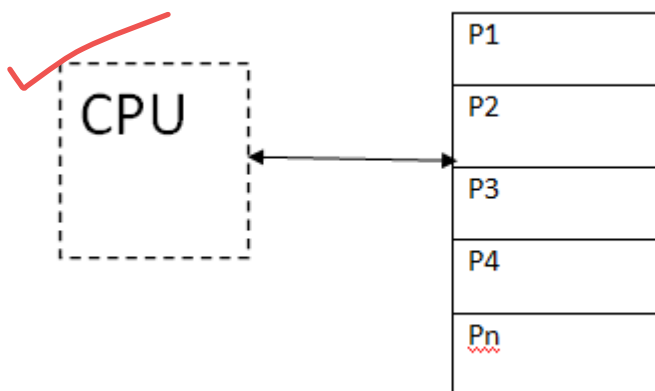


JavaTpoint:

Multiprogramming vs Multiprocessing vs Multitasking vs Multithreading

Multiprogramming

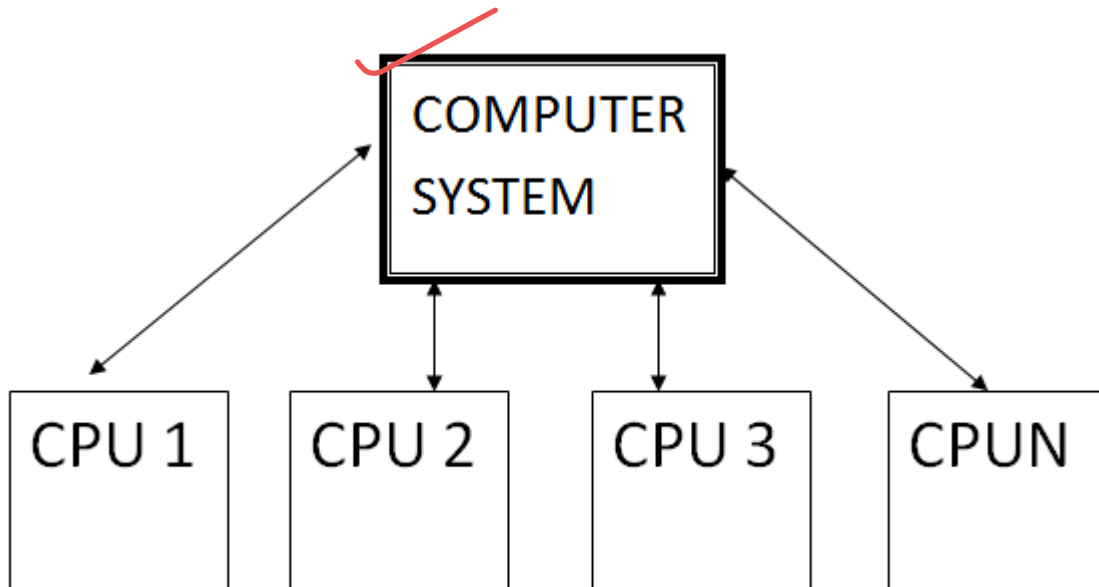
- "The concurrent residency of more than one program in the main memory is referred as multiprogramming."
- Since multiple programs are resident in the memory, as soon as the currently executing program finishes its execution, the next program is dispatched for its consumption.
- Also if the currently executing program asks for input output resources then meanwhile another program is dispatched to the CPU for execution.
- The main objective of multiprogramming is:
 - ✓ Maximum CPU utilization.
 - ✓ Efficient management of the main memory.
- Multiprogramming can be virtually shown as:



Multiprocessing

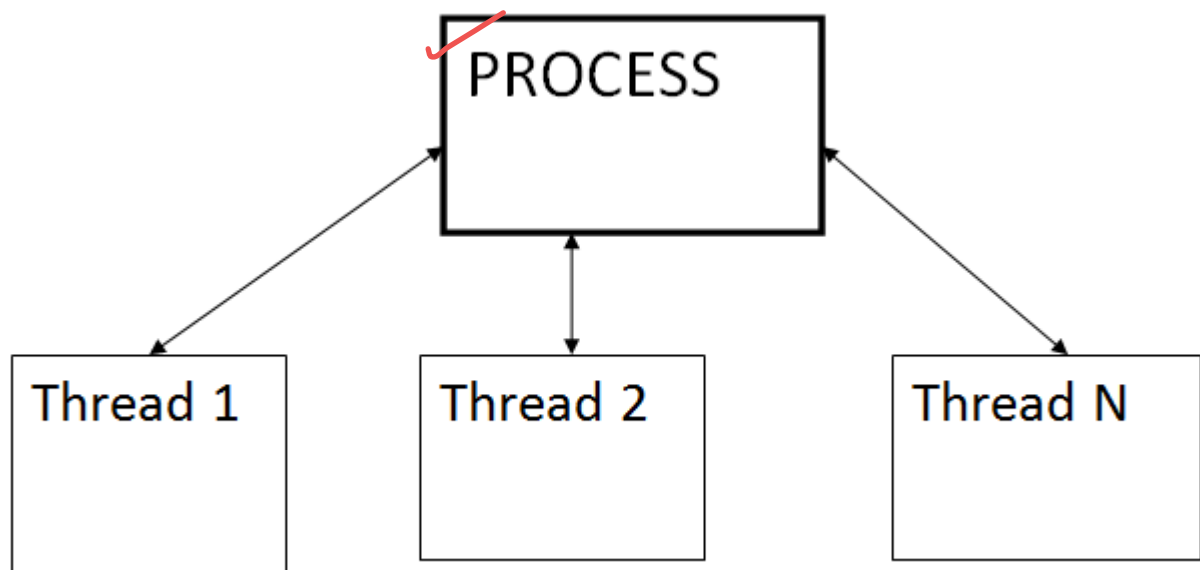
- When one system is connected to more than one processor which collectively work for the completion of the task, it is called as multiprocessing systems.
- Multiprocessing systems can be divided in two types:

- **Symmetric Multiprocessing:** The operating system here resides on one processor and the other processors run user's programs.
- **Asymmetric Multiprocessing:** The OS runs on any available processor or all the processor simultaneously run the user program.
- Multiprocessing systems can be virtually represented as:



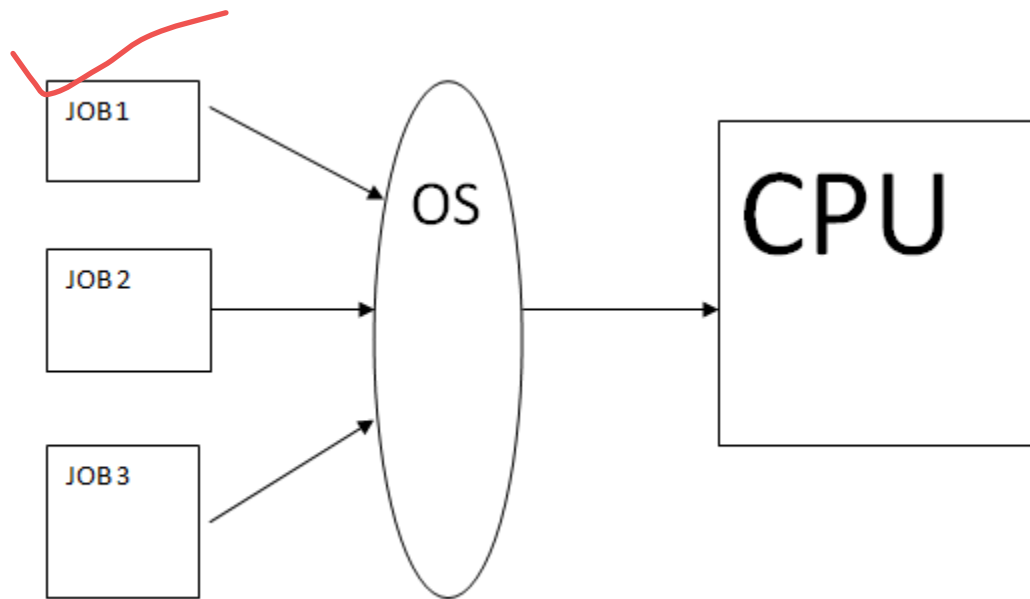
Multithreading

- "Multithreading is a conceptual programming paradigm where a process is divided into a number of sub-processes called as threads. Each thread is independent and has its own path of execution with enabled inter thread communication."
- "Thread is the path followed while executing a program. Each thread has its own program counter, stack and register."
- A thread is a light weight process.
- It can be virtually represented as:



Multitasking

- Earlier when computers were invented, a user was allowed to submit only job or task at a time. But later with availability of high-speed processor, one can submit more than one task.
- So the capability of OS to accept more the one task per user is termed as multitasking.
- Multiple jobs are executed by the CPU simultaneously by switching between them.
- The various job can be accepted from same user or different users. There are 2 types of multitasking systems:
 - **Single User Multitasking**
 - **Multi User multitasking**
- It can be virtually represented as:



Now, let's take a look at difference between these types of system:

No	Characteristic	Multiprogramming	Multiprocessing	Multithreading	Multitasking
1	What it is:	The concurrent residency of <u>more than one program</u> in the main memory is called as multiprogramming.	The availability of <u>more than one processor</u> per system, which can execute several set of instructions in <u>parallel</u> is called as multiprocessing.	A process is <u>divided into several different sub-processes</u> called as <u>threads</u> , which has its own path of execution. This concept is called as multithreading.	The execution of <u>more than one task</u> simultaneously is called as multitasking.
2	Number of CPU:	One	More than one	Can be <u>one or more than one</u>	One
3	Job processing time:	<u>More time</u> is taken to process the jobs.	<u>Less time</u> is taken for job processing.	<u>Moderate</u> amount of time is taken for job processing.	Moderate amount of time.

4	Number of process being executed:	<u>One process</u> is executed <u>at a time</u> .	<u>More than one process</u> can be executed at a time	Various components of the same process are being executed at a time.	One by one job is being executed at a time.
5	Economical:	It is <u>economical</u> .	Is <u>less economical</u> .	Is economical.	It is economical.
6	Number of users:	One at a time.	Can be one or more than one.	Usually one.	More than one.
7	Throughput :	Throughput is <u>less</u> .	Throughput <u>maximum</u> is	<u>Moderate</u> .	Throughput is moderate.
8	Efficiency:	Less	Maximum	Moderate	Moderate
9	Categories:	No further <u>divisions</u>	<u>Symmetric</u> & <u>Asymmetric</u> .	No <u>further divisions</u> .	<u>Single User</u> & <u>Multiuser</u> .

1. Multiprogramming – Multiprogramming is known as keeping multiple programs in the main memory at the same time ready for execution.
2. Multiprocessing – A computer using more than one CPU at a time.
3. Multitasking – Multitasking is nothing but multiprogramming with a Round-robin scheduling algorithm.
4. Multithreading is an extension of multitasking.

Feature	Multiprogramming	Multitasking	Multithreading	Multiprocessing
Definition	Running multiple programs on a single CPU	Running multiple tasks (applications) on a single CPU	Running multiple threads within a single task (application)	Running multiple processes on multiple CPUs (or cores)
Resource Sharing	Resources (CPU, memory) are shared among programs	Resources (CPU, memory) are shared among tasks	Resources (CPU, memory) are shared among threads	Each process has its own set of resources (CPU, memory)
Scheduling	Uses round-robin or priority-based scheduling to allocate	Uses priority-based or time-slicing scheduling to	Uses priority-based or time-slicing scheduling to	Each process can have its own scheduling algorithm

	CPU time to programs	allocate CPU time to tasks	allocate CPU time to threads	
Memory Management	Each program has its own memory space	Each task has its own memory space	Threads share memory space within a task	Each process has its own memory space
Context Switching	Requires a context switch to switch between programs	Requires a context switch to switch between tasks	Requires a context switch to switch between threads	Requires a context switch to switch between processes
Inter-Process Communication (IPC)	Uses message passing or shared memory for IPC	Uses message passing or shared memory for IPC	Uses thread synchronization mechanisms (e.g., locks, semaphores) for IPC	Uses inter-process communication mechanisms (e.g., pipes, sockets) for IPC