Comparison of CPU Scheduling Algorithms

1. First-Come, First-Served (FCFS)

Theory:

- Description: FCFS is the simplest CPU scheduling algorithm. It executes processes in the order they arrive in the ready queue.
- Characteristics:
  - Non-preemptive: Once a process starts execution, it runs to completion.
  - Fair: Every process gets executed in the order it arrives.
  - Disadvantages:
    - May lead to the convoy effect (longer processes may delay shorter ones).
    - Poor average waiting time when processes have varying burst times.

Practical Example:

- Process P1 arrives at time 0 and requires 5 units of CPU time.
- Process P2 arrives at time 1 and requires 3 units.
- Process P3 arrives at time 2 and requires 8 units.

Execution Order: P1 -> P2 -> P3

Average Waiting Time = (0 + 5 + 8) / 3 = 4.33 units.

Oral Questions:

Q: How does FCFS work?

A: FCFS schedules processes based on their arrival time; the first process to arrive gets executed first.

Q: What is the major disadvantage of FCFS?

A: It may cause high waiting time, especially if long processes arrive before shorter ones.

2. Shortest Job First (SJF)

Theory:

- Description: SJF schedules processes based on their burst time (execution time). The process with the shortest burst time is executed first.
- Characteristics:
  - Can be preemptive (Shortest Job Next or SJN) or non-preemptive.
  - Ideal for minimizing average waiting time.
  - Disadvantages:
    - Requires knowledge of the burst time in advance.
    - May cause starvation for long processes.

Practical Example:

- Process P1 requires 8 units.
- Process P2 requires 3 units.
- Process P3 requires 5 units.

Execution Order: P2 -> P3 -> P1 (based on burst time)

Average Waiting Time = (0 + 3 + 8) / 3 = 3.67 units.

Oral Questions:

Q: What is the main principle of SJF?

A: SJF schedules the process with the shortest burst time first.

Q: What is the issue with SJF?

A: It may cause starvation for longer processes and requires knowledge of burst times beforehand.

3. Priority Scheduling

Theory:

- Description: Processes are scheduled based on priority levels, with the highest priority being executed first.
- Characteristics:
  - Can be preemptive or non-preemptive.
  - If two processes have the same priority, FCFS can be used to break the tie.
  - Disadvantages:
    - Starvation may occur for low-priority processes.
    - Needs a priority assignment mechanism.

Practical Example:

- Process P1 has priority 3, P2 has priority 1, and P3 has priority 2.
- Execution Order: P2 -> P3 -> P1

Average Waiting Time = (0 + 3 + 8) / 3 = 3.67 units.

Oral Questions:

Q: How does Priority Scheduling work?

A: It schedules processes based on their priority levels, where higher priority processes are executed first.

Q: What are the drawbacks of Priority Scheduling?

A: Low-priority processes may never get executed (starvation), and assigning priorities can be complex.

4. Round Robin (RR)

Theory:

- Description: Round Robin scheduling allocates each process a fixed time quantum (time slice). Each process is executed for a time quantum, and if it doesn't complete, it is preempted and moved to the end of the queue.
- Characteristics:
  - Preemptive.
  - Fair in nature, as each process gets an equal share of CPU time.
  - Disadvantages:
    - If the time quantum is too large, it behaves like FCFS; if too small, it can cause high overhead due to frequent context switching.

Practical Example:

- Processes P1, P2, and P3 each have a burst time of 5 units, and the time quantum is 2 units.

Execution Order:

- P1 executes for 2 units, then P2 for 2 units, then P3 for 2 units.
- This continues until all processes are complete.

Average Waiting Time = Calculation depends on time quantum and number of processes.

Oral Questions:

Q: What is the purpose of Round Robin scheduling?

A: Round Robin aims to provide a fair share of CPU time to each process in a circular manner.

Q: What factors affect the performance of Round Robin scheduling?

A: The length of the time quantum affects the context switching overhead and CPU utilization.

Comparative Summary of CPU Scheduling Algorithms

Algorithm	Non-Preemptive	Preemptive	Average Waiting Time	Starvation
FCFS	Yes	No	High (Convoy effect)	No
SJF	Yes	Yes	Low	Yes
Priority	Yes	Yes	Depends on priority	Yes
Round Robin	No	Yes	Depends on time quantum	No