Multi-programming and Multitasking Operating System

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Operating System

Operating System is a collection of modules which provides an efficient computing environment between hardware and software.

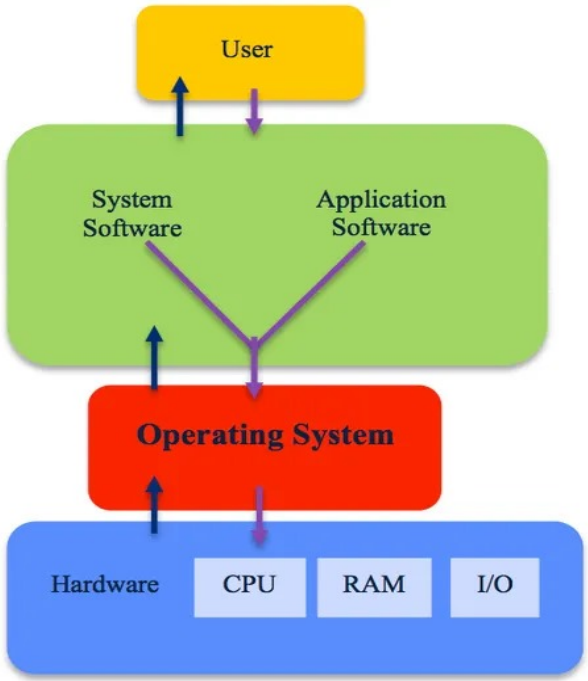

Figure: Role of Operating System

Functions of Operating System

- Process Management:
  - Create, schedule, and terminate processes.
  - Manage process communication and synchronization.
- Memory Management:
  - Allocate and deallocate memory for processes.
  - Implement virtual memory for efficient use of physical RAM.
- File Management:
  - Provide access to files and directories.
  - Handle file creation, deletion, and organization.
- Device Management:
  - Control and interact with hardware devices.
  - Manage device drivers and input/output operations.
- User Interface Interaction
  - Provide a user-friendly interface (GUI/CLI).
  - Handle user input, output, and window management.

Definition of Multi-programming

- Multi-programming in an operating system as the name suggests multi means more than one and programming means the execution of the program. when more than one program can execute in an operating system then this is termed a multi-programming operating system.

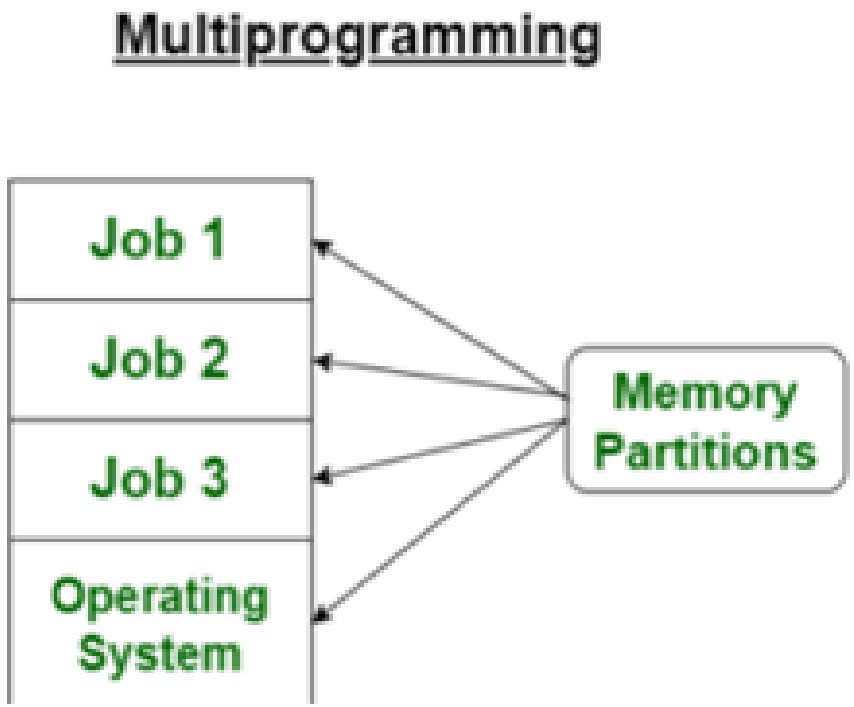

Figure: Multiprogramming Operating System

Operations of Multi-programming

- Multiple programs are to be stored in memory and each program has to be given a specific portion of memory which is known as process.
- Before the process undergoes execution, the operating system selects a ready process by checking which one process should undergo execution.
- Process need any input/output operation at that time process goes out of main memory for I/O operation and temporarily stored in secondary storage and CPU switches to next ready process.
- The process which undergoes for I/O operation comes again after completing the work, then CPU switches to this process.

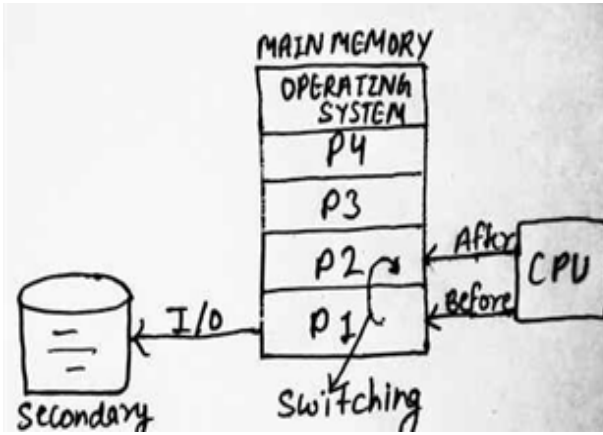

Figure: Working Principle of Multiprogramming

Mathematical Representation of Multiprogramming

$c_i \in C$ Collection of CPU Cycles

$p_i \in P$ Collection of Processes

The functionality of Multiprogramming can be represented using function like this
$f{:}c_i \rightarrow \cup_{i=1}^{n} p_i$

Advantages of Multi-programming

- Need Single CPU for implementation.
- Very high throughput.
- Optimal Response time.
- Context Switching happens when current process undergoes waiting state.
- CPU idle time is reduced.
- High resource utilization.

