

Operating Systems

| CPU Scheduling Algorithms

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| Agenda

- CPU Scheduling Algorithms
- First-Come, First-Served (FCFS)



CPU Scheduling Algorithms



Purpose: To decide which process gets the CPU next —in a way that balances efficiency, fairness, and responsiveness ⚡ 💻

- 1 First-Come, First-Served (FCFS)
- 2 Shortest Job First (SJF)
- 3 Shortest Remaining Time First (SRTF)
- 4 Priority Scheduling
- 5 Round Robin (RR)
- 6 Multilevel Queue Scheduling (MLQ)
- 7 Multilevel Feedback Queue (MLFQ)

First-Come, First-Served (FCFS)

 Simplest algorithm

- The process that arrives first runs first.
- Like standing in line at a bank — whoever came first gets served first.

 Problem: Convoy effect **تأثير القافلة** — short jobs wait behind long ones - slow jobs can block the queue



Best for batch systems with no need for interactivity.

1 First-Come, First-Served (FCFS)

- Consider the following set of processes that arrive at time 0, with the length of the CPU burst given in milliseconds:

<u>Process</u>	<u>Burst Time</u>
P_1	24
P_2	3
P_3	3

- If the processes arrive in the order P_1, P_2, P_3 , and are served in FCFS order
- Draw the Gantt Chart - Average Waiting Time - Average Turnaround Time

1 First-Come, First-Served (FCFS)

<u>Process</u>	<u>Burst Time</u>
P_1	24
P_2	3
P_3	3

1 FCFS – Example 02

Process	Arrival Time	Burst Time
P1	0	7
P2	2	4
P3	4	1
P4	5	4

Shortest Job First (SJF) Scheduling

-  Selects the process with the shortest CPU burst to run next.
 -  Can be Non-Preemptive or Preemptive (SRTF).
 -  Goal: Minimize average waiting time.
-

How it works

- The scheduler predicts the next CPU burst for each process.
- The shortest job gets the CPU first.
- Long jobs wait until shorter ones finish.

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How it works

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- The shortest job gets the CPU first.
- Long jobs wait until shorter ones finish.

Shortest Job First (SJF) Scheduling

- Consider the following set of processes that arrive at the time 0: Using the Non-Preemptive Shortest Job First (SJF) scheduling algorithm:

Required

- Draw the Gantt Char
- Calculate the following:
 - Average Waiting Time
 - Average Turnaround Time

<u>Process</u>	<u>Burst Time</u>
P_1	6
P_2	8
P_3	7
P_4	3

Shortest Job First (SJF) Scheduling

<u>Process</u>	<u>Burst Time</u>
P_1	6
P_2	8
P_3	7
P_4	3

Shortest Job First (SJF) Scheduling

- Consider the following set of processes that arrive at the times shown:
Using the Non-Preemptive Shortest Job First (SJF) scheduling algorithm:

Required

- Draw the Gantt Char
- Calculate the following:
 - Average Waiting Time
 - Average Turnaround Time

Process	Arrival Time (ms)	Burst Time (ms)
P1	0	6
P2	2	4
P3	4	2
P4	6	3

Shortest Job First (SJF) Scheduling

Process	Arrival Time (ms)	Burst Time (ms)
P1	0	6
P2	2	4
P3	4	2
P4	6	3

Shortest Remaining Time First (SRTF)

- SRTF is the preemptive version of the Shortest Job First algorithm.
- The CPU always executes the process that has the least remaining burst time.
- If a new process arrives with a shorter remaining time than the current one
→ The CPU immediately switches to the new process.

Shortest Remaining Time First (SRTF)

How It Works

- 1 When a process arrives → compare its burst time with the remaining time of the running process.
- 2 If it's shorter, preempt the current process.
- 3 Otherwise, let the current process continue.
- 4 Continue until all processes are complete.

Shortest Remaining Time First (SRTF)



Key Features



Preemptive: CPU can switch anytime.



Responsive: Short jobs finish quickly.



Optimal (theoretically) for minimizing average waiting time.



Drawback: May cause starvation for long processes.

Shortest Remaining Time First (SRTF)

Analogy

- Think of a hospital  where the doctor always treats the patient who can be helped the fastest
- if a new patient arrives with a simpler case, treatment order changes immediately

Shortest Remaining Time First (SRTF)

- Consider the following set of processes that arrive at the times shown:
Using the **Preemptive** Shortest Job First (SJF) scheduling algorithm:

Required

- Draw the Gantt Chart
- Calculate the following:
 - Average Waiting Time
 - Average Turnaround Time

<u>Process</u>	<u>Arrival Time</u>	<u>Burst Time</u>
P_1	0	8
P_2	1	4
P_3	2	9
P_4	3	5

Shortest Remaining Time First (SRTF)

<u>Process</u>	<u>Arrival Time</u>	<u>Burst Time</u>
P_1	0	8
P_2	1	4
P_3	2	9
P_4	3	5