

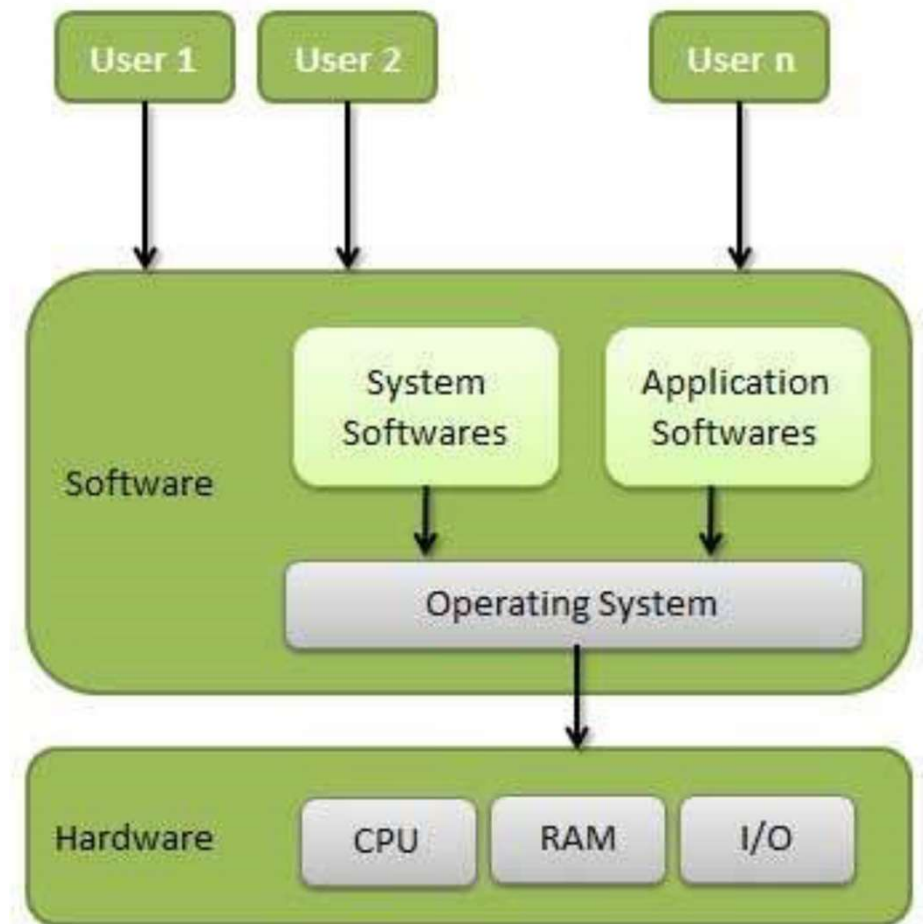


OPERATING SYSTEM

4th Semester CSE (R-23)

OUTLINE

➤ An Operating System (OS) is an interface between a computer user and computer hardware. An operating system 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.



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.

Following are some of important functions of an operating System.

- ☐ 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

- ❖ Memory management refers to management of Primary Memory or Main Memory. Main memory is a large array of words or bytes where each word or byte has its own address.
- ❖ Main memory provides a fast storage that can be accessed directly by the CPU.
- ❖ For a program to be executed, it must be in the main memory.

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

In multiprogramming environment, the OS decides which process gets the processor when and for how much time. This function is called process scheduling. An Operating System does the following activities for processor management :

- ☐ Keeps tracks of processor and status of process. The program responsible for this task is known as traffic controller.
- ☐ Allocates the processor (CPU) to a process.
- ☐ De-allocates processor when a process is no longer required.

DEVICE MANAGEMENT

An Operating System manages device communication via their respective drivers. It does the following activities for device management :

- ☐ Keeps tracks of all devices. Program responsible for this task is known as the I/O controller.
- ☐ Decides which process gets the device when and for how much time.
- ☐ Allocates the device in the efficient way.
- ☐ De-allocates devices.

FILE MANAGEMENT

A file system is normally organized into directories for easy navigation and usage. These directories may contain files and other directories.

An Operating System does the following activities for file management –

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

OTHER IMPORTANT ACTIVITIES

Following are some of the important activities that an Operating System performs :

- ☐ Security : By means of password and similar other techniques, it prevents unauthorized access to programs and data.
- ☐ Control over system performance : 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.

OTHER IMPORTANT ACTIVITIES

- ☐ 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 OPERATING SYSTEM

A lot of operating system has been designed as per the necessity of users. We will summarize some of them here.

