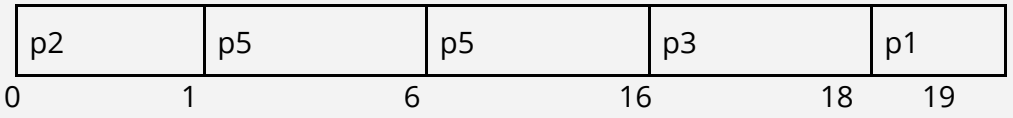
# Priority Scheduling

- CPU is allocated to the particular process with the highest priority .
- Priority range be 0 to 7 (say), with 0 representing the highest or the lowest priority
- Priority may depend on internal factors (time limit, memory requirement, number of open files, etc.) and external factors (user, department, etc.)
- May be preemptive or non-preemptive .
- SJF is an important case of priority scheduling, with priority inversely proportional to predicted next CPU burst length.
- May cause starvation, i.e. indefinite blocking of processes
- Aging: gradually increase the priority of a process waiting for a long time
- Priority inversion: a low-priority process gets the priority of a high-priority process waiting for it

**Example:**

| Process | Burst Time | Priority |
|---|---|---|
| P1 | 10 | 3 |
| P2 | 1 | 1 |
| P3 | 2 | 4 |
| P4 | 1 | 5 |
| P5 | 5 | 2 |

Gantt chart:



AWT = 8.2 mS

Problem with priority scheduling algorithms is indefinite blocking or starvation. A solution to the problem of indefinite blockage of low priority processes is aging. Aging is a technique of gradually increasing the priority of processes that wait in the system for a long time. For example if priorities range from 0 (low) to 127 (high), we could increment the priority of a waiting process by 1 every 15 mins.

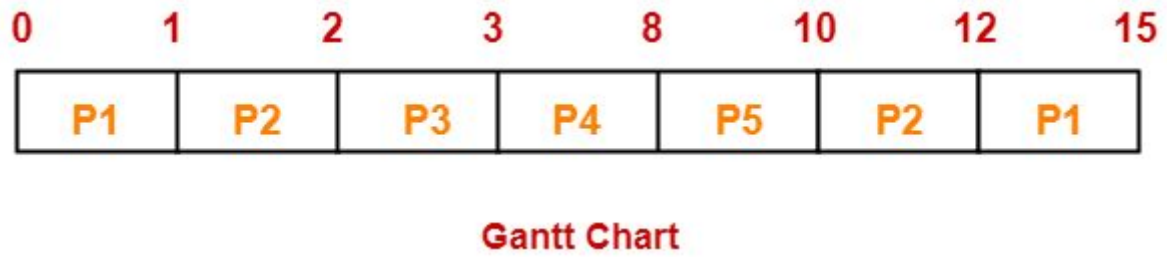
**User Problems:**

**Problem 1:**
**Consider the set of 5 processes whose arrival time and burst time are given below-**

| Process Id | Arrival time | Burst time | Priority |
|---|---|---|---|
| P1 | 0 | 4 | 2 |
| P2 | 1 | 3 | 3 |
| P3 | 2 | 1 | 4 |
| P4 | 3 | 5 | 5 |
| P5 | 4 | 2 | 5 |

**If the CPU scheduling policy is priority preemptive, calculate the average waiting time and average turnaround time. (Higher number represents higher priority)**
**Solution-**

Gantt Chart-




Gantt Chart

Now, we know-

- Turn Around time = Exit time – Arrival time

- Waiting time = Turnaround time – Burst time

| Process Id | Exit time | Turn Around time | Waiting time |
|---|---|---|---|
| P1 | 15 | 15 – 0 = 15 | 15 – 4 = 11 |
| P2 | 12 | 12 – 1 = 11 | 11 – 3 = 8 |
| P3 | 3 | 3 – 2 = 1 | 1 – 1 = 0 |
| P4 | 8 | 8 – 3 = 5 | 5 – 5 = 0 |
| P5 | 10 | 10 – 4 = 6 | 6 – 2 = 4 |

Now,

- Average Turnaround time = (15 + 11 + 1 + 5 + 6) / 5 = 38 / 5 = 7.6 unit
- Average waiting time = (11 + 8 + 0 + 0 + 4) / 5 = 23 / 5 = 4.6 unit

**Problem 2:**
**Consider the set of 5 processes whose arrival time and burst time are given below-**

| **Process Id** | **Arrival time** | **Burst time** | **Priority** |
|---|---|---|---|
| **P1** | **0** | **4** | **2** |
| **P2** | **1** | **3** | **3** |
| **P3** | **2** | **1** | **4** |
| **P4** | **3** | **5** | **5** |
| **P5** | **4** | **2** | **5** |

**If the CPU scheduling policy is priority non-preemptive, calculate the average waiting time and average turnaround time. (Higher number represents higher priority)**

**Solution-**


Gantt Chart

Now, we know-

- Turn Around time = Exit time – Arrival time
- Waiting time = Turnaround time – Burst time

| Process Id | Exit time | Turn Around time | Waiting time |
|---|---|---|---|
| P1 | 4 | 4 – 0 = 4 | 4 – 4 = 0 |
| P2 | 15 | 15 – 1 = 14 | 14 – 3 = 11 |
| P3 | 12 | 12 – 2 = 10 | 10 – 1 = 9 |
| P4 | 9 | 9 – 3 = 6 | 6 – 5 = 1 |
| P5 | 11 | 11 – 4 = 7 | 7 – 2 = 5 |

Now,

- Average Turnaround time = (4 + 14 + 10 + 6 + 7) / 5 = 41 / 5 = 8.2 unit
- Average waiting time = (0 + 11 + 9 + 1 + 5) / 5 = 26 / 5 = 5.2 unit

**Interview Questions**

**1 . What is Priority scheduling? (Paypal)**

Please refer to the notes for definitions of the aforementioned operating systems under the heading "**priority scheduling**".

**2.What is the major problem with priority scheduling algorithms? (Vmware)**

A major problem with priority scheduling is indefinite blocking or starvation. A solution to the problem of indefinite blockage of the low-priority process is aging. Aging is a

technique of gradually increasing the priority of processes that wait in the system for a long period of time.

**3.What is the benefit of priority scheduling with aging? (Amazon)**
Aging is used to ensure that jobs with lower priority will eventually complete their execution. This technique can be used to reduce starvation of low priority tasks. There are many ways to implement aging, but all have the same principle that the priority of a process should increase as it waits in the ready queue.

**4.What is starvation and aging? (Nagarro)**
Starvation: Starvation is a resource management problem where a process does not get the resources it needs for a long time because the resources are being allocated to other processes. Aging: Aging is a technique to avoid starvation in a scheduling system.