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UNIT - 1

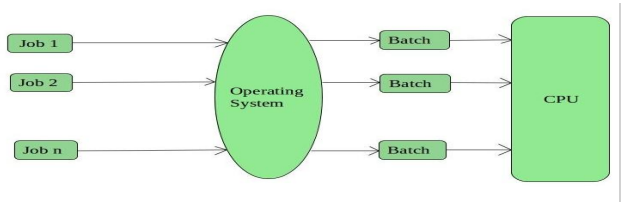
Types of Operating Systems

An Operating System performs all the basic tasks like managing files, processes, and memory. Thus operating system acts as the manager of all the resources, i.e. **resource manager**. Thus, the operating system becomes an interface between user and machine.

Types of Operating Systems: Some widely used operating systems are as follows-

1. Batch Operating System –

This type of operating system does not interact with the computer directly. There is an operator which takes similar jobs having the same requirement and group them into batches. It is the responsibility of the operator to sort jobs with similar needs.



Advantages of Batch Operating System:

- It is very difficult to guess or know the time required for any job to complete. Processors of the batch systems know how long the job would be when it is in 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 of Batch Operating System:

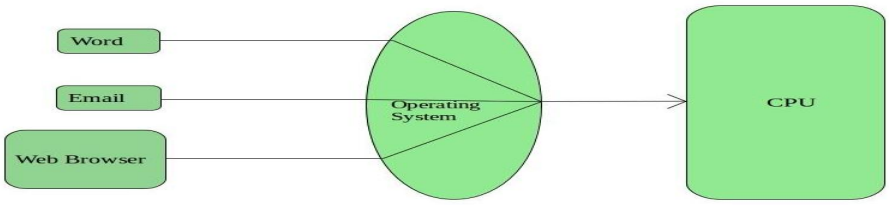
- The computer operators should be well known with batch systems
- Batch systems are hard to debug
- It is sometimes costly

- The other jobs will have to wait for an unknown time if any job fails

Examples of Batch based Operating System: Payroll System, Bank Statements, etc.

2. Time-Sharing Operating Systems –

Each task is given some time to execute so that all the tasks work smoothly. Each user gets the time of CPU as they use a single system. These systems are also known as Multitasking Systems. The task can be from a single user or different users also. The time that each task gets to execute is called quantum. After this time interval is over OS switches over to the next task.



Advantages of Time-Sharing OS:

- Each task gets an equal opportunity
- Fewer chances of duplication of software
- CPU idle time can be reduced

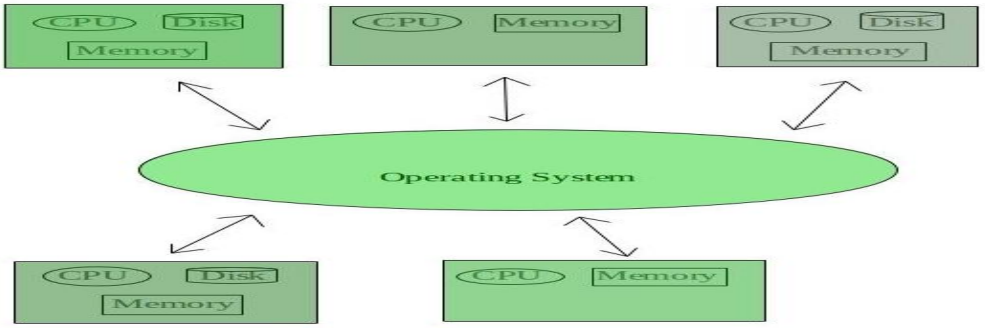
Disadvantages of Time-Sharing OS:

- Reliability problem
- One must have to take care of the security and integrity of user programs and data
- Data communication problem

Examples of Time-Sharing OSs are: Multics, Unix, etc.

3. Distributed Operating System –

These types of the operating system is a recent advancement in the world of computer technology and are being widely accepted all over the world and, that too, with a great pace. Various autonomous interconnected computers communicate with each other using a shared communication network. Independent systems possess their own memory unit and CPU. These are referred to as **loosely coupled systems** or distributed systems. These system's processors differ in size and function. The major benefit of working with these types of the operating system is that it is always possible that one user can access the files or software which are not actually present on his system but some other system connected within this network i.e., remote access is enabled within the devices connected in that network.



