Operating System (OS)

- Start of 01 chapter

Content:

- Introduction to Operating Systems.
- Operating system goals.
- Computer System Structure.
- Computer Startup.
- Functions of Operating system.

Introduction:

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

- Some popular Operating Systems include Linux Operating System, Windows Operating System etc...
- OS is a **resource allocator:**

1) Manages all resources
2) Decides between conflicting requests for efficient and fair resource use.

- OS is a **control program:**

1) Controls execution of programs to prevent errors and improper use of the computer.

Operating system goals:

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

Computer System Structure:

Computer system can be divided into four components:

1. Hardware:

provides basic computing resources CPU, memory, I/O devices etc…

2. Operating system:

Controls and coordinates use of hardware among various applications and users.

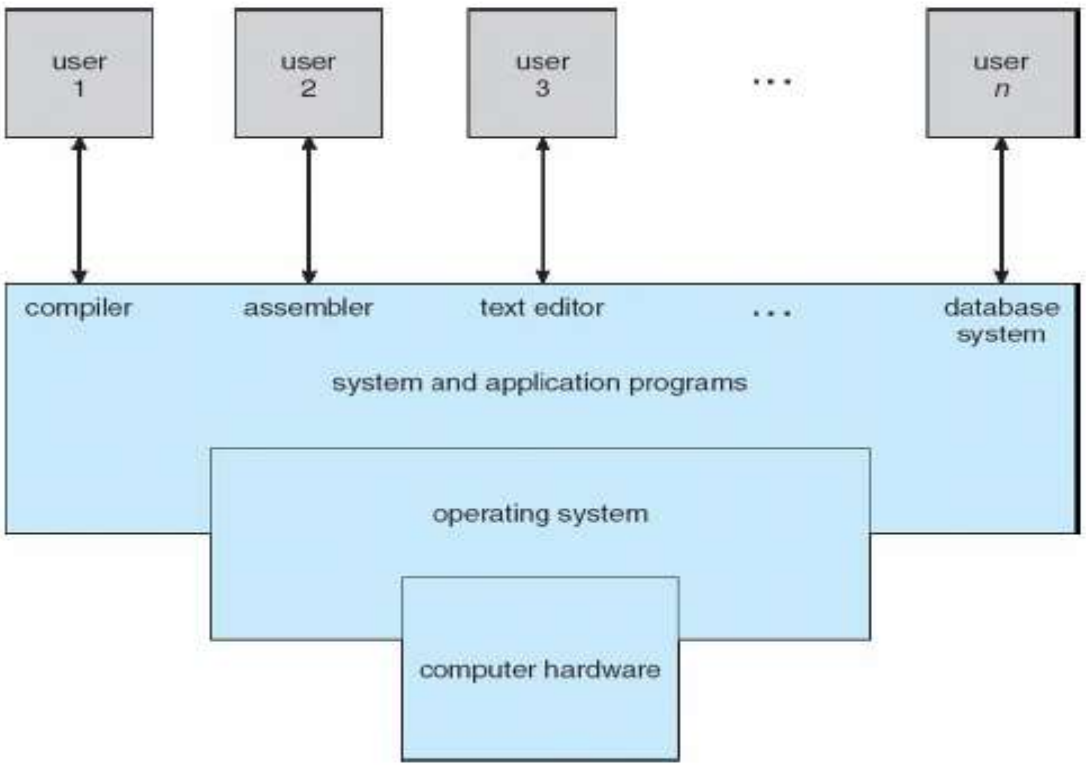
3. Application programs:

define the ways in which the system resources are used to solve the computing problems of the users Word processors, compilers, web browsers, database systems and video games.

4. Users:

People, machines and other computers.

Four components of computer system:



Computer Startup:

- bootstrap program is loaded at power-up or reboot.

1. Typically stored in ROM or EPROM, generally known as **firmware**.
2. Initializes all aspects of system.
3. Loads operating system kernel and starts execution.