Disadvantages of Multi-programming

- If it has a large number of jobs, then long-term jobs will have to require a long wait.
- Memory management is needed in the operating system because all types of tasks are stored in the main memory.

Definition of Multitasking

- Multi tasking operating systems allow multiple users to perform multiple tasks at the same time. The allocation of system resources such as input/output devices, CPU and memory among processes can be easily managed by multi-tasking operating system.
- Multitasking is the ability of an OS to execute more than one task simultaneously on a CPU machine.

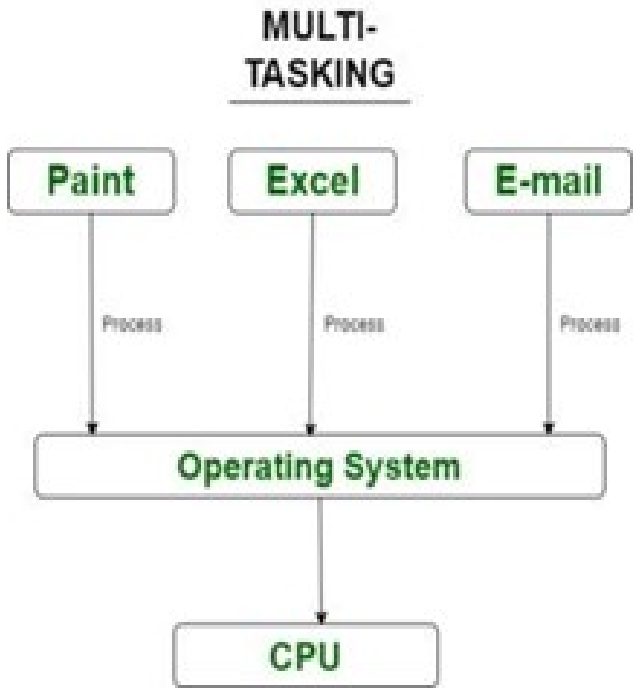

Figure: Multitasking Operating System

Mathematical Representation of Multitasking

$c_i \in P$ Collection of CPU Cycle

$T_i \in T$ Collection of User tasks

m is no. of CPU cores

n is no. of processes in each core

The functionality of Multitasking can be represented using function like this
$f: {c_i}^m \rightarrow \cup_{i=1}^{n} T_i$

Features of Multitasking

- Time Sharing – In this, many processes are allocated with resources of computer in respective time slots, processors time is shared with multiple processes.
- Context Switching – Context switching is a process of saving the context of one process and loading the context of another process.
- Hardware Interrupt – When a process or an event requires urgent attention, hardware or software will signal with an interrupt. It informs the processor that a high-priority task has arisen that necessitates interrupting the running process.

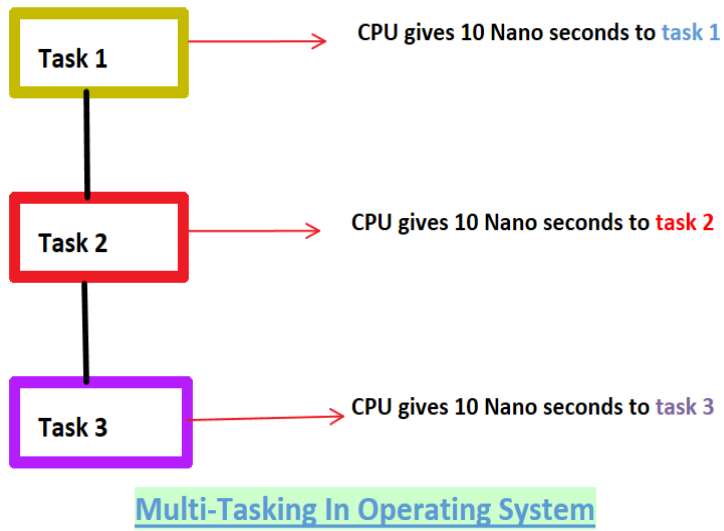

Figure: Working Principle of Multitasking

Advantages of Multitasking

- Multi-Tasking Operating System is capable of executing multiple application simultaneously without slowing down the system.
- Each process is assigned specific length of time(i.e time sharing), hence a process does not have to wait for longer duration to utilize CPU. Starvation of process is not found in these operating system.
- A multitasking OS can effectively manage I/O devices, RAM, hard disks, CPU, and other computer resources.

Disadvantages of Multitasking

- As a single processor is executing multiple processes at the same time then there will be load on CPU.
- Computer system will be lagging if the processor is slow in Multi-Tasking Operating System while executing multiple programs simultaneously.

Comparison between Multiprogramming and Multitasking

Serial No.	Multiprogramming	Multitasking
1	It includes single CPU to execute the program.	It uses multiple tasks for the task allocation.
2	Concept of Context Switching is used.	Concept of Time Sharing is used.
3	Multiprogramming increases CPU utilization by organizing jobs.	In multitasking also increases CPU utilization, it also increases responsiveness.
4	The idea is to reduce the CPU idle time for as long as possible.	The idea is to further extend the CPU utilization by increasing responsiveness Time Sharing.
5	Execution of process takes more time.	Execution of process takes less time.

Thank You