Advantages of Distributed Operating System:

- Failure of one will not affect the other network communication, as all systems are independent from each other
- Electronic mail increases the data exchange speed
- Since resources are being shared, computation is highly fast and durable
- Load on host computer reduces
- These systems are easily scalable as many systems can be easily added to the network
- Delay in data processing reduces

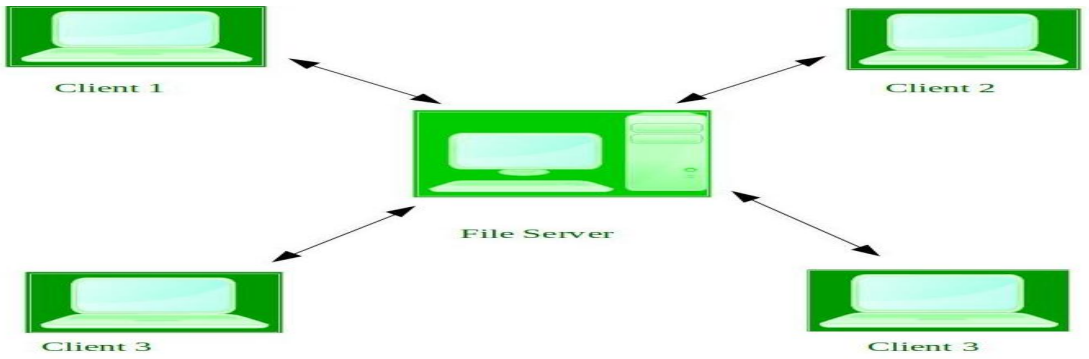
Disadvantages of Distributed Operating System:

- Failure of the main network will stop the entire communication
- To establish distributed systems the language which is used are not well defined yet
- These types of systems are not readily available as they are very expensive. Not only that the underlying software is highly complex and not understood well yet

Examples of Distributed Operating System are- LOCUS, etc.

4. Network Operating System –

These systems run on a server and provide the capability to manage data, users, groups, security, applications, and other networking functions. These types of operating systems allow shared access of files, printers, security, applications, and other networking functions over a small private network. One more important aspect of Network Operating Systems is that all the users are well aware of the underlying configuration, of all other users within the network, their individual connections, etc. and that's why these computers are popularly known as **tightly coupled systems**.



Advantages of Network Operating System:

- Highly stable centralized servers
- Security concerns are handled through servers
- New technologies and hardware up-gradation are easily integrated into the system
- Server access is possible remotely from different locations and types of systems

Disadvantages of Network Operating System:

- Servers are costly
- User has to depend on a central location for most operations
- Maintenance and updates are required regularly

Examples of Network Operating System are: Microsoft Windows Server 2003, Microsoft Windows Server 2008, UNIX, Linux, Mac OS X, Novell NetWare, and BSD, etc.

5. 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.

Advantages of RTOS:

- **Maximum Consumption:** Maximum utilization of devices and system, thus more output from all the resources
- **Task Shifting:** The time assigned for shifting tasks in these systems are very less. For example, in older systems, it takes about 10 microseconds in shifting one task to another, and in the latest systems, it takes 3 microseconds.
- **Focus on Application:** Focus on running applications and less importance to applications which are in the queue.
- Real-time **operating system in** the **embedded system:** Since the size of programs are 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 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.
- **Device driver and interrupt signals:** It needs specific device drivers and interrupts signals to respond earliest to interrupts.
- **Thread Priority:** It is not good to set thread priority as these systems are very less prone to switching tasks.

Examples of Real-Time Operating Systems are: Scientific experiments, medical imaging systems, industrial control systems, weapon systems, robots, air traffic control systems, etc.

Major Functionalities of Operating System:

- **Resource Management:** When parallel accessing happens in the OS means when multiple users are accessing the system the OS works as Resource Manager, Its responsibility is to provide hardware to the user. It decreases the load in the system.
- **Process Management:** It includes various tasks like **scheduling**, **termination** of the process. OS manages various tasks at a time. Here **CPU Scheduling** happens means all the tasks would be done by the many algorithms that use for scheduling.

