

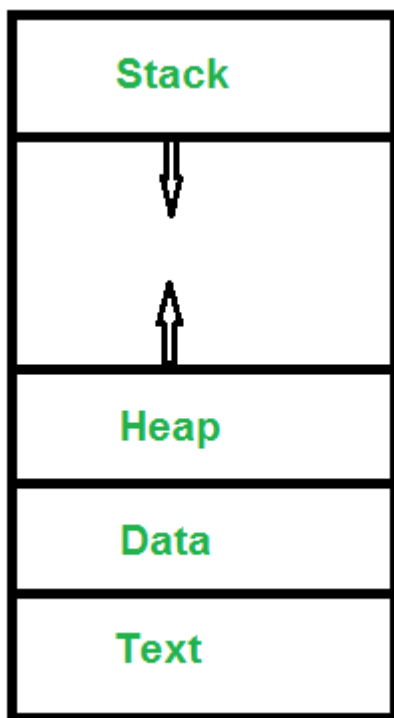
Short note:-

1] Process:

- A process is the instance of a computer program that is being executed.
- It contains program code and its activity.
- A computer program is a passive collection of instruction, a process is the actual execution of those instructions.
- Several process may be associated with same program

For example, when we write a program in C or C++ and compile it, the compiler creates binary code. The original code and binary code are both programs. When we actually run the binary code, it becomes a process.

A process look like in memory:-



Text Section: A Process, sometimes known as the Text Section, also includes the current activity represented by the value of the Program Counter.

Stack: The stack contains temporary data, such as function parameters, returns addresses, and local variables.

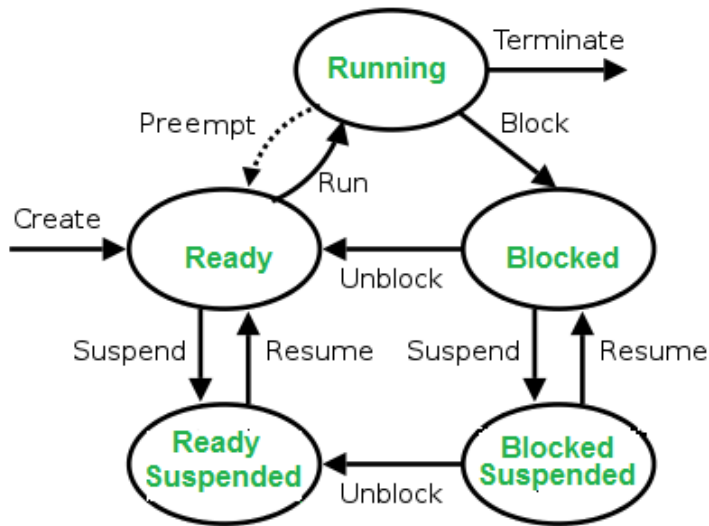
Data Section: Contains the global variable.

Heap Section: Dynamically allocated memory to process during its run time.

Every process has its own process control block(PCB), i.e each process will have a unique PCB. All of the above attributes are part of the PCB.

States of Process:

A process is in one of the following states:



2] Threads:

A thread is a path of execution within a process.

A process can contain multiple threads. A thread is also known as light weight process.

The idea of thread is to achieve parallelism by dividing a process into multiple threads.

Threads are executed one after another but gives the illusion as if they are executing in parallel.

Each thread has different states. Each thread has:-

- **A program counter**
- **A register set**
- **A stack space**
- A thread of execution is the smallest sequence of programmed instruction that can be managed independently by a scheduler.
- Multiple threads can exist within a process.
- Executing concurrently and sharing resources such as memory.
- Threads are not independent of each other as they share the code, data, OS resources, etc.

