Mahatma Gandhi Charitable Trust Managed

Shri Labhubhai Trivedi Institute of Engineering & Technology

CREATING CREATORS - SLTIET

BASICS OF OPERATING SYSTEM

BOS - Subject Code: 4330703

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CSE DEPARTMENT

SLTIET, RAJKOT

Unit - 1

Introduction of Operating System

Sub Topics:

1.1 What is Operating System?
1.2 Fundamental Goals of Operating System
1.3 Overview of Operating System
1.4 Operating System Services
1.5 Generations of Operating Systems

1.1 What is Operating System?

An operating system is a program used to interact between the system hardware and the user. The operating system acts as an interface between the software and the hardware.

A Computer System consists of:

- Users (people who are using the computer)
- Application Programs (Compilers, Databases, Games, Video player, Browsers, etc.)
- System Programs (Shells, Editors, Compilers, etc.)

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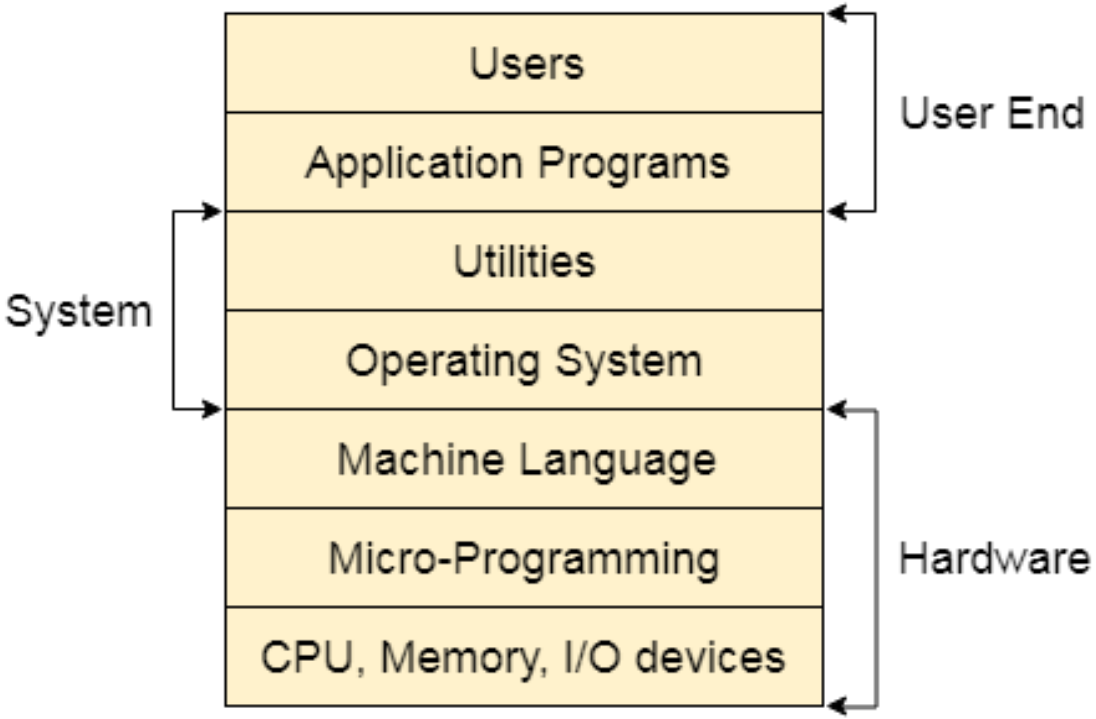
- Operating System (A special program which acts as an interface between user and hardware)
- Hardware (CPU, Disks, Memory etc.)



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What does an Operating system do?

- Process Management
- Process Synchronization
- Memory Management
- CPU Scheduling
- File Management
- Security

1.2 Fundamental Goals of Operating System

- The operating system controls and coordinates the user of the hardware among the various application programs for the various users.
- It hides the complexity of its hardware from the user and provides an easy interface.
- An operating system is a control program. It controls the execution of user programs to prevent errors and improper use of the computer.
- The Primary goal of an operating system is convenience for the user. The operating system makes the use of the system easier.
- The secondary goal of an operating system is efficient operation of the computer system.

