of software.*
  - *Reduces CPU idle time.*
- Disadvantages
  - *Problem of reliability.*
  - *Question of security and integrity of user programs and data.*
  - *Problem of data communication*

Distributed operating System

- This system uses multiple central processors to serve multiple real-time applications and multiple users. Data processing jobs are distributed among the processors accordingly.
- The processors communicate with one another through various communication lines (such as high-speed buses or telephone lines). These are referred as **loosely coupled systems** or distributed systems.
- **Advantages –**
  - *With resource sharing facility, a user at one site may be able to use the resources available at another.*
  - *Speedup the exchange of data with one another via electronic mail.*
  - *If one site fails in a distributed system, the remaining sites can potentially continue operating.*
  - *Better service to the customers.*
  - *Reduction of the load on the host computer.*
  - *Reduction of delays in data processing.*

Network Operating System

- A NOS runs on a server and provides the server the capability to manage data, users, groups, security, applications, and other networking functions.
- The primary purpose of the network operating system is to allow shared file and printer access among multiple computers in a network, typically a local area network (LAN), a private network or to other networks.
- Advantages −
  - *Centralized servers are highly stable.*
  - *Security is server managed.*
  - *Upgrades to new technologies and hardware can be easily integrated into the system.*
  - *Remote access to servers is possible from different locations and types of systems.*
- Disadvantages −
  - *High cost of buying and running a server.*
  - *Dependency on a central location for most operations.*
  - *Regular maintenance and updates are required.*

Real-time Operating System

- Is a data processing system in which the time interval required to process and respond to inputs is so small that it controls the environment. The time taken by the system to respond to an input and display of required updated information is termed as the **response time.**
- Real-time systems are used when there are rigid time requirements on the operation of a processor or the flow of data and real-time systems can be used as a control device in a dedicated application.
- A real-time operating system must have well-defined, fixed time constraints, otherwise the system will fail.
- **Two types :**
  - ***Hard real-time systems:*** *guarantee that critical tasks complete on time. In hard real-time systems, secondary storage is limited or missing and the data is stored in ROM*
  - ***Soft real-time systems:*** *are less restrictive. A critical real-time task gets priority over other tasks and retains the priority until it completes*

Advantages of OS

- Easy to use
- User friendly
- Intermediate between hardwares and softwares of the system
- No need to know any technical languages

Services of an OS

- OS provides services to both the users and to the programs.
  - *It provides programs an environment to execute.*
  - *It provides users the services to execute the programs in a convenient manner.*
- OS common services provided:
  - *Program execution*
  - *I/O operations*
  - *File System manipulation*
  - *Communication*
  - *Error Detection*
  - *Resource Allocation*
  - *Protection*

Program execution

- OS handle many kinds of activities from user programs to system programs like printer spooler, name servers, file server, etc.
- A process includes the complete execution context (code to execute, data to manipulate, registers, OS resources in use). Following are the major activities of an OS with respect to program management −
  - *Loads a program into memory.*
  - *Executes the program.*
  - *Handles program's execution.*
  - *Provides a mechanism for process synchronization.*
  - *Provides a mechanism for process communication.*
  - *Provides a mechanism for deadlock handling.*

- Questions?
- Comments?
- Contributions?

I/O Operation

- An I/O subsystem comprises of I/O devices and their corresponding driver software. Drivers hide the peculiarities of specific hardware devices from the users.
- An Operating System manages the communication between user and device drivers.
  - *I/O operation means read or write operation with any file or any specific I/O device.*
  - *Operating system provides the access to the required I/O device when required.*

File system manipulation

- A file system is normally organized into directories for easy navigation and usage. These directories may contain files and other directions.
- Major activities of an OS with respect to file management −
  - *Program needs to read a file or write a file.*
  - *The OS gives the permission to the program for operation on file.*
  - *Permission varies from read-only, read-write, denied and so on.*
  - *OS provides an interface to the user to create/delete files.*
  - *OS provides an interface to the user to create/delete directories.*