Functions of 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:

1. **Keeps tracks of primary memory**, i.e., what part of it are in use by whom, what part are not in use.
2. In multiprogramming, the OS decides **which process will get memory when and how much.**
3. **Allocates the memory** when a process requests it to do so.
4. **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:

1. Keeps **tracks** of processor and **status** of process. The program responsible for this task is known as **traffic controller**.
2. **Allocates** the processor (CPU) to a process.
3. **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:

1. **Keeps tracks of all devices**. Program responsible for this task is known as the **I/O controller**.
2. Decides **which process** gets the device when and for how much time.
3. **Allocates** the device in the efficient way.
4. **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 directions.
An Operating System does the following activities for file management:

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

Other Important Activities:

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

1. **Security** − By means of password and similar other techniques, it prevents unauthorized access to programs and data.
2. **Control over system performance** − Recording delays between request for a service and response from the system.
3. **Job accounting** − Keeping track of time and resources used by various jobs and users.
4. **Error detecting aids** − Production of dumps, traces, error messages, and other debugging and error detecting aids.
5. **Coordination between other software's and users** − Coordination and assignment of compilers, interpreters, assemblers and other software to the various users of the computer systems.

- Start of 02 chapter:

Content:

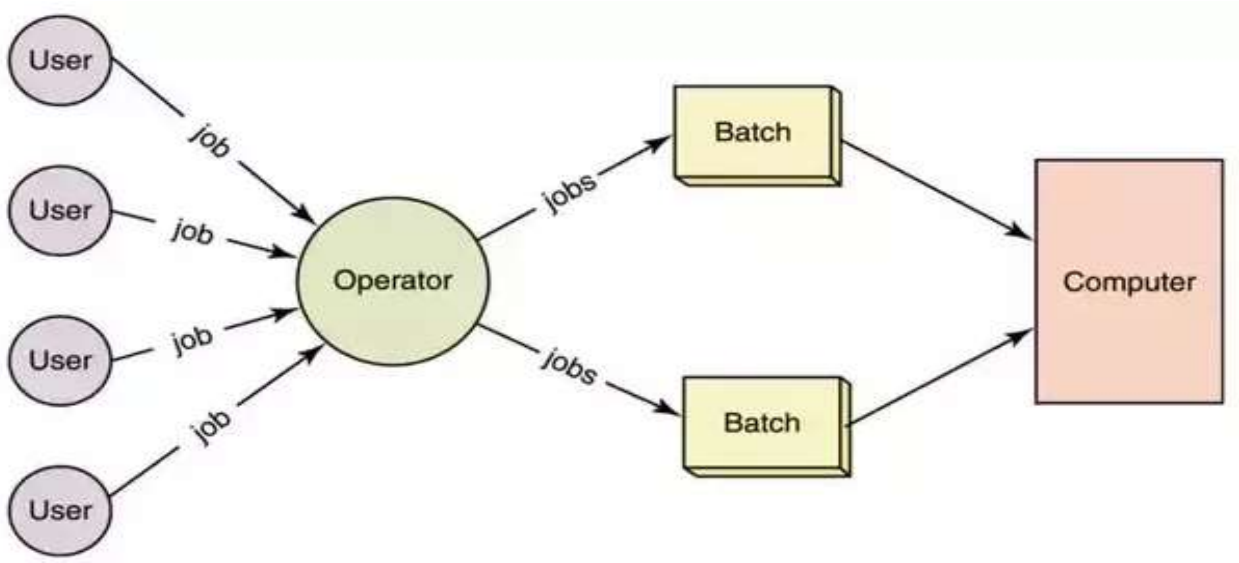
Types of Operating Systems

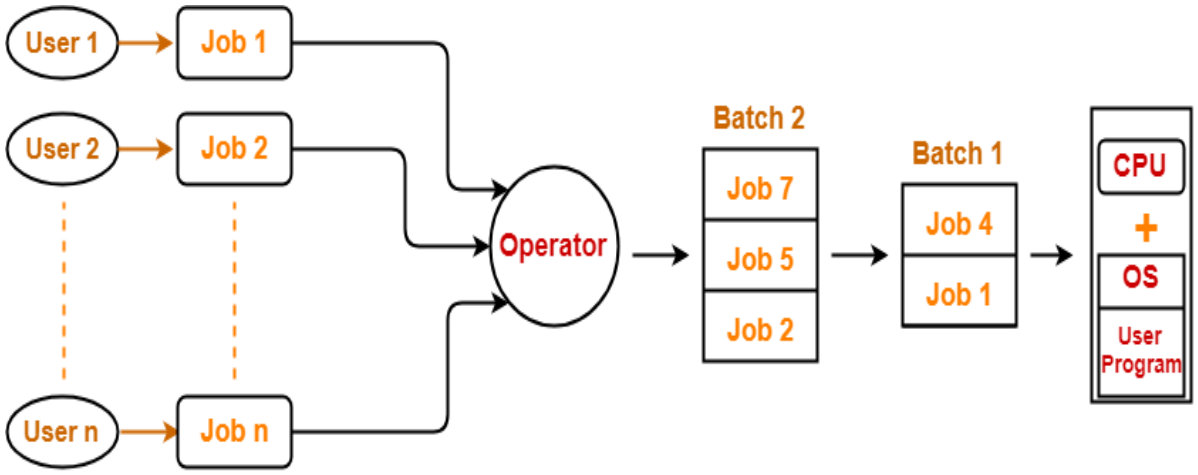
a. Batch operating system
b. Time-sharing operating systems
c. Distributed operating System
d. Network operating System
e. Real Time operating System

1) 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**.

Batch operating system:





Batch Operating System

Advantage & disadvantage:

- **Advantage:**

1. Multiple user can share Batch System
2. Repeated jobs are done fast
3. Batch system could manage large repeated work easily