- **Storage Management:** The **file system** mechanism used for the management of the storage. **NIFS**, **CFS**, **CIFS**, **NFS**, etc. are some file systems. All the data stores in various tracks of Hard disks that all managed by the storage manager. It included **Hard Disk**.
- **Memory Management:** Refers to the management of primary memory. The operating system has to keep track, how much memory has been used and by whom. It has to decide which process needs memory space and how much. OS also has to allocate and deallocate the memory space.
- **Security/Privacy Management:** Privacy is also provided by the Operating system by means of passwords so that unauthorized applications can't access programs or data. For example, Windows uses **Kerberos** authentication to prevent unauthorized access to data.

Functions of an Operating System :

An operating system has a variety of functions to perform. Some of the prominent functions of an operating system can be broadly outlined as:

- Processor Management: This deals with the management of the Central Processing Unit (CPU). The operating system takes care of the allotment of CPU time to different processes. When a process finishes its CPU processing after executing for the allotted time period, this is called scheduling. There is various type of scheduling techniques that are used by the operating systems:

1. Shortest Job First(SJF): The process which needs the shortest CPU time is scheduled first.
2. Round Robin Scheduling: Each process is assigned a fixed CPU execution time in a cyclic way.
3. Priority Based scheduling (Non-Preemptive): In this scheduling, processes are scheduled according to their priorities, i.e., the highest priority process is scheduled first. If the priorities of the two processes match, then schedule according to arrival time.

- **Context Switching:** In most multitasking OSs, multiple running processes on the system may need a change of state in execution. Even if there are multiple processes being executed at any one point in time, only one task is executed in the foreground, while the others are put in the background. So the process that is in the foreground is determined by the priority-based scheduling, and the OS saves the execution state of the previous process before switching to the current one. This is known as context switching.

- **Device Management:**

The Operating System communicates with the hardware and the attached devices and maintains a balance between them and the CPU. This is all the more important because the CPU processing speed is much higher than that of I/O devices. In order to optimize the CPU time, the operating system employs two techniques – Buffering and Spooling.

- **Buffering:**

In this technique, input and output data are temporarily stored in Input Buffer and Output Buffer. Once the signal for input or output is sent to or from the CPU respectively, the operating system through the device controller moves the data from the input device to the input buffer

and for the output device to the output buffer. In the case of input, if the buffer is full, the operating system sends a signal to the program which processes the data stored in the buffer. When the buffer becomes empty, the program informs the operating system which reloads the buffer and the input operation continues.

- Spooling (Simultaneous Peripheral Operation on Line):
  This is a device management technique used for processing different tasks on the same input/output device. When there are various users on a network sharing the same resource then it can be a possibility that more than one user might give it a command at the same point in time. So, the operating system temporarily stores the data of every user on the hard disk of the computer to which the resource is attached. The individual user need not wait for the execution process to be completed. Instead, the operating system sends the data from the hard disk to the resource one by one.
  Example: printer

- Memory management:
  In a computer, both the CPU and the I/O devices interact with the memory. When a program needs to be executed it is loaded onto the main memory till the execution is completed. Thereafter that memory space is freed and is available for other programs. The common memory management techniques used by the operating system are Partitioning and Virtual Memory.

- **Partitioning:**
  The total memory is divided into various partitions of the same size or different sizes. This helps to accommodate a number of programs in the memory. The partition can be fixed i.e. remains the same for all the programs in the memory or variable i.e. memory is allocated when a program is loaded onto the memory. The latter approach causes less wastage of memory but in due course of time, it may become fragmented.

- Virtual Memory:
  This is a technique used by the operating systems which allow the user can load programs that are larger than the main memory of the computer. In this technique, the program is executed even if the complete program can not be loaded inside the main memory leading to efficient memory utilization.

- **File Management:**
  The operating system manages the files, folders, and directory systems on a computer. Any data on a computer is stored in the form of files and the operating system keeps the information about all of them using the File Allocation Table (FAT), or a data structure called an inode in Linux. The FAT stores general information about files like filename, type (text or binary), size, starting address, and access mode (sequential/indexed sequential/direct/relative). The file manager of the operating system helps to create, edit, copy, allocate memory to the files, and

also updates the FAT. The operating system also takes care that files are opened with proper access rights to read or edit them.

Layer of OS

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Introduction of System Call

In computing, a **system call** is the programmatic way in which a computer program requests a service from the kernel of the operating system it is executed on. A system call is a way for programs to **interact with the operating system**. A computer program makes a system call when it makes a request to the operating system's kernel. System call **provides** the services of the operating system to the user programs via Application Program Interface(API). It provides an interface between a process and operating system to allow user-level processes to request services of the operating system. System calls are the only entry points into the kernel system. All programs needing resources must use system calls.