Pipelining basic concept and general structure of pipelining:-

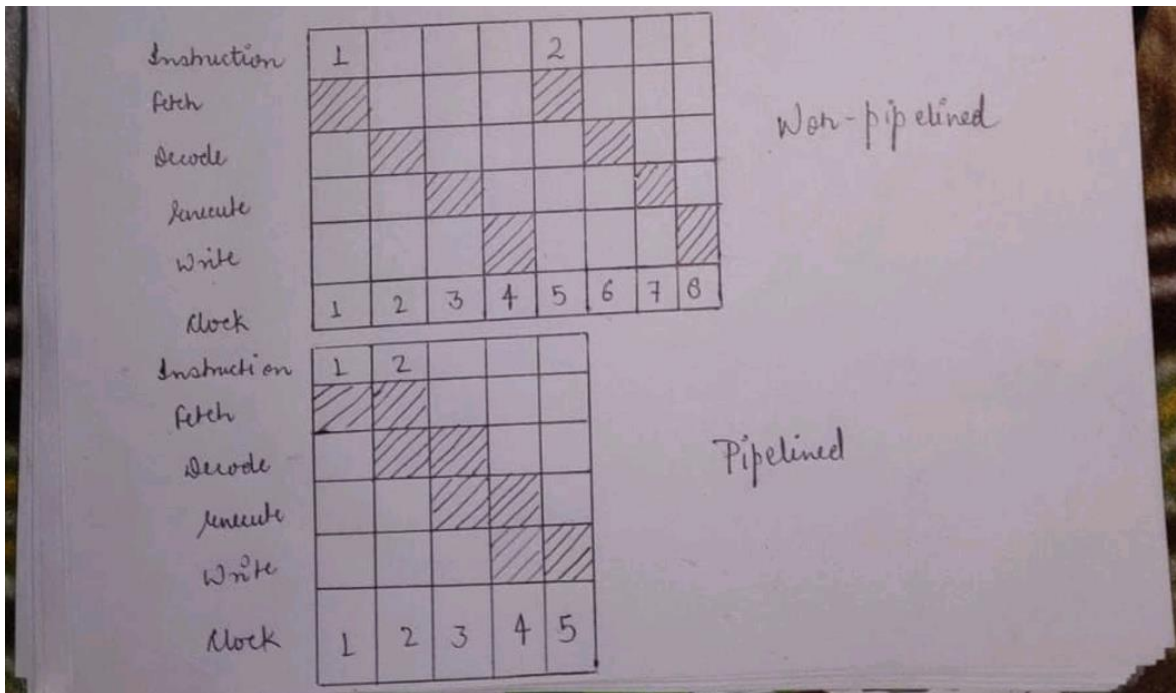
Pipelining is a process of arrangement of hardware elements of the CPU such that its overall performance is increased. Simultaneous execution of more than one instruction takes place in a pipelined processor.

OR

Pipelining is a technique used to improve the execution throughput of a CPU by using the processor resource in a more efficient manner. The basic idea is to split the processor instruction into a series of small independent states.

Each state is designed to perform a certain part of the instruction. At a very basic level, these stages can be broken into:

- **Fetch unit:-** Fetch the instruction from memory
- **Decode unit:-** Decode the instruction from memory to be executed
- **Execute unit:-** Execute the instruction
- **Write unit:-** Write the result back to register or memory



- Multiple instructions are executed parallelly.
- This style of executing the instruction is highly efficient.

Instruction pipelining is a technique that implements a form of parallelism called as instruction level parallelism within a single processor.

A pipelined processor does not wait until the previous instruction executed completely.

Pipelined Architecture:-

- The hardware of the CPU is split up into several functional units.
- Each functional unit performs a dedicated task.
- The number of functional units may vary from processor to processor.
- These functional units are called as stages of the pipeline.
- Control unit manages all the stages using control signals.
- There is a register associated with each stage that holds the data.
- It consists a global clock that synchronizes the working of all the stages.

CLASSIFICATION OF PIPELINE PROCESSORS

1. Arithmetic Pipelining: The arithmetic logic units of a computer can be segmented for pipeline operations in various data formats.

2. Instruction Pipelining:

An instruction cycle may consist of many operations like fetch, decode, compute, operand address, fetch operands and execute instruction. Each of these operations forms one stage of a pipeline.

The execution stream of instructions can be pipelined by overlapping the execution of current instruction with the fetch, decode and execution of subsequent instructions. This technique is known as instruction lookahead.

3. Processor Pipelining: Pipeline processing of the same data stream by a cascade of processors, each of which processes a specific task. The data stream passes the first processor with the results stored in memory block which is also accessible by the second processor.

Advantages of Pipelining

- Instruction throughput increases.
- Increase in the number of pipeline stages increases the number of instructions executed simultaneously.
- Faster ALU can be designed when pipelining is used.
- Pipelined CPU's works at higher clock frequencies than the RAM.
- Pipelining increases the overall performance of the CPU.

Disadvantages of Pipelining

- Designing of the pipelined processor is complex.
- Instruction latency increases in pipelined processors.
- The throughput of a pipelined processor is difficult to predict.
- The longer the pipeline, worse the problem of hazard for branch instructions.