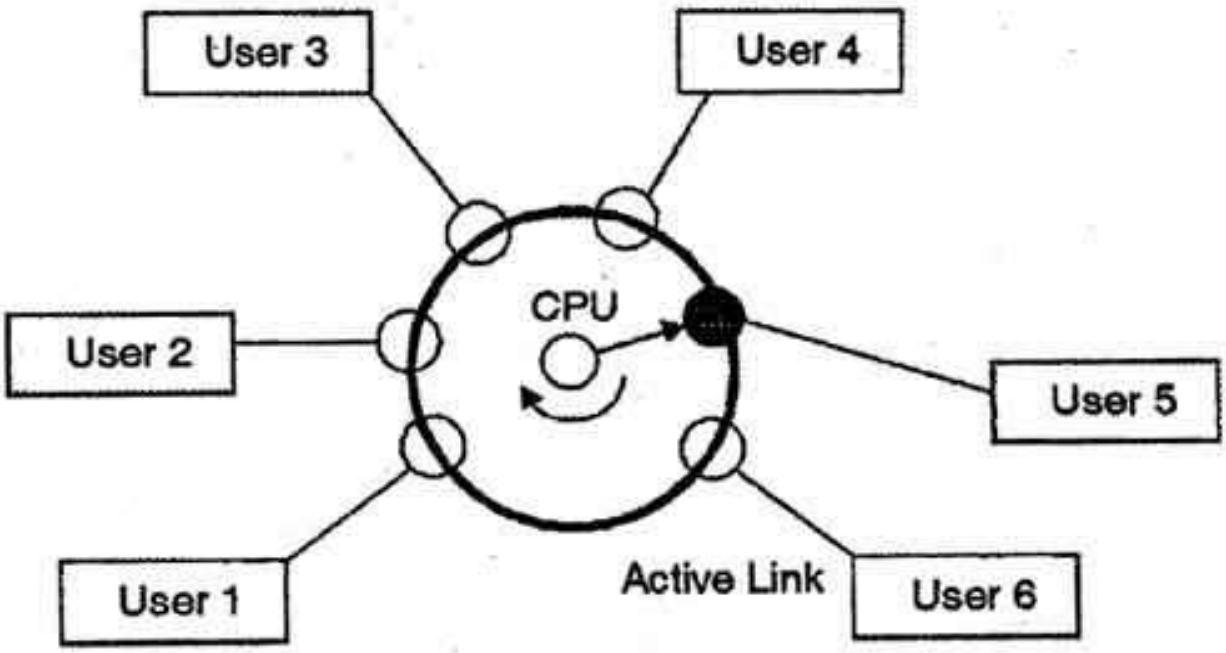
- **Dis-Advantages:**

1. Lack of interaction between the user and the job.
2. CPU is often idle, because the speed of the mechanical I/O devices is slower than the CPU.
3. Difficult to provide the desired priority.

2) Time-sharing operating systems:

- Time-sharing is a technique which **enables many people**, located at various terminals, to use a particular computer system **at the same time**.
- **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.

- The **main difference** between **multi programmed Batch Systems** and **Time-Sharing Systems** is that in case of **multi-programmed** batch systems, the objective is to **maximize processor use**, whereas in Time-Sharing Systems, the objective is to **minimize response time**.
- **Multiple jobs** are executed by the **CPU by switching** between them, but the switches occur so frequently.