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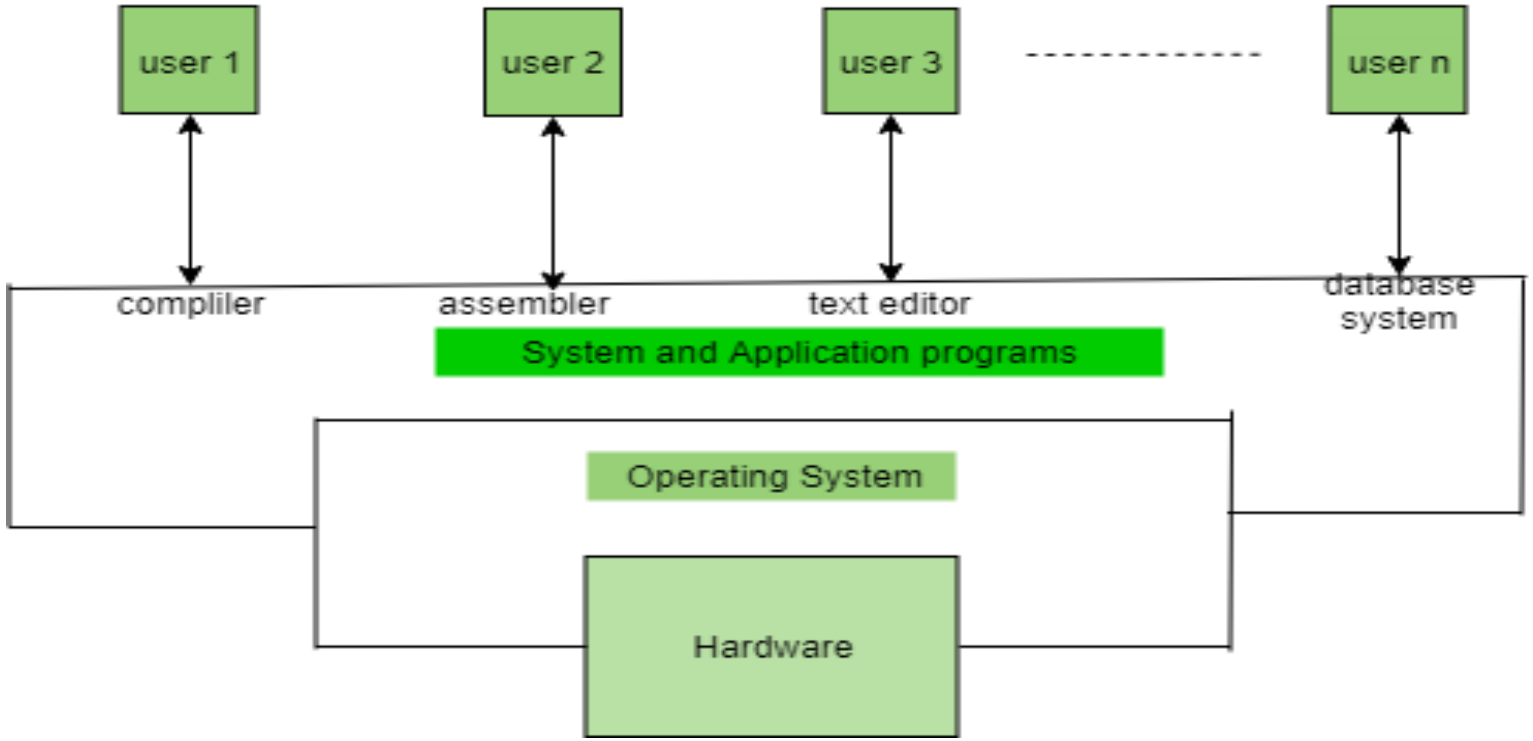
A Computer system can be divided into four components:

1. Hardware 2. Operating System 3. Application Programs 4. Users



1.3 Overview of Operating System

1) Multi - Programming

A multiprogramming operating system may run many programs on a single processor computer. If the one program must wait for an input/output transfer in a multiprogramming operating system, the other programs are ready to use the CPU.

When a program is being performed, it is known as a "**Task**", "**Process**", and "**Job**".

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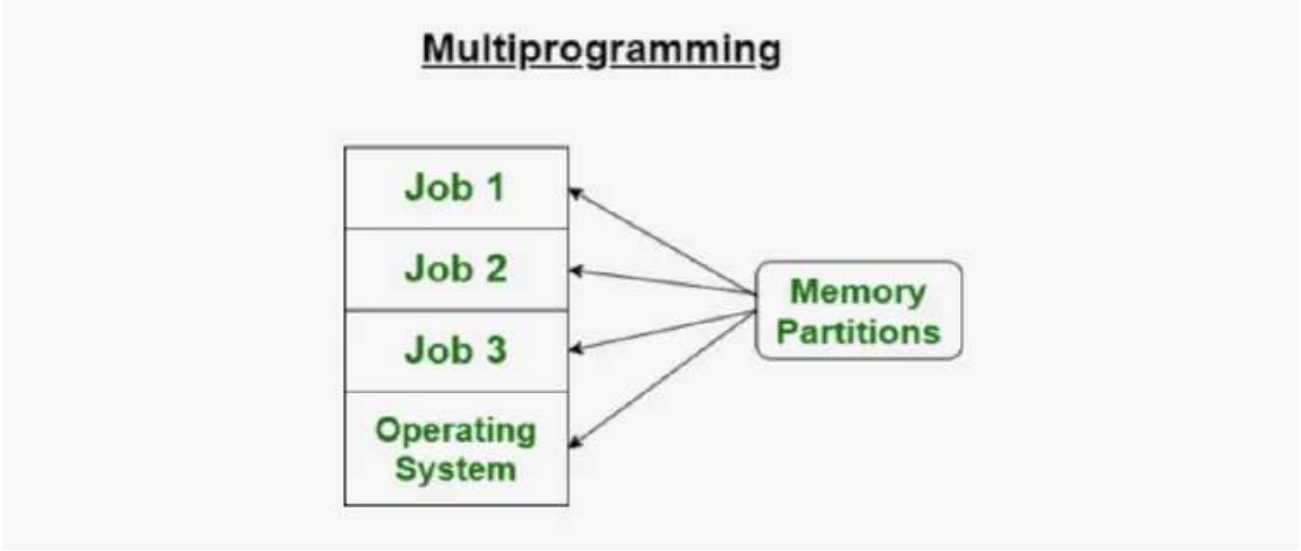
i) Multiprogramming :