Communication

- The OS handles routing and connection strategies, and the problems of contention and security.
- Major activities of an OS with respect to communication –
  - *Two processes often require data to be transferred between them*
  - *Both the processes can be on one computer or on different computers, but are connected through a computer network.*
  - *Communication may be implemented by two methods, either by Shared Memory or by Message Passing.*

Error handling

- Errors can occur anytime and anywhere. An error may occur in CPU, in I/O devices or in the memory hardware.
- Major activities of an OS with respect to error handling –
  - *The OS constantly checks for possible errors.*
  - *The OS takes an appropriate action to ensure correct and consistent computing.*

Resource Management

- In case of multi-user or multi-tasking environment, resources such as main memory, CPU cycles and files storage are to be allocated to each user or job.

- Major activities of an OS with respect to RM
  - *The OS manages all kinds of resources using schedulers.*
  - *CPU scheduling algorithms are used for better utilization of CPU.*

Protection

- Protection refers to a mechanism or a way to control the access of programs, processes, or users to the resources defined by a computer system.
- Major activities of an OS with respect to protection −
  - *The OS ensures that all access to system resources is controlled.*
  - *The OS ensures that external I/O devices are protected from invalid access attempts.*
  - *The OS provides authentication features for each user by means of passwords.*

Properties of an OS - Batch Processing

- It is a technique in which programs and data are collected together in batches before processing.
- The Operating System
  - *Defines a job which has predefined sequence of commands, programs and data as a single unit*
  - *Keeps in jobs in memory and executes them afterwards*

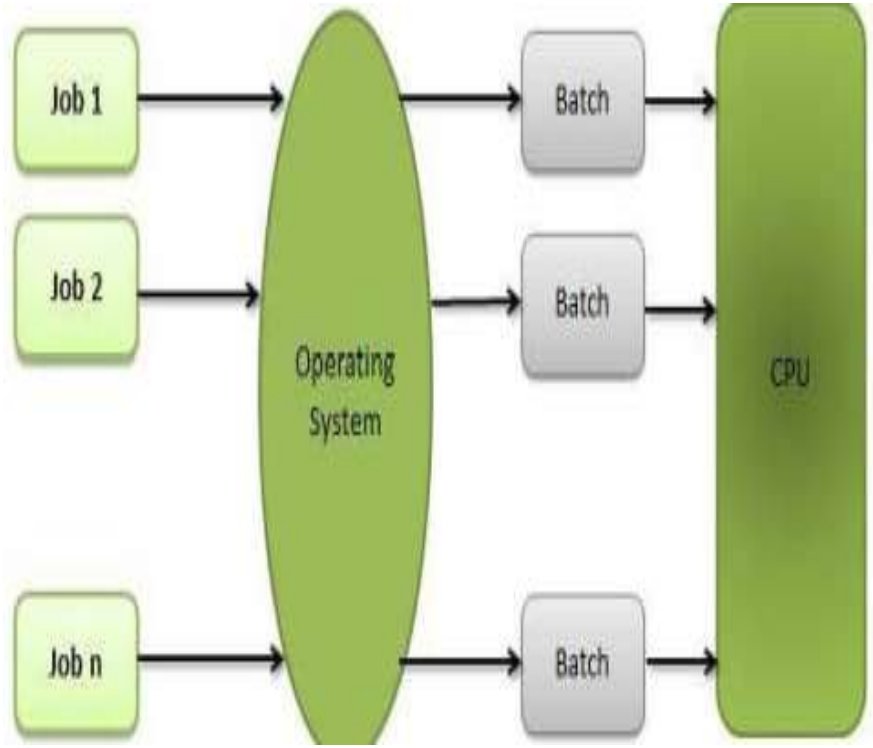

Figure 2 – Batch Processing

Merits and Demerits of Batch processing

Batch processing takes much of the work of the operator to the computer	Debugging program is difficult
It increases performance as a new job begins	One batch job can affect other pending jobs

Multitasking

- The execution of multiple jobs simultaneously by switching between them. The user may interact with each program while it is running.
- The OS
  - *Handles multitasking in a way that it can handle and execute multiple operations at a time*
  - *Helps the user to give instructions to a program directly, and receives an immediate response*
  - *It also allows the users to share the computer simultaneously.*
- Multitasking Operating Systems are also known as ***Time-Sharing systems.*** ***(see slide 4)***