- Thus, the user can receive an **immediate response**. For example, in a transaction processing, the processor executes each user program in a **short burst or quantum** of computation.
- That is, if **n** users are present, then each user can get a **time quantum**. When the user submits the command, the response time is in few seconds at most.
- The operating system uses **CPU scheduling** and **multiprogramming** to provide each user with a small portion of a time.
- Computer systems that were designed primarily as batch systems have been **modified** to time-sharing systems.



Advantages & disadvantages:

- **Advantages:**

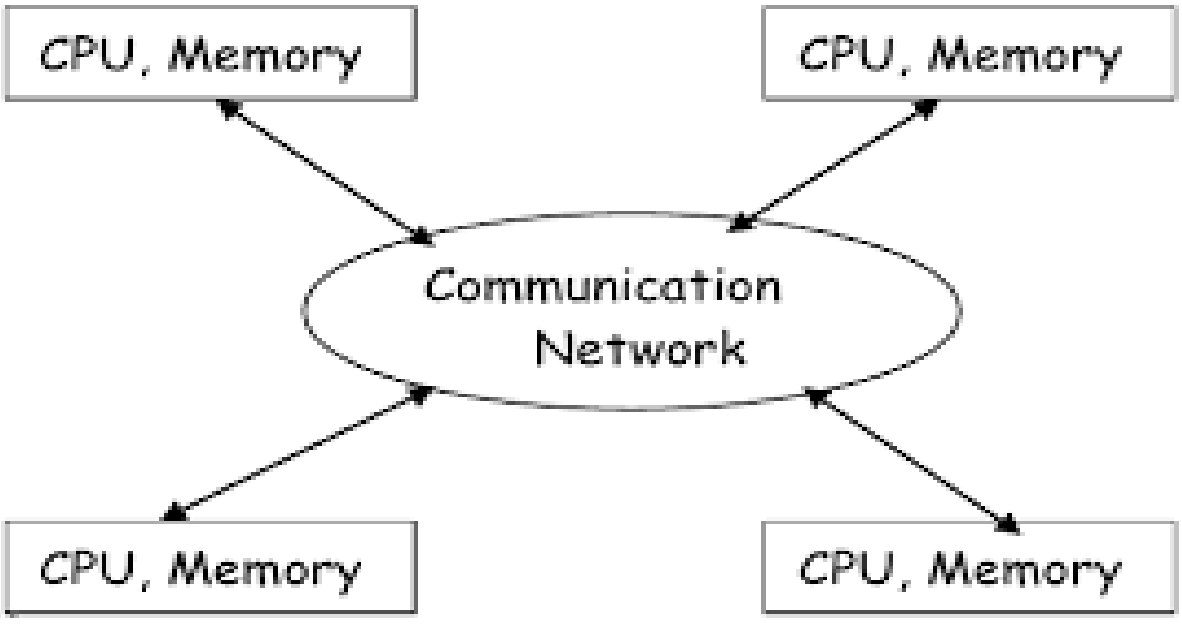
1. Provides the advantage of quick response.
2. Avoids duplication of software.
3. Reduces CPU idle time.