Batch system:

□ Early computers were enormous machine run from a console. The users did not interact directly with the computer systems. To speed up processing, operators batched jobs together with similar needs and ran them through the computer as a group. The operator would sort programs into batches with similar requirements and as the system became available would run each batch. The output from each job would be sent back to the programmer.

TYPES OF OPERATING SYSTEM

- ☐ In the execution environment the CPU is often idle, as the speed of mechanical IO devices are much slower than those of electronic devices. The difference in speed makes the CPU wait for a long time always.
- ☐ Later on the introduction of disk technology allowed the operating system to keep all jobs on a disk and to perform better.

MULTI PROGRAMMED SYSTEMS:

- The most important aspect of job scheduling is the ability to multiprogramming. Multiprogramming increases CPU utilization by organizing jobs so that the CPU always has one to execute.
- The Operating System keeps several jobs in memory simultaneously. These set of jobs are the part of jobs reside in the job pool of the disk. These jobs can be executed one by one. The Operating System can assign another job to the CPU whenever the running process needs any IO, so that the CPU can be used in a optimal way.

MULTI PROGRAMMED SYSTEMS:

- Multiprogramming is the first instance where the Operating System must make decisions for the users. The jobs reside in the job pool can be chosen by the Operating System through different scheduling criteria and scheduling algorithms.

TIME SHARING SYSTEMS:

- Time sharing (multi tasking) is a logical extension of multiprogramming. The CPU executes multiple jobs by switching among them, but the switches occur so frequently that the user can interact with each program while it is running.
- An interactive computer system provides direct communication between the user and the system. So the response time of it should be short typically within 1 second. A time shared operating system allows many users to share the computer simultaneously. It uses CPU scheduling and multiprogramming to provide each user with a small portion of a time-shared computer.

TIME SHARING SYSTEMS:

- ☐ Here several jobs may be kept simultaneously in memory, so the system may have memory management and protection. To obtain a reasonable response time jobs may have to be swapped in and out of main memory.
- ☐ A common method virtual memory is implemented to achieve this goal.

MULTIPROCESSOR SYSTEM:

Multiprocessor system also known as parallel system or tightly coupled system have more than one processor. In close communication, sharing the computer bus, the clock and sometimes memory and peripheral devices.

Advantage:

□ **Increased throughput:** by increasing the number of processors, we hope to get more work done in less time, whereas it also incurs some overhead to maintain the processors.

MULTIPROCESSOR SYSTEM:

- ☐ **Economy of scale:** we can save money by sharing some system resources.
- ☐ **Increased reliability:** if functions can be distributed properly among several processors, then the failure of one processor will not halt the system, only slow it down.
- ☐ The ability to continue service providing proportional to the level of surviving hardware is called graceful degradation. Systems designed for graceful degradation are also fault tolerant systems.

MULTIPROCESSOR SYSTEM:

- The most common multiple processor systems now use **symmetric multiprocessing (SMP)**, in which each processor runs an identical copy of the operating system and these copies communicate with one another as needed. Some systems use **asymmetric multiprocessing**, in which each processor is assigned a specific task. A master processor controls the system, other processors either look to the master for instruction or have predefined task. This scheme defines a **master slave** relationship.

DISTRIBUTED SYSTEMS:

A network is a communication path between two or more systems. **Distributed systems** depend on network for their functionality. By being able to communicate, distributed systems are able to share computational tasks and provide a rich set of features to users. As a part of this centralized systems today act as server systems to satisfy requests generated by client systems.

□ Server systems can be broadly categorized as compute server and file server

DISTRIBUTED SYSTEMS:

Compute server system: provide an interface to which clients can send requests to perform an action, in response to which they execute the action and send back results to the client.

File server system: provides a file system interface where clients can create, update, delete and read files.

The computer network used in the distributed operating system does not share a memory or a clock instead, each processor has its own local memory. The processors communicate with each other through various communication lines, such as high-speed buses or telephone lines. These systems are usually referred to as loosely coupled system.

REAL TIME SYSTEM:

A **real time system** is used when rigid time requirements have been placed on the operations of a processor or the flow of data, thus it is often used as a control device in a dedicated application.

- **Sensors** being data to the computer. The computer must analyze the data and possibly adjust controls to modify the sensor inputs. For e.g. scientific experiments, medical imaging systems etc.
- A **real time system** has well defined fixed time constraints, hence processing must be done within the defined constraints or the system fails.

