Operating System

An operating system is an integrated set of specialized programs that is used to manage the resources and overall operations of a computer. The operating system works as a bridge(interface) between the user and the computer hardware. The O/S tends to isolate the hardware from the users. Main goal of O/S developer has to define ways to operate a computer in idle time and in the most efficient and economical ways. Before the development of O/S the program and data has to be loaded on the input devices and after compilation, program and output had to be unloaded and the entire process would begin again for the next job. Because the computer sat idle with the loaded and unloaded jobs. A great deal of processing time was lost. The O/S saves this time.

Functions of O/S

1. 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.

2. 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 in the main memory. An Operating System does the following activities for memory management. Following activities is done under the 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.

3. 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.

4. 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 −

* 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

5. **Security** − By means of password and similar other techniques, it prevents unauthorized access to programs and data.
6. **Control over system performance** − Recording delays between request for a service and response from the system.
7. **Job accounting** − Keeping track of time and resources used by various jobs and users.
8. **Error detecting aids** − Production of dumps, traces, error messages, and other debugging and error detecting aids.
9. **Coordination between other softwares and users** − Coordination and assignment of compilers, interpreters, assemblers and other software to the various users of the computer systems.
10. **Providing Interfaces**- Os provides interfaces for user to work with computer. There are two types of interfaces CUI and GUI.

Types of Operating System

1. Single Programming

In the single programing currently loaded job being executed is the sole occupant of user's area of main memory and has CPU exclusively available for itself. In this only one job is processed at a time and all system resources are available for the job until its completion.

Advantages

- This operating system occupies less space in memory.

Disadvantages

- It can perform only a single task at a time.

2. Batch processing

In batch processing system programmers would prepare their programs and data in a series and submitted them to the system. The operator then gives a command to the system to start executing the batch jobs. Jobs were then loaded automatically from the input device and executed by the system one by one without any operator intervention. Batch processing mechanism helped in reducing idle time of a computer system.

Advantages

- Processors of the batch systems know how long the job would be when it is in the queue.
- Multiple users can share the batch systems.
- The idle time for the batch system is very less.
- It is easy to manage large work repeatedly in batch systems.

Disadvantages

- The computer operators should be well known with batch systems.
- Batch systems are hard to debug.
- It is sometimes costly.
- The other jobs will have to wait for an unknown time if any job fails.

3. Multiprogramming

Multiprogramming is execution of two or more different and independent programs by a computer. This concept is carried a step further in multiprogramming by enabling two or more user programs to reside simultaneously in main memory and carrying out their execution. Whenever a user program that was executing goes to perform I/O

operations, CPU is allocated to another user program in main memory that is ready to use CPU. Instead of allowing CPU to remain idle, CPU switches from one program to another almost simultaneously. Hence in multiprogramming, several users programs share CPU time to keep it busy.

Advantages

- Throughout the system, it increased as the CPU always had one program to execute.
- Response time can also be reduced.

Disadvantages

- Multiprogramming systems provide an environment in which various systems resources are used efficiently, but they do not provide any user interaction with the computer system.

4. Multitasking

Technically multitasking is same as multiprogramming. Many authors do not distinguish between multiprogramming and multitasking because both refer to the same concept. However some author prefers to use term multiprogramming for multiuser system and multitasking for single user system. In fact a user of a single user system often has multiple tasks being processed by the system. E.g. while editing a file in foreground a sorting job can be given in background.

Advantages

- This operating system is more suited to supporting multiple users simultaneously.
- The multitasking operating systems have well-defined memory management.

Disadvantages

- The multiple processors are busier at the same time to complete any task in a multitasking environment, so the CPU generates more heat.

5. Multiprocessing

Up to this point we have considered uniprocessor system. However we have already seen that the use of I/O processors improves the efficiency of a computer system by making concurrent input, processing and output operations possible. CPU performs arithmetic and logical operations while I/O processors carry out I/O operations concurrently. Such type of system called multiprocessing system because it uses multiple processors and can execute multiple processes concurrently.

Advantages

- It increases the throughput(how many information processed at a time) of the system.
- As it has several processors, so, if one processor fails, we can proceed with another processor.

Disadvantages

- Due to the multiple CPU, it can be more complex and somehow difficult to understand.

6. Real Time Operating System

These types of OSs serve real-time systems. The time interval required to process and respond to inputs is very small. This time interval is called response time.
Real-time systems are used when there are time requirements that are very strict like missile systems, air traffic control systems, robots, etc
There are two types of Real Time Operating Systems :

- **Hard Real-Time Systems:**
  Hard Real-Time OSs are meant for applications where time constraints are very

strict and even the shortest possible delay is not acceptable. These systems are built for saving life like automatic parachutes or airbags which are required to be readily available in case of an accident. Virtual memory is rarely found in these systems.

- **Soft Real-Time Systems:**
  These OSs are for applications where time-constraint is less strict. In this type of system, missing an occasional deadline, while not desirable, is acceptable and does not cause any permanent damage.Digital audio, digital telephone, and multimedia systems fall into this category.

Advantages of RTOS

- **Maximum Consumption:** Maximum utilization of devices and systems, thus more output from all the resources.
- **Task Shifting:** The time assigned for shifting tasks in these systems is very less. For example, in older systems, it takes about 10 microseconds in shifting from one task to another, and in the latest systems, it takes 3 microseconds.
- **Focus on Application:** Focus on running applications and less importance on applications that are in the queue.
- Real-time **operating system in** the **embedded system:** Since the size of programs is small, RTOS can also be used in embedded systems like in transport and others.
- **Error Free:** These types of systems are error-free.
- **Memory Allocation:** Memory allocation is best managed in these types of systems.

Disadvantages of RTOS

- **Limited Tasks:** Very few tasks run at the same time and their concentration is very less on a few applications to avoid errors.
- **Use heavy system resources:** Sometimes the system resources are not so good and they are expensive as well.
- **Complex Algorithms:** The algorithms are very complex and difficult for the designer to write on.
- **Thread Priority:** It is not good to set thread priority as these systems are very less prone to switching tasks.