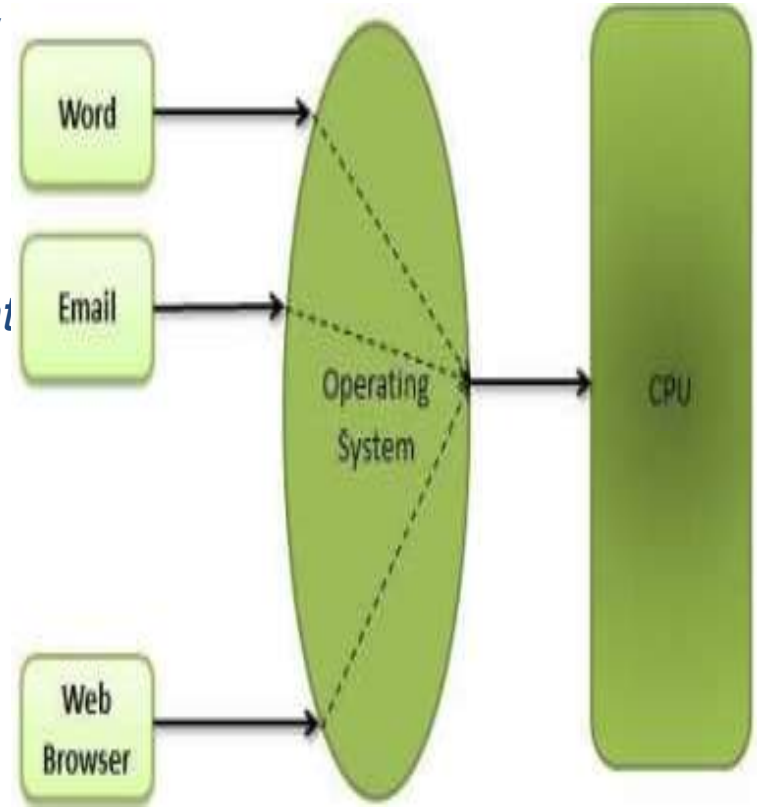

Figure 3 – An OS performing multiple jobs at a time

Multiprogramming

- It is simply sharing the processor when multiple programs reside in memory at the same time.
- It increases CPU utilization.
- An OS does the following
  - *It keeps several jobs in memory at a time*
  - *It picks and begins to execute one of the jobs in the memory*
- An advantage of this is that, the user feels that many programs are allotted CPU almost simultaneously

Figure 4 – memory layout for multiprogramming system

Processes of an Operating System

- A process is defined as an entity which represents the basic unit of work to be implemented in the system.
- It is basically a program in execution.
- The layout of a process inside a memory is
  - *Stack*
  - *Heap*
  - *Data*
  - *Text*

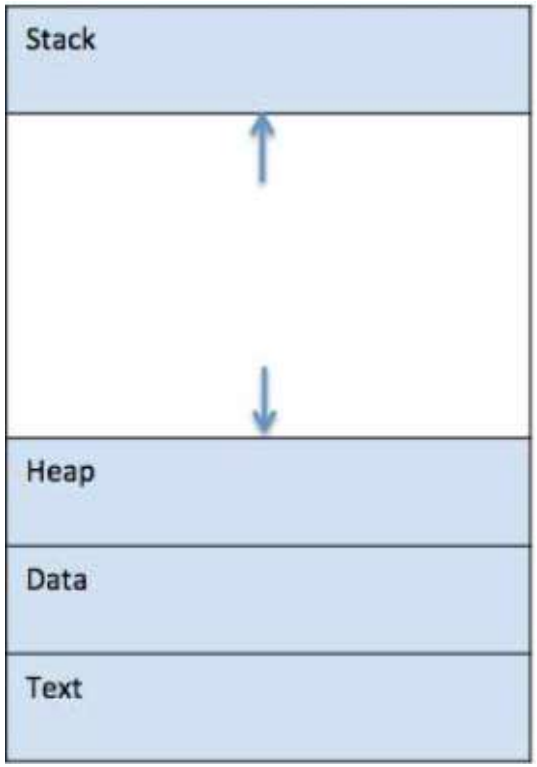

Figure 5 – simplified layout of a process

Process Components and Description

- Stack - The process Stack contains the temporary data such as method/function parameters, return address and local variables.
- Heap - This is dynamically allocated memory to a process during its run time.
- Text - This includes the current activity represented by the value of Program Counter and the contents of the processor's registers.
- Data - This section contains the global and static variables.