- **Disadvantages:**

1. Problem of reliability.
2. Question of security and integrity of user programs and data.
3. Problem of data communication.

3) Distributed operating System:

- Distributed systems use 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.
- Processors in a distributed system may vary in size and function.
- These processors are referred as sites, nodes, computers, and so on.



Advantages & disadvantages:

- **Advantages:**

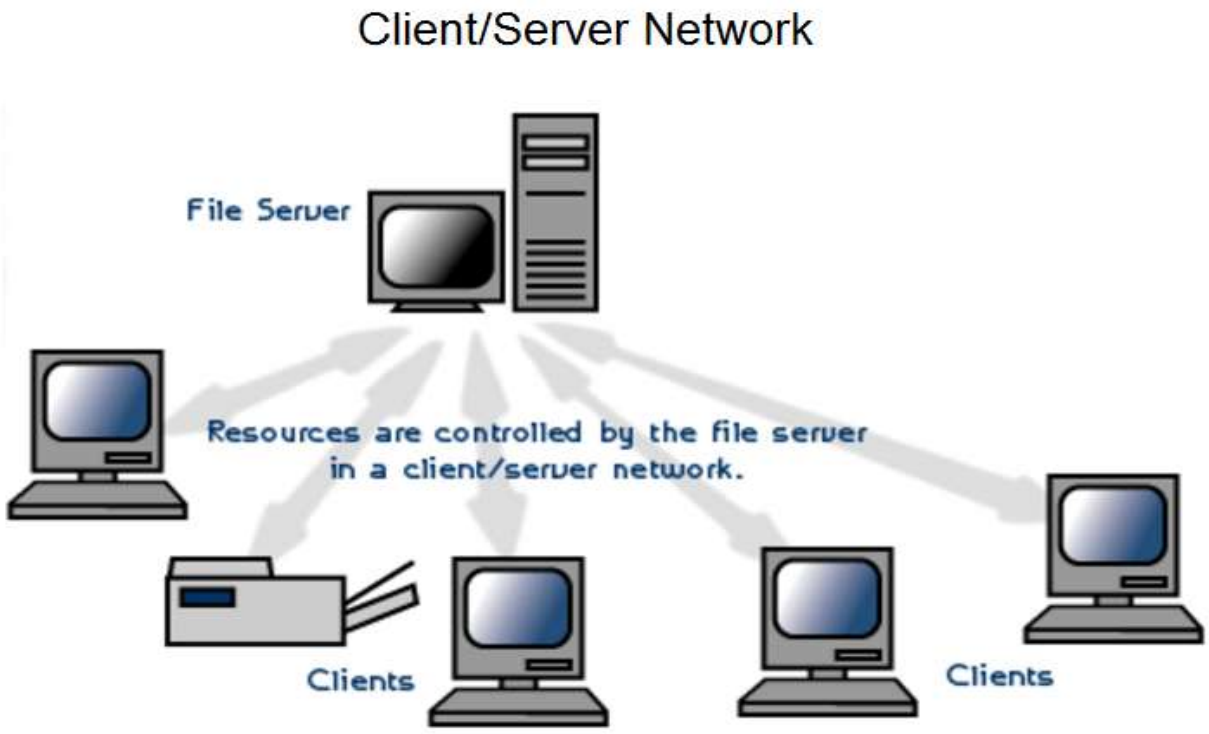
1) With resource sharing facility, a user at one site may be able to use the resources available at another.
2) Speedup the exchange of data with one another via electronic mail.
3) If one site fails in a distributed system, the remaining sites can potentially continue operating.
4) Better service to the customers.
5) Reduction of the load on the host computer.
6) Reduction of delays in data processing.