By organizing jobs (code and data) that the CPU always has one to execute. Multiprogramming improves CPU utilization. The goal is to keep several tasks active in main memory. CPU can be reassigned to another job if one job becomes overloaded with IO.



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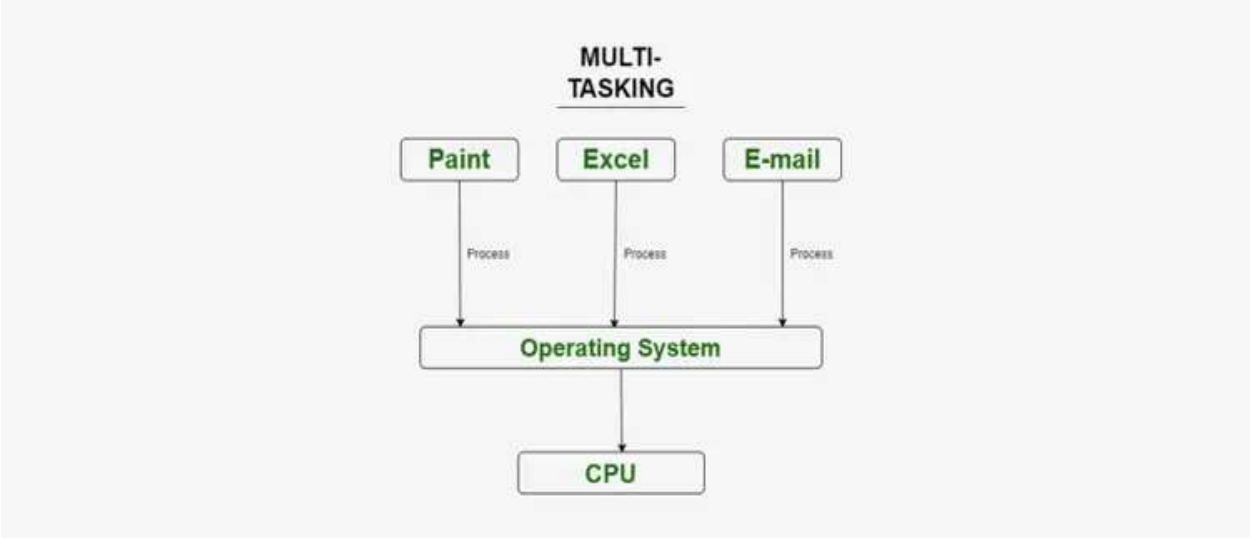
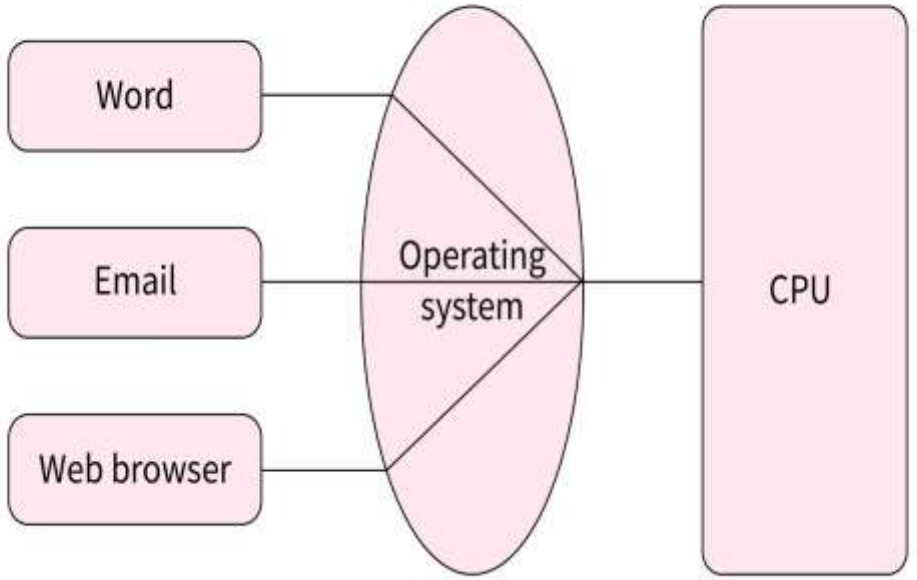
ii) Multi Tasking :

An OS's capacity to run multiple tasks concurrently on a CPU machine is known as multitasking. Common resources are shared by these various tasks (like CPU and memory). In multi-tasking systems, the CPU executes multiple jobs by switching between them, typically using a short-time slot.