Process Life Cycle

- The stages a process goes through when executing may differ in different operating systems. In general, a process can have one of the following:

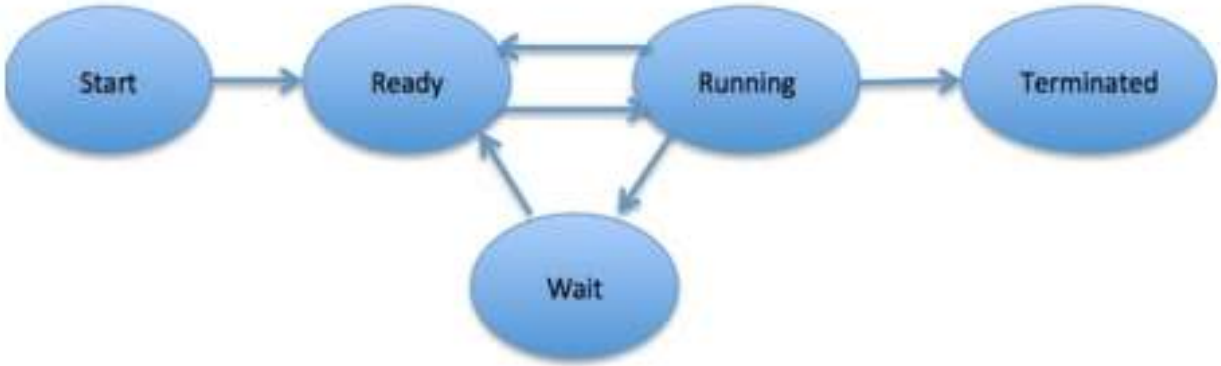

Figure 6 – Process life cycle

Stages and Description

- **Start -** This is the initial state when a process is first started/created.
- **Ready -** The process is waiting to be assigned to a processor.
- **Running -** At this stage, the processor is set to execute the instructions assigned to it.
- **Waiting -** Process moves into the waiting state if it needs to wait for a resource, such as waiting for user input, or waiting for a file to become available.
- **Terminated -** Once the process finishes its execution, or it is terminated by the operating system, it is moved to the terminated state where it waits to be removed from main memory

Process Control Block (PCB)

- A PCB is a data structure maintained by the OS for every process.
- It is identified by an integer process ID (PID)
- A PCB keeps all the information needed to keep track of a process as listed below –
  - ***Process State*** *- The current state of the process i.e., whether it is ready, running, waiting, or whatever*
  - ***Process privileges -*** *This is required to allow/disallow access to system resources.*
  - ***Process ID -*** *Unique identification for each of the process in the operating system.*
  - ***Pointer -*** *A pointer to parent process.*
  - ***Program Counter -*** *Program Counter is a pointer to the address of the next instruction to be executed for this process.*

Cont.

- **CPU registers -** Various CPU registers where process need to be stored for execution for running state.
- **CPU Scheduling Information** - Process priority and other scheduling information which is required to schedule the process.
- **Memory management information -** This includes the information of page table, memory limits, Segment table depending on memory used by the OS.
- **Accounting information -** This includes the amount of CPU used for process execution, time limits, execution ID etc.
- **IO status information -** This includes a list of I/O devices allocated to the process.

- Questions?
- Comments?
- Contributions?

Assignment 1 (Due: 26 – 09 – 2019)

1. Explain the relationship between operating systems and computer hardware.
2. How can buffering improve the performance of a Computer system?
3. State three (3) primary differences between Network Operating System and Distributed Operating System
4. Which inconveniences can a user can face while interacting with a computer system, which is without an operating system?