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CPU Scheduling Algo: FCFS & SJF

Comprehensive Course on Operating System for GATE - 2024/25

Vishvadeep Gothi • Lesson 5 • Apr 24, 2023

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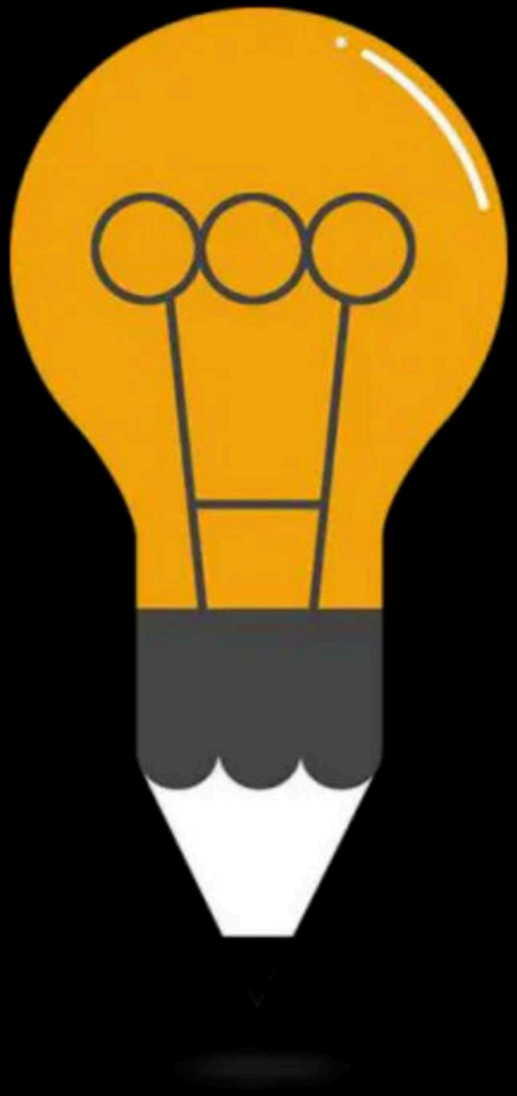

Operating System
CPU Scheduling
FCFS SJF SRTF

By: Vishvadeep Gothi

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▲ 1 • Asked by Bivas

can mutiple process present in running state? if yes then what is the flow of a process running state to suspened ready state?

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Scheduling Algorithms

1. FCFS
2. SJF
3. SRTF
4. HRRN
5. Priority Based
6. Round Robin
7. Multilevel Queue Scheduling
8. Multilevel Feedback Queue Scheduling

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FCFS (First Come First Serve)

Criteria: Lesser AT first | Tie breaker => smaller_id first

Mode: Non-preemptive

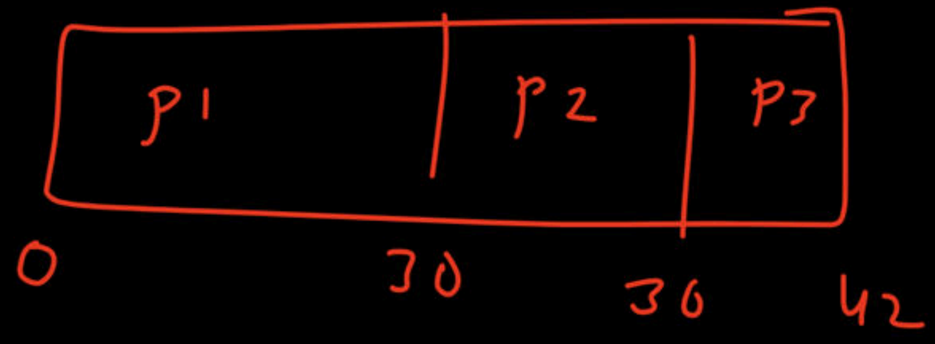
FCFS (First Come First Serve)

avg TAT = 36

avg WT = 22

Process	Arrival Time	Burst Time
P1	0	30
P2	0	6
P3	0	6

CT	TAT	WT
30	30	0
36	36	30
42	42	36



$$\text{Scheduling length} = \max(CT_i) - \min(AT_j)$$

$$= 42 - 0$$

$$= 42$$

$$\text{Throughput} = \frac{3}{42}$$

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FCFS (First Come First Serve)

