CHAPTER 3

Process management

Topics:-

Concepts of Process

1) **Overview of the Process & threads**
2) **Process Life Cycle/ Process States**
3) **Process Control Block**

Process Scheduling

1) **Scheduling Criteria**
2) **Scheduling Algorithms**
   a. **First Come First Serve (FCFS)**
   b. **Shortest Job First (SJF)**
   c. **Round Robin (RR)**
3) **Overview of Schedulers**
4) **Scheduling Queues**
5) **Context Switch**

Process Synchronization

1) **Critical Section**
2) **Mutual Exclusion**

Deadlock

1) **Conditions for Deadlock**
2) **Resource allocation graph**

Concepts of Process

1. Overview of the Process & threads

=> In computing, **processes** and **threads** are fundamental concepts in operating systems that enable multitasking, the concurrent execution of tasks, and efficient use of system resources.

=> **Processes**

A process is a program in execution. It consists of:

=> Process is a set of instruction when it was executing in main memory that was called Process.

- **Code (program instructions)**: The set of instructions that the CPU executes.
- **Data**: Variables and other dynamic data that the program operates on.
- **Resources**: Open files, memory allocation, etc.
- **Execution context**: This includes the state of the processor registers, program counter (PC), and stack pointer.

=> **Threads**

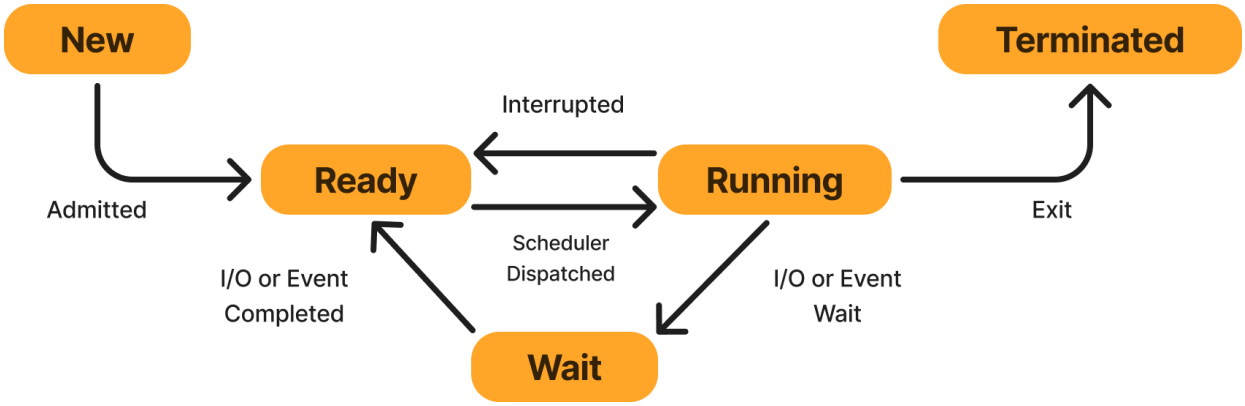
A thread is the smallest unit of execution within a process. A process can have multiple threads that:

- Share the same memory space (code, data, and files).
- Have their own stack and program counter.

Threads allow **parallelism** within a process, enabling tasks to be divided and run concurrently, which leads to more efficient use of system resources

2) Process Life Cycle/ Process States

=>



1) New (Creation State)

- The process is being created.
- The operating system allocates necessary resources, such as memory, and sets up process control blocks (PCB), which contain process-specific information (e.g., process ID, program counter, register states).
- The process has not started execution yet.

Transition: When the process is ready to execute, it moves to the ready state.

2) Ready (Waiting to Execute)

- The process is fully initialized and ready to run.
- It is waiting in the ready queue, a list of processes waiting for CPU time.
- In this state, the process has all resources needed to execute except the CPU.

Transition:

- If the CPU is available, the operating system's scheduler selects this process to run, and it transitions to the running state.

3) Running (Executing)

- The process is currently being executed by the CPU.
- It has all necessary resources and is actively executing instructions.

Transitions:

- **To Waiting:** If the process needs to wait for an event (like I/O completion), it transitions to the waiting state.
- **To Terminated:** If the process completes execution, it moves to the terminated state.
- **To Ready:** If the process's CPU time slice expires (in time-sharing systems), it transitions back to the ready state to allow other processes to run.

4) Waiting (Blocked)

- The process is waiting for an event, such as an I/O operation (e.g., reading from a file, waiting for user input).
- It cannot proceed until the event is completed.

- While in this state, the process does not use the CPU but may still hold other resources like memory.

Transition: Once the event or I/O operation is complete, the process moves back to the ready state.

5) Terminated (Exit State)

- The process has finished execution or has been terminated by the operating system.
- The operating system deallocates resources used by the process (e.g., memory, open files).
- The process control block is also removed.

Transition: Once terminated, the process is completely removed from the system.

3) Process Control Block

=> The **Process Control Block (PCB)** is a crucial data structure in an operating system that stores all the information about a specific process. It helps the operating system manage processes efficiently by tracking the state of the process as it transitions through its life cycle (from creation to termination).

Contents of a Process Control Block