2) Time Sharing

The Time-Sharing Operating System is a type of operating system in which the user can perform more than one task and each task gets the same amount of time to execute. It is also called a multitasking operating system.



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Working of Time-Sharing Operating System

- Let's see how CPU scheduling and multiprogramming are used in Timesharing Operating System.
- When the user performs more than one task, for each process's CPU time is divided.
- There is a time slot fixed for each process to execute at a time. This time slot is minimal and in 10-100 milliseconds. Time slot is also known as time slice or time quantum.

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- For example, if there are three processes, P1, P2, and P3 running on the system. Suppose the time slot is fixed to 4 nanoseconds (ns). Let's see further how these processes will be executed.
- Process P1 will execute first for 4ns and as soon as it gets over, process P2 starts executing for 4ns, and when P2 is executed for 4ns then process P3 executes for 4ns. This process continues till all the processes get completed.
- In this way, if the process runs for only the fixed time slot, the switching between the process is very fast. So, the user thinks that all the processes are running simultaneously. In this way response time of the CPU is minimized.

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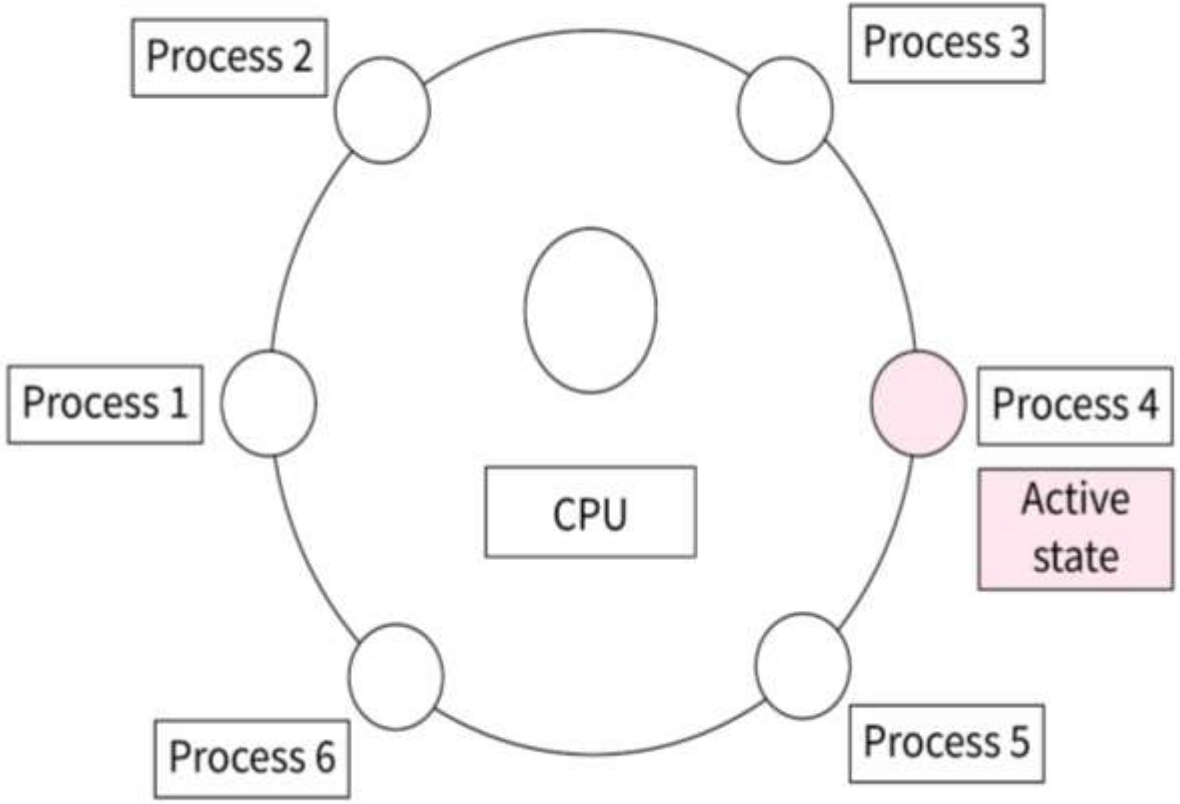
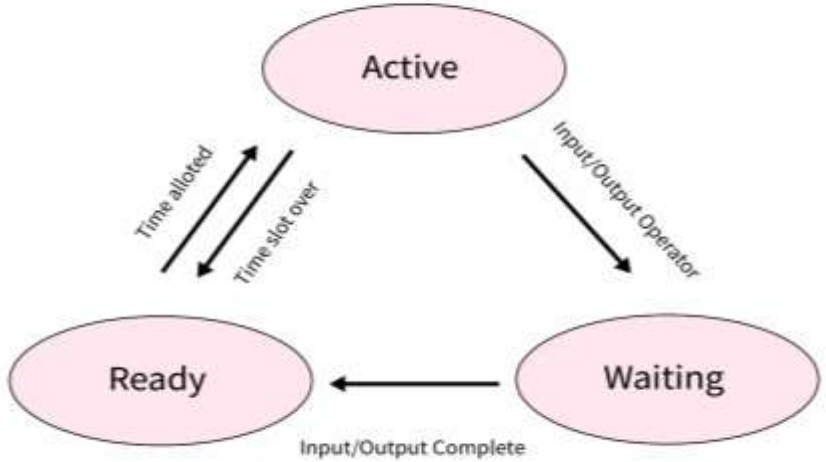