REAL TIME SYSTEM:

Real time system comes in two flavors :

- **Hard real time system** guarantees that the critical task be completed on time. This goal requires that all delays in the system be bounded from the retrieval of stored data to the time that it takes the operating system to finish any request made of it.
- **Soft real time system** is less restrictive compared to hard real time system, where a critical real time task gets priority over other tasks and retain that priority until it completes.

REAL TIME SYSTEM:

- The **soft real time systems** are useful however in several areas including multimedia, virtual reality and advanced scientific projects.
- **Virtual memory** almost never found in real time systems.

THE COMPUTER SYSTEM STRUCTURE RELATED TO OPERATING SYSTEM

- A modern general-purpose system consists of a CPU and a number of device controllers that are connected through a common bus, which provides access to **share memory**. Each device control is in charge of a specific type of device.
- To start a program or a computer system we need a **bootstrap program**, which is stored in read only memory (ROM) or in EEPROM as firmware. It initializes all aspects of the system from CPU registers to device controller to the memory contents. After execution of the bootstrap program the OS starts executing the first process **“init”** and wait for some event to occur.

THE COMPUTER SYSTEM STRUCTURE RELATED TO OPERATING SYSTEM

- The occurrence of an event is usually signaled by an **interrupt** from either the hardware or software.
- Software may trigger an interrupt by executing a special operation called a **system call or monitor call**. When the CPU is interrupted it stops what it is doing and immediately transfers execution to a fixed location, which actually contains the starting address where the service routine for the interrupt is located.
- The information about the **interrupts** may be stored in a **table of pointer** which is generally stored in low memory (generally the first hundred location).

THE COMPUTER SYSTEM STRUCTURE RELATED TO OPERATING SYSTEM

- These locations hold the address of the **interrupt service routines** for the various devices. This array or interrupt vector of addresses is then indexed by a unique device number given with the interrupt request, to provide the address of the interrupt service routine for the interrupting device.
- A **system call** is invoked in a variety of ways, depending on the functionality provided by the processor. In all forms it is the method used by a process to **request action** by the operating system.

THE COMPUTER SYSTEM STRUCTURE RELATED TO OPERATING SYSTEM

- **IO structure:** A device controller is in charge of a specific type of device or may be attached to more than one device. The device controller is responsible for moving the data between the peripheral devices that it controls and its local storage buffer.
- **IO interrupts:** To start an IO operation, the CPU loads the appropriate register with in the device controller, in turn the device controller examines the registers to find the action, that is **READ or WRITE**.
- For a **read** operation it starts transfer of data from the device to its **local buffer** and after completion it informs the CPU. The information passing can be done by triggering an interrupt.

OPERATING SYSTEM - SERVICES

➤ **An Operating** System 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.

Following are a few common services provided by an operating system:

- | | |
|---|--|
| <input type="checkbox"/> Program execution | <input type="checkbox"/> I/O operations |
| <input type="checkbox"/> File System manipulation | <input type="checkbox"/> Communication |
| <input type="checkbox"/> Error Detection | <input type="checkbox"/> Resource Allocation |
| <input type="checkbox"/> Protection | |

OPERATING SYSTEM - SERVICES

➤ **Program execution :** Operating systems handle many kinds of activities from user programs to system programs. Following are the major activities of an operating system 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.

OPERATING SYSTEM - SERVICES

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.

OPERATING SYSTEM - SERVICES

File system manipulation : A file represents a collection of related information. Computers can store files on the disk (secondary storage), for long term storage purpose.

- A file system is normally organized into directories for easy navigation and usage. These directories may contain files and other directories.
- Following are the major activities of an operating system with respect to file management:

OPERATING SYSTEM - SERVICES

- ☐ Program needs to **read a file or write a file**.
- ☐ The operating system gives the **permission** to the program for operation on file.
- ☐ Permission varies from **read-only, read-write, denied and so on**.
- ☐ Operating System provides an **interface** to the user to **create/delete files**.
- ☐ Operating System provides an **interface** to the user to **create/delete directories**.
- ☐ Operating System provides an **interface** to create the **backup of file system**.

COMMUNICATION

The OS handles **routing and connection** strategies, and the problems of contention and security. Following are the major activities of an operating system 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. Following are the major activities of an operating system 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. Following are the major activities of an operating system with respect to resource management:

- ☐ 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. Following are the major activities of an operating system 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