- **Disadvantage**

1) Lack of Security

4) Network operating System:

- A Network Operating System 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.
- Examples of network operating systems include Microsoft Windows Server 2003, Microsoft Windows Server 2008, UNIX, Linux, Mac OS X.



Advantages & disadvantages:

- **Advantages:**

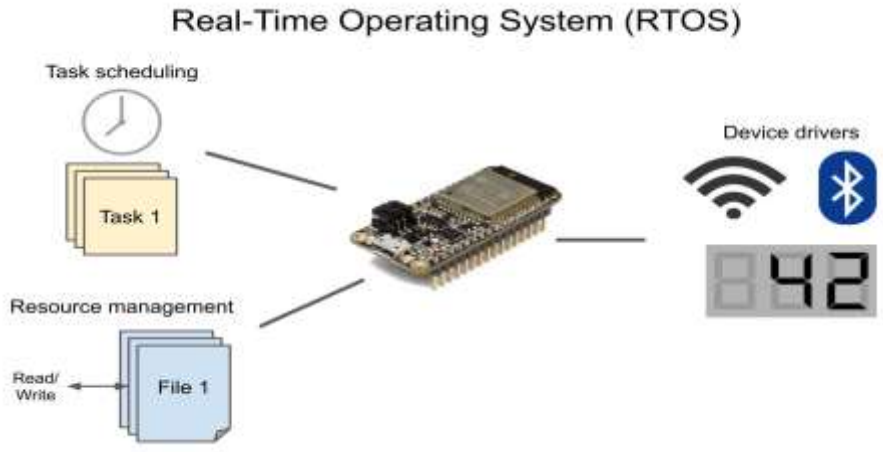
1) Centralized servers are highly stable.
2) Security is server managed.
3) Upgrades to new technologies and hardware can be easily integrated into the system.
4) Remote access to servers is possible from different locations and types of systems.

- **Disadvantages**

1) High cost of buying and running a server.
2) Dependency on a central location for most operations.
3) Regular maintenance and updates are required.

5) Real Time operating System

- A real-time system is defined as 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**.
- So in this method, the response time is very less as compared to online processing.
- A real-time operating system must have **well-defined, fixed time constraints**, otherwise the system will fail.
- For example, Scientific experiments, medical imaging systems, industrial control systems, weapon systems, robots, air traffic control systems, etc.



There are **two** types of real-time operating systems:

a) Hard real-time systems:

- 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.

b) Soft real-time systems

- Soft real-time systems are **less restrictive**. A critical real-time task gets **priority** over other tasks and retains the priority until it completes.

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:

1. Program execution.
2. I/O operations.
3. File System manipulation.
4. Communication.

5. Error Detection.
6. Resource Allocation.
7. Protection.

Program execution:

- 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 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.

I/O Operation:

1. An I/O subsystem includes of **I/O devices** and their corresponding driver software.
2. An Operating System manages the communication between user and device drivers.
3. I/O operation means read or write operation with any file or any specific I/O device.

4. Operating system provides the access to the required I/O device when required.

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.
- Examples of storage media include magnetic tape, magnetic disk and optical disk drives like CD, DVD. Each of these media has its own properties like speed, capacity, data transfer rate and data access methods.
- A file system is normally organized into directories for easy navigation and usage. These directories may contain files and other directions. Following are the major activities of an operating system with respect to file management.
- 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:

- In case of distributed systems which are a collection of processors that do not share memory, peripheral devices, or a clock, the operating system manages communications between all the processes.
- Multiple processes communicate with one another through communication lines in the network.
- 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:

1. The OS constantly checks for possible errors.

2. 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:

1. The OS manages all kinds of resources using schedulers.
2. CPU scheduling algorithms are used for better utilization of CPU.

Protection:

Considering a computer system having multiple users and concurrent execution of multiple processes, the various processes must be protected from each other's activities.

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 −

1. The OS ensures that all access to system resources is controlled.
2. The OS ensures that external I/O devices are protected from invalid access attempts.

3. The OS provides authentication features for each user by means of passwords.