Process 2
Process 3
Process 1
Process 4
CPU
Active state
Process 6
Process 5


Active
Time alloted
Time slot over
Input/Output Operator
Ready
Waiting
Input/Output Complete

Continue…

This diagram shows the working of the time-sharing operating system.

- The process 4 in the diagram is shown in active state. Process 5 is in ready state while process 1,2,3 and 6 are in waiting state.
- Let's understand what these active state, ready state, and waiting for state mean.

Active state - The process currently using the CPU is said to be in an active state. Only one process can be active state as the CPU can be assigned to only one process at a time for processing.

Continue…

Ready state - The process which is ready for execution and is waiting for the CPU to get assigned to them is said to be in a Ready state. More than one process can be in a Ready state at a time, but the CPU is allocated to only one of them at a time for processing.

Waiting State - The processes that are not ready for execution and are waiting for some input/output process to be completed is said to be in waiting state. Once the input/output process is completed, the process jumps to a Ready state and is ready for execution.

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Some examples of Time-sharing operating systems are :

- UNIX
- Multics
- Linux
- Windows 2000 server

3) Real Sharing

Real-time operating systems (RTOS) are used in environments where a large number of events, mostly external to the computer system, must be accepted and processed in a short time or within certain deadlines. such applications are industrial control, telephone switching equipment, flight control, and real-time simulations.

Examples of the real-time operating systems: Airline traffic control systems, Command Control Systems, Airlines reservation system, Heart Pacemaker, Network Multimedia Systems, Robot etc.

The real-time operating systems can be of 2 types –

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Hard Real-Time operating system:

- These operating systems guarantee that critical tasks be completed within a range of time.
  For example, a robot is hired to weld a car body. If the robot welds too early or too late, the car cannot be sold, so it is a hard real-time system that requires complete car welding by robot hardly on the time.
- Example: scientific experiments, medical imaging systems, industrial control systems, weapon systems, robots, air traffic control systems, etc.

Continue…

Soft real-time operating system:

- This operating system provides some relaxation in the time limit.
- For example – Multimedia systems, digital audio systems etc.
- Explicit, programmer-defined and controlled processes are encountered in real-time systems.
- A separate process is changed with handling a single external event. The process is activated upon occurrence of the related event by an interrupt.

4) Multithreading

- A thread is a flow of execution through the process code, with its own program counter that keeps track of which instruction to execute next, system registers which hold its current working variables, and a stack which contains the execution history.

- **A thread is also called a lightweight process.** Threads provide a way to improve application performance through parallelism. Threads represent a software approach to improving performance of operating system.