Services Provided by System Calls :

1. Process creation and management
2. Main memory management
3. File Access, Directory and File system management
4. Device handling(I/O)
5. Protection
6. Networking, etc.

Types of System Calls : There are 5 different categories of system calls –

7.

1. **Process control:** end, abort, create, terminate, allocate and free memory.
2. **File management:** create, open, close, delete, read file etc.
3. Device management
4. Information maintenance
5. Communication

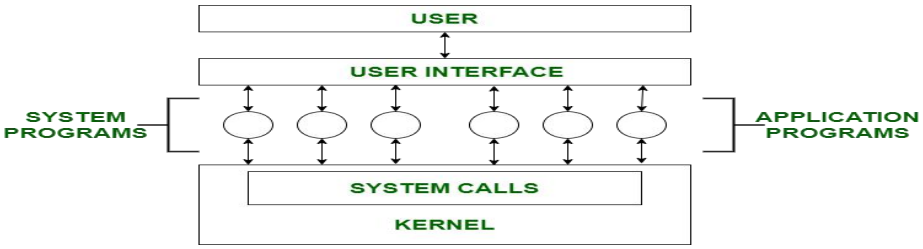
Examples of Windows and Unix System Calls –

	Windows	Unix
Process Control	CreateProcess() ExitProcess() WaitForSingleObject()	fork() exit() wait()
File Manipulation	CreateFile() ReadFile() WriteFile() CloseHandle()	open() read() write() close()
Device Manipulation	SetConsoleMode() ReadConsole() WriteConsole()	ioctl() read() write()

Information Maintenance	GetCurrentProcessID() SetTimer() Sleep()	getpid() alarm() sleep()
Communication	CreatePipe() CreateFileMapping() MapViewOfFile()	pipe() shmget() mmap()
Protection	SetFileSecurity() InitlializeSecurityDescriptor() SetSecurityDescriptorGroup()	chmod() umask() chown()

System Programs in Operating System

System Programming can be defined as the act of building Systems Software using System Programming Languages. According to Computer Hierarchy, one which comes at last is Hardware. Then it is Operating System, System Programs, and finally Application Programs. Program Development and Execution can be done conveniently in System Programs. Some of the System Programs are simply user interfaces, others are complex. It traditionally lies between the user interface and system calls.



So here, the user can only view up-to-the System Programs he can't see System Calls.
System Programs can be divided into these categories :

1. **File Management –**
   A file is a collection of specific information stored in the memory of a computer system. File management is defined as the process of manipulating files in the computer system, its management includes the process of creating, modifying and deleting files.
   - It helps to create new files in the computer system and placing them at specific locations.
   - It helps in easily and quickly locating these files in the computer system.
   - It makes the process of sharing files among different users very easy and user-friendly.
   - It helps to store files in separate folders known as directories.
   - These directories help users to search files quickly or to manage files according to their types of uses.

- It helps users to modify the data of files or to modify the name of files in directories.

2. **Status Information –**

Information like date, time amount of available memory, or disk space is asked by some users. Others providing detailed performance, logging, and debugging information which is more complex. All this information is formatted and displayed on output devices or printed. Terminal or other output devices or files or a window of GUI is used for showing the output of programs.

3.

4. **File Modification –**

For modifying the contents of files we use this. For Files stored on disks or other storage devices, we used different types of editors. For searching contents of files or perform transformations of files we use special commands.

5.

6. **Programming-Language support –**

For common programming languages, we use Compilers, Assemblers, Debuggers, and interpreters which are already provided to users. It provides all support to users. We can run any programming language. All languages of importance are already provided.

7.

8. **Program Loading and Execution –**

When the program is ready after Assembling and compilation, it must be loaded into memory for execution. A loader is part of an operating system that is responsible for loading programs and libraries. It is one of the essential stages for starting a program. Loaders, relocatable loaders, linkage editors, and Overlay loaders are provided by the system.

9.

10. **Communications –**

Virtual connections among processes, users, and computer systems are provided by programs. Users can send messages to another user on their screen, User can send e-mail, browsing on web pages, remote login, the transformation of files from one user to another.

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