Process	Arrival Time	Burst Time	Completion Time	Turnaround Time	Waiting Time
P1	0	30			
P2	0	6			
P3	0	6			

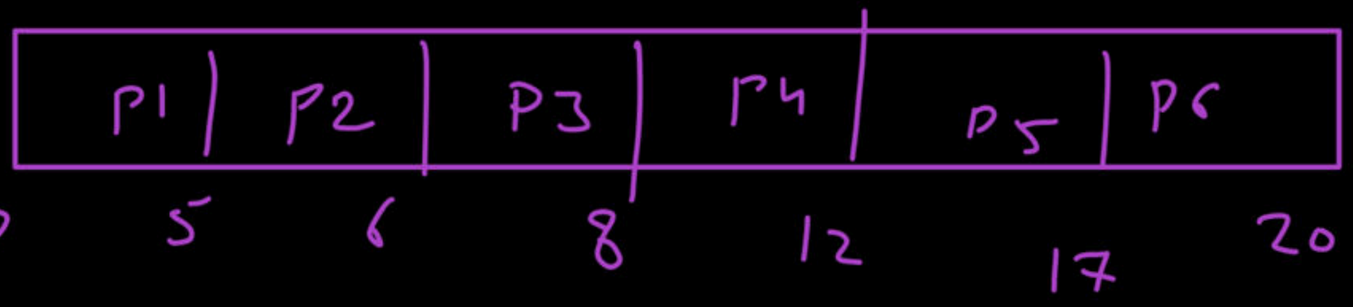
FCFS (First Come First Serve)

Process	Arrival Time	Burst Time
P1	0	5
P2	1	1
P3	2	2
P4	3	4
P5	4	5
P6	5	3

scheduling length = 20 − 0

= 20

Throughput = $\frac{6}{20}$



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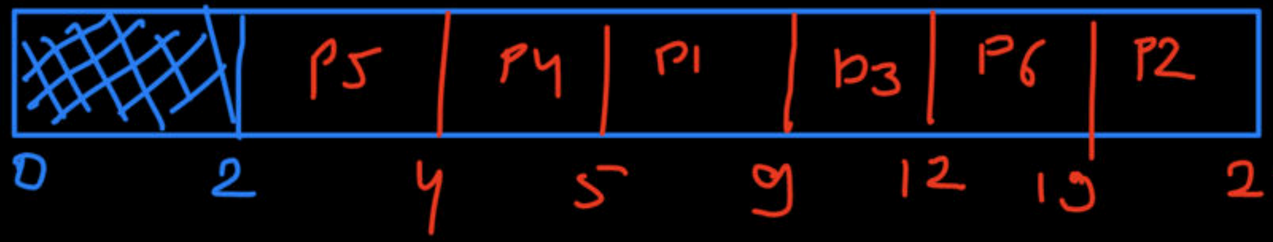
FCFS (First Come First Serve)

Process	Arrival Time	Burst Time	CT	TAT	WT
P1	5	4	9	4	0
P2	8	2	21	13	11
P3	6	3	12	6	3
P4	3	1	5	2	1
P5	2	2	4	2	0
P6	7	7	19	12	5

CPU idle



avg TAT = $\frac{39}{6}$

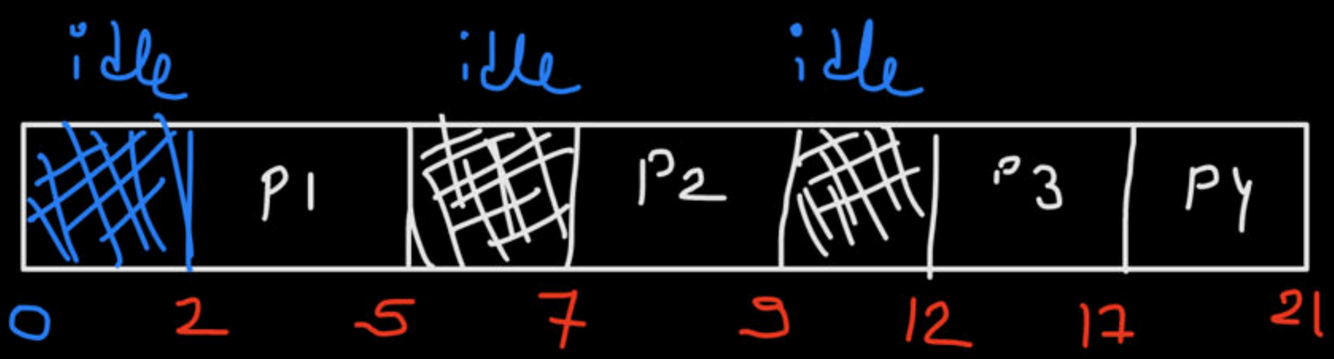
avg WT = $\frac{20}{6}$

Scheduling length (L) = 21 − 2 = 19

Throughput = $\frac{6}{19}$

FCFS (First Come First Serve)

Process	Arrival Time	Burst Time	CT	TAT	WT
P1	2	3	5	3	0
P2	7	2	9	2	0
P3	12	5	17	5	0
P4	13	4	21	8	4



avg TAT = $\frac{18}{4}$

avg WT = $\frac{4}{4} = 1$

$L = 21 - 2 = 19$

Throughput = $\frac{4}{19}$

In entire time from 0 to 21,

CPU used = 14 time unit

CPU idle = 7 time unit

% of time CPU utilized = $\frac{14}{21} * 100\% = 66.67\%$

% of time CPU idle = $\frac{7}{21} * 100\% = 33.33\%$

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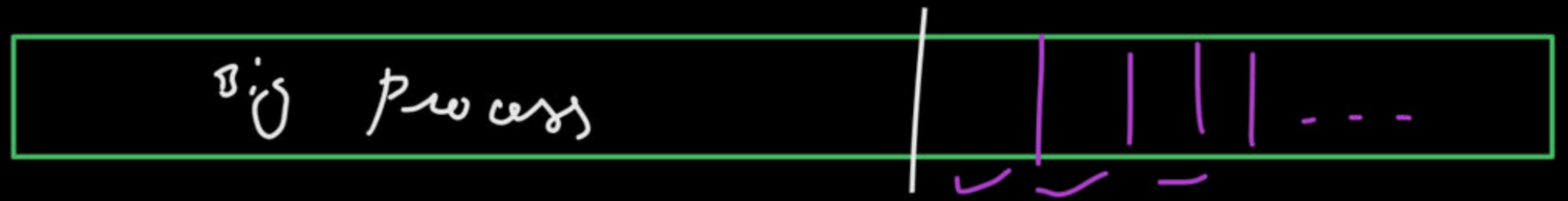
Convoy Effect



If a big process is scheduled ahead of small processes, then w.T. of small processes will increase; and it will eventually slow down the system.

FCFS (First Come First Serve)

Advantages:

1. Easy to implement
2. No complex logic
3. No starvation

Disadvantages:

1. No option of Preemption
2. Convoy effect makes the system slow

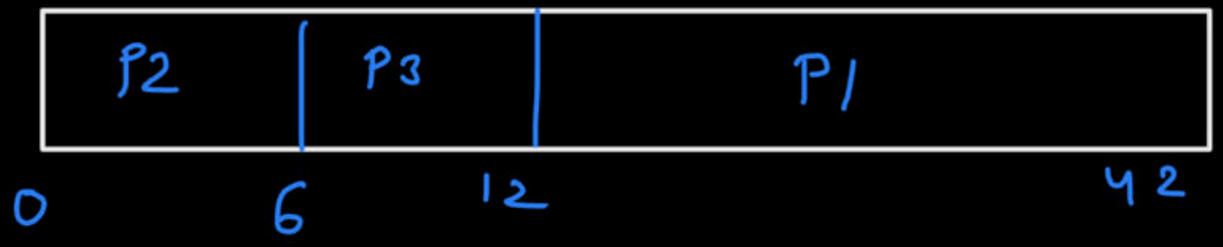
SJF (Shortest Job First)

Criteria: Small Burst Time | Tie breaker ⇒ FCFS

Mode: Non-preemptive

SJF (Shortest Job First)

Process	Arrival Time	Burst Time	Completion Time	Turnaround Time	Waiting Time
P1	0	30	42	42	12
P2	0	6	6	6	0
P3	0	6	12	12	6



	R. Q..
time 0	P1, P2, P3
Time 6	P1, P3
time 12	P1

avg TAT = 20 | avg WT = 6

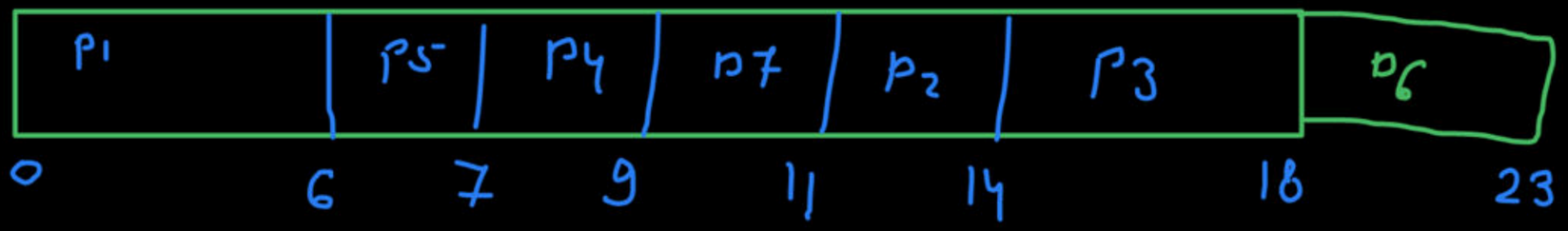
SJF (Shortest Job First)

Process	Arrival Time	Burst Time	Completion Time	Turnaround Time	Waiting Time
P1	0	6	6	6	0
P2	1	3	14	13	10
P3	2	4	18	16	12
P4	4	2	9	5	3
P5	5	1	7	2	1
P6	6	5	23	17	12
P7	8	2	11	3	1

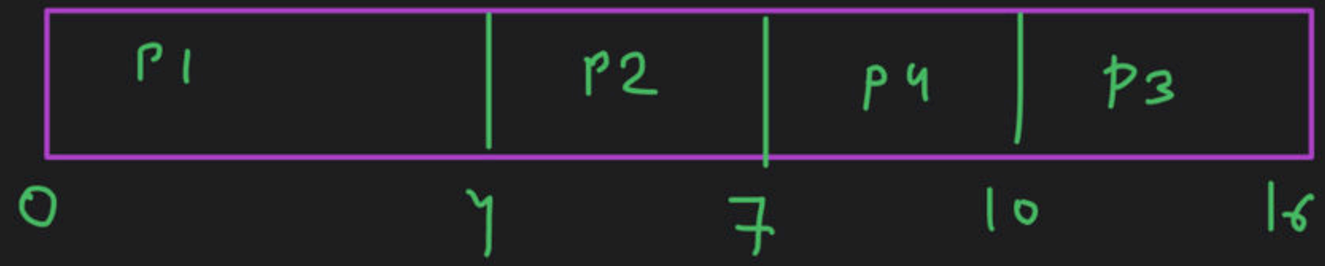
	R.Q.
0	P1
6	P2, P3, P4, ~~P5~~, P6
9	P2, P3, P6, P7

avg WT = $\frac{39}{7}$

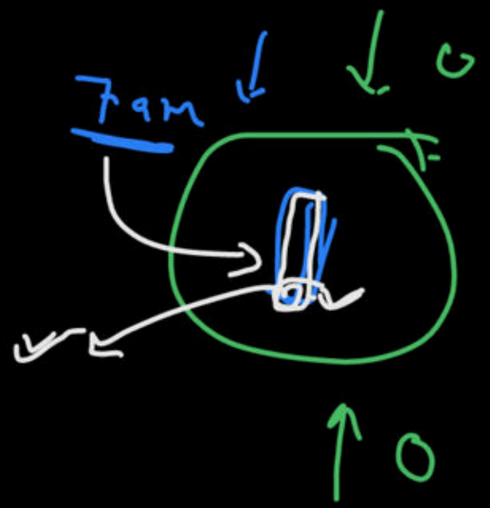
avg TAT = $\frac{62}{7}$



Process_id	AT	BT
P1	0	4
P2	2	3
P3	3	6
P4	4	3



SJF (Shortest Job First)



Advantages:

1. Minimum average waiting time among non-preemptive scheduling
2. Better throughput in continuous execution

Disadvantages:

1. No practical implementation because Burst time is not known in advance
2. No option of Preemption
3. Longer Processes may suffer from starvation

→ indefinite waiting

SRTF (Shortest Remaining Time First)

Criteria: Smaller BT Fcrst | Tie breaker => FCFS

Mode: Preemptive

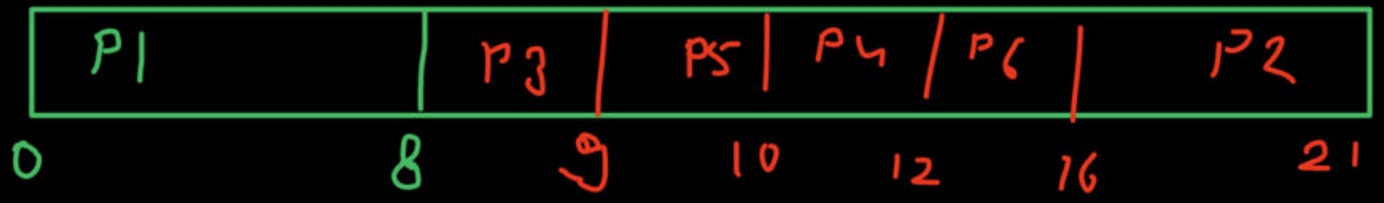
(Preemptive SJF)

Preemption happens when a new process arrives, and it has lesser BT then current running process's remaining time.

SRTF (Shortest Remaining Time First)

Process	Arrival Time	Burst Time	Completion Time	Turnaround Time	Waiting Time
P1	0	8			
P2	1	5			
P3	2	1			
P4	3	2			
P5	4	1			
P6	5	4			

SJF:-



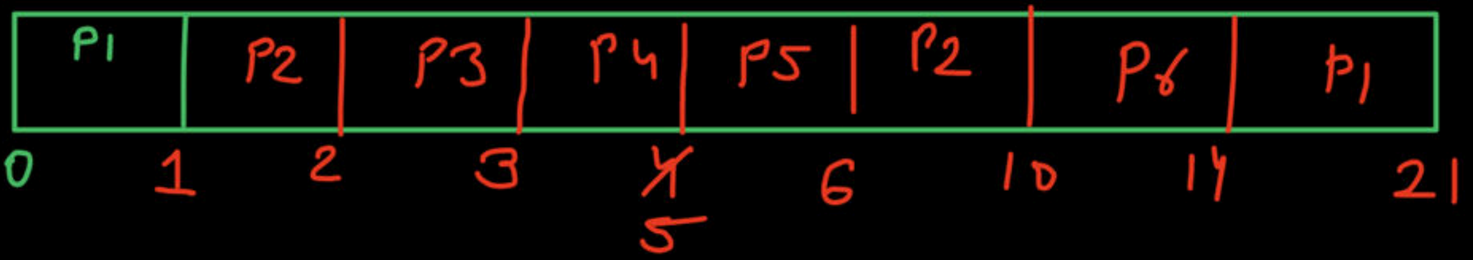
SRTF (Shortest Remaining Time First)

Process	Arrival Time	Burst Time	Completion Time	Turnaround Time	Waiting Time	RT
P1	0	8	21	21	13	0
P2	1	5	10	9	4	0
P3	2	1	3	1	0	0
P4	3	2	5	2	0	0
P5	4	1	6	2	1	1
P6	5	4	14	9	5	5

Time	RQ
0	P1
1	P1, P2
2	P1, P2, ~~P3~~
3	P1, P2, P4
4	P1, P2, ~~P4~~, P5
5	P1, ~~P2~~, ~~P5~~, P6

	BT
P1	~~8~~ 7
P2	~~5~~ 4
P3	~~1~~
P4	~~2~~ 1
P5	~~1~~
P6	4

SRTF:-



avg TAT = 44/6

avg WT = 23/6

avg RT = 6/6 = 1

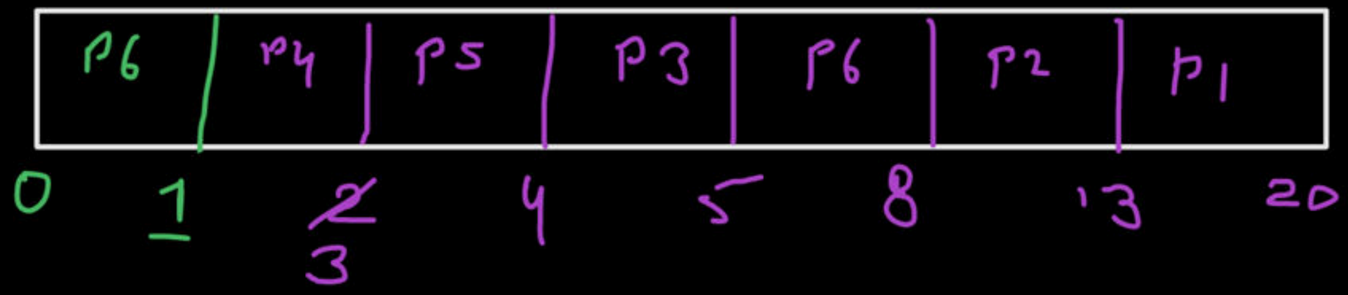
SRTF (Shortest Remaining Time First)

Process	Arrival Time	Burst Time	Completion Time	Turnaround Time	Waiting Time
P1	4	7	20	16	9
P2	5	5	13	8	3
P3	3	1	5	2	1
P4	1	2	3	2	0
P5	2	1	4	2	1
P6	0	4	8	8	4

RT

9
3
1
0
1
0

	RQ
0	P6
1	P6 , P4
2	P6 , P4 , P5
3	P6 , P5 , P3
4	P6 , ~~P3~~ , P1
5	P6 , P1 , P2



$$\text{avg TAT} = \frac{38}{6}$$

$$\text{avg WT} = \frac{18}{6}$$

$$\text{avg RT} = \frac{14}{6}$$

SRTF (Shortest Remaining Time First)

Advantages:

1. Minimum average waiting time among all scheduling algorithm
2. Better throughput in continue run

Disadvantages:

1. No practical implementation because Burst time is not known in advance
2. Longer Processes may suffer from starvation

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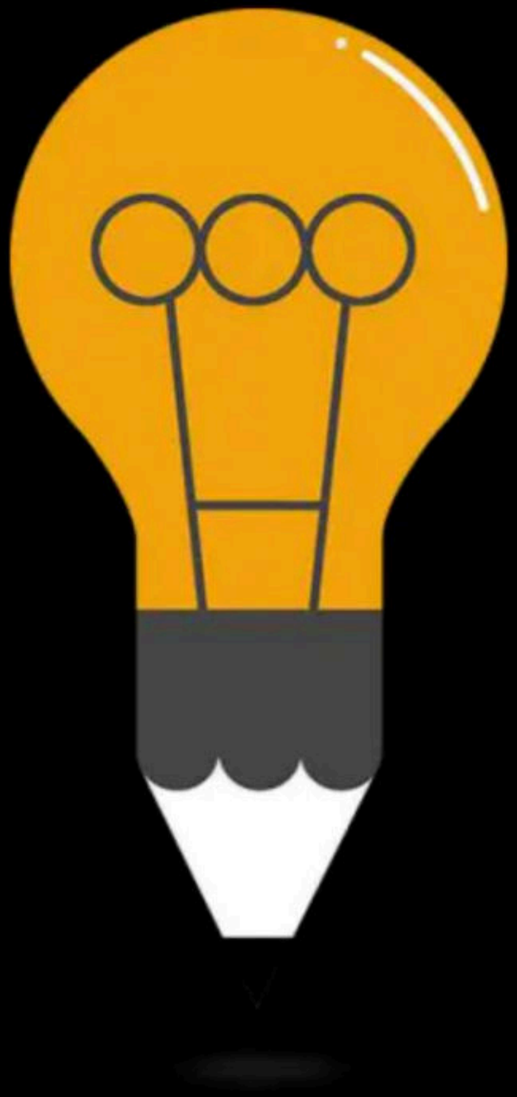

DPP

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Question 1

Response time of processes in non-preemptive scheduling algorithms are equal to waiting time of processes?

True or False

Justify your answer with appropriate explanation.

After waiting for CPU initially, process runs and completes. Hence afterwards no any waiting of process.

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Question 2

Consider the following process scenario.

Calculate the average waiting time and average TAT for processes for FCFS?

Process	Arrival Time	Burst Time
P1	5	6
P2	5	3
P3	8	4
P4	7	2
P5	3	1
P6	0	2
P7	7	2

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Question 3

Consider the following process scenario.

Calculate the average waiting time and average TAT for processes for SJF algo?

Process	Arrival Time	Burst Time
P1	5	6
P2	3	3
P3	1	4
P4	2	2
P5	4	1
P6	0	5
P7	1	2

Question 4

Consider a CPU performance metric *throughput* which is calculated as:

$$Throughput = \frac{Number\