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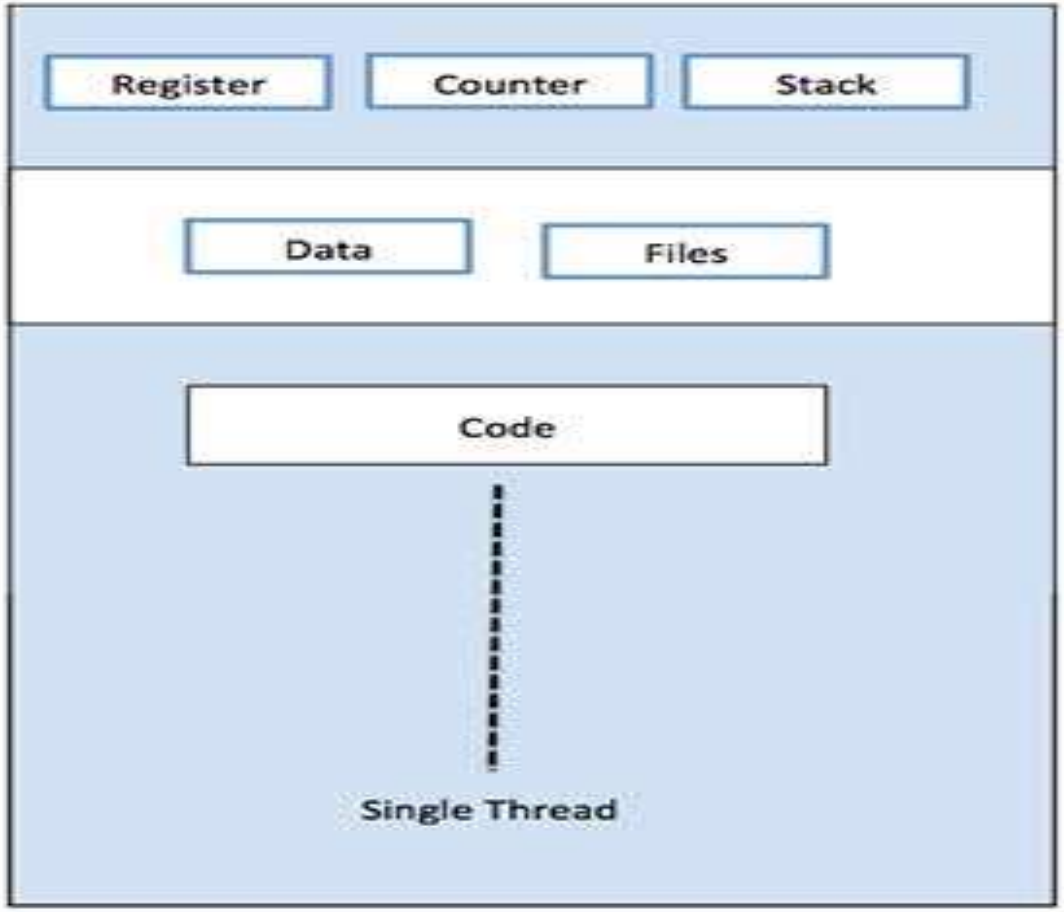
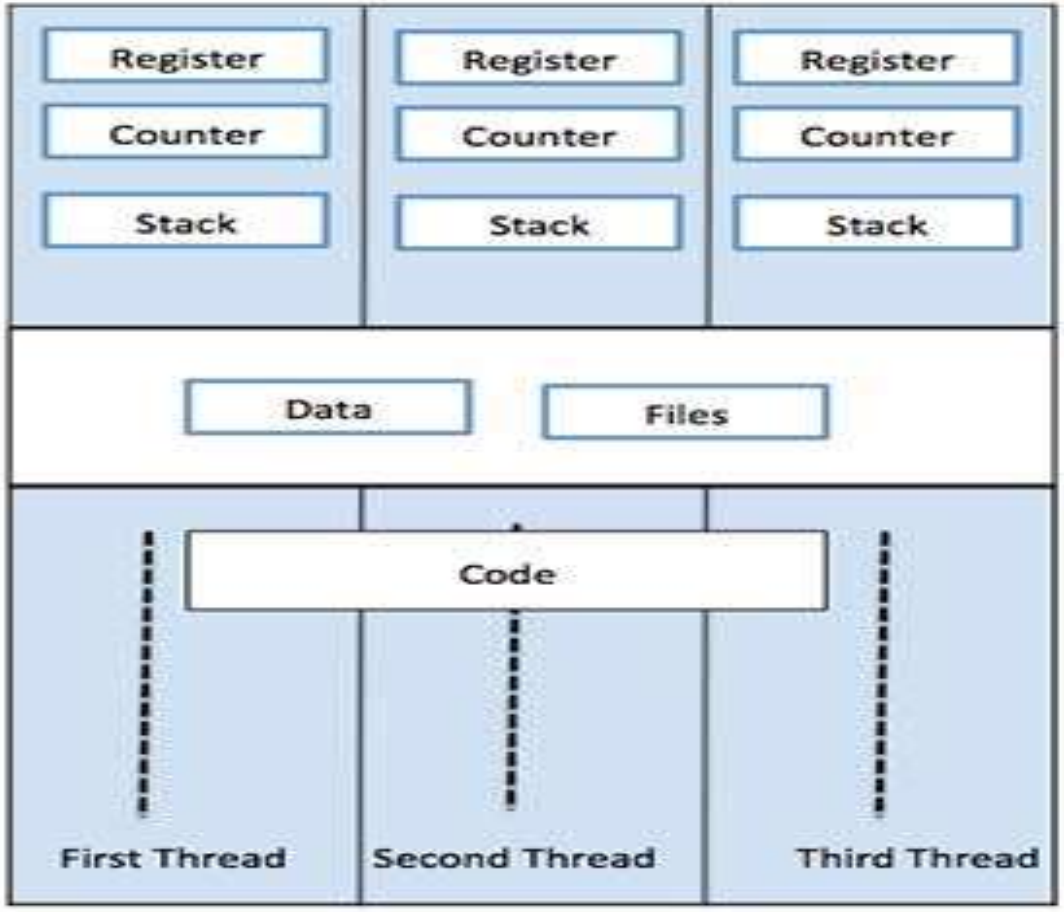


Single Process P with single thread



Single Process P with three threads

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Lifecycle of a thread :

There are various stages in the lifecycle of a thread. Following are the stages a thread goes through in its whole life.

- **New**: The lifecycle of a born thread (new thread) starts in this state. It remains in this state till a program starts.
- **Runnable**: A thread becomes runnable after it starts. It is considered to be executing the task given to it.

Continue…

- **Waiting**: While waiting for another thread to perform a task, the currently running thread goes into the waiting state and then transitions back again after receiving a signal from the other thread.
- **Timed Waiting**: A runnable thread enters into this state for a specific time interval and then transitions back when the time interval expires.
- **Terminated (Dead)**: A thread enters into this state after completing its task.

5) Distributed System

- A distributed system is a collection of loosely coupled processors interconnected by a communication network.
- An OS that manage a group of independent computers via a single communication channel and makes them to be a single computer is know as distributed OS.
- In distributed operating system processors do not share memory or a clock. Instead, each processor has its own local memory and the processors. It communicate with one another through various communication lines, such as high-speed buses or telephone-lines.
- This OS consists of many computers, nodes and sites joined together via LAN/WAN lines.

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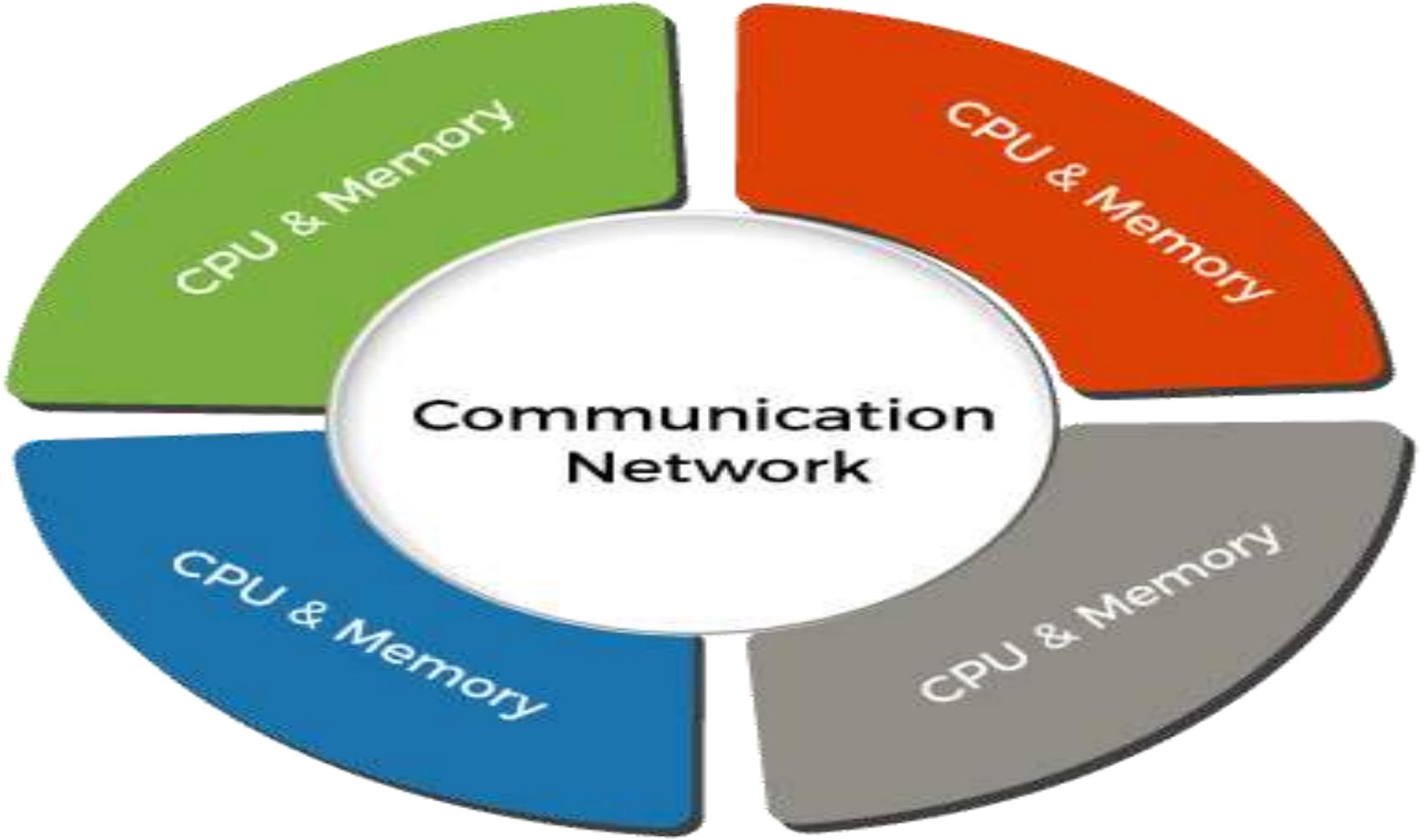
CPU & Memory
CPU & Memory
Communication Network
CPU & Memory
CPU & Memory

Continue…

Advantages of distributed systems:

- If one system fails, it will not affect other systems connected in the network as all the systems are independent of each other.
- Resources are being shared so computation are quick and durable.
- As many systems can be easily added to network, this type of system is easily scalable.
- Customers receive batter service.

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Disadvantages of distributed systems:

- If main network fails, the entire system will be terminated.
- This type of system is not readily available and it is very expensive.

Example:

- AIX OS for IBM
- Solaris OS for sun multiprocessor workstations.

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Applications Area of Distributed System:

- Finance and Commerce: Amazon, eBay, Online Banking, E-Commerce websites.
- Information Society: Search Engines, Wikipedia, Social Networking, Cloud Computing.
- Cloud Technologies: AWS, Salesforce, Microsoft Azure, SAP.
- Entertainment: Online Gaming, Music, youtube.

Continue…

- Healthcare: Online patient records, Health Informatics.
- Education: E-learning.
- Transport and logistics: GPS, Google Maps.
- Environment Management: Sensor technologies.

1.4 Operating System Services

For user point of view services:

1. User Interface:

It provides interface to user. So user can perform some action. It provides three types of interfaces,

- a) Command line Interface (CLI), in which user can type command and methods for executing them.
- b) Batch interface, in which commands and directives to control those commands are entered into files ,and those files are executed.

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- c) Graphical User Interface (GUI),in which interface is a window system with pointing device to direct I/O ,chooses from menus, keyboard to enter text.

2. Program execution:

- The system must be able to load a program into memory and run it. The program must be able to end its execution either normally or abnormally (indicating error).

Continue…

3. I/O operations:

- A running program may require I/O involves a file or an I/O device. For specific devices, special functions may be desired. For efficiency protection , users usually cannot control I/O devices directly.

4. File-system manipulation:

- The programs need to read and write files and programs must also create and delete files. The operating system maintains the file system.

Continue…

5. Communications:

- In many conditions the process needs to exchange information with another process. Such communications can occur in two ways:

a) The fist takes place between processes that are executing on the same computer.

b) The second takes place between processes that are executing on different computer systems that are tied together by a network. Communications may be implemented via shared memory or via message passing , in which the information is moved between processes by operating system.

Continue…

6. Error Detection:

- The operating system constantly needs to be aware of possible errors. Errors may occur in the CPU, memory hardware, I/O devices and user programs.
- For each type of errors, the operating system should take the proper action to ensure correct and consistent computing.

Continue…

For System point of view services:

Operating a system function that exists not for helping the user, but rather ensuring the efficient operation of the system.

1. Resource allocation:

- Operating system manages many resources like CPU cycles, main memory, and file storage. Resources are allocated to multiple users.

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2. Accounting:

- The tracking of which user use how many and which kind of computer resources can be used for billing or simply accumulating usage statistics. Usage statistics may be a valuable tool for researchers who wish to reconfigure the system to improve computing services.

3.Protection:

- Protection involves ensuring that all access to system resources is controlled.

1.5 Generations of Operating System

The First Generation (1940 to early 1950s):

- When the first electronic computer was developed in 1940, it was created without any operating system.
- In early times, users have full access to the computer machine and write a program for each task in absolute machine language. The programmer can perform and solve only simple mathematical calculations during the computer generation, and this calculation does not require an operating system.

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The Second Generation (1955 - 1965):

- The first operating system (OS) was created in the early 1950s and was known as GMOS. General Motors has developed an OS for the IBM computer.
- The second-generation operating system was based on a single stream batch processing system because it collects all similar jobs in groups or batches and then submits the jobs to the operating system using a punch card to complete all jobs in a machine.

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The Third Generation (1965 - 1980):

- During the late 1960s, operating system designers were very capable of developing a new operating system that could simultaneously perform multiple tasks in a single computer program called multiprogramming.
- The introduction of multiprogramming plays a very important role in developing operating systems that allow a CPU to be busy every time by performing different tasks on a computer at the same time.

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The Fourth Generation (1980 - Present Day):

- The fourth generation of operating systems is related to the development of the personal computer.
- However, the personal computer is very similar to the minicomputers that were developed in the third generation. The cost of a personal computer was very high at that time; there were small fractions of minicomputers costs. Currently, most Windows users use the Windows 10 operating system.
- Besides the Windows operating system, Apple is another popular operating system built in the 1980s, and this operating system was developed by Steve Jobs, a co-founder of Apple. They named the operating system Macintosh OS or Mac OS.

Questions

Q-1) What is Operating System?

Q-2) Explain Multi-programming and Time Sharing Operating System with example.

Q-3) Write the different state of Time Sharing Operating System.

Q-4) What is thread? Also explain lifecycle of thread.

Q-5) Write in detailed about Distributed Operating System.

Q-6) Explain generation of Operating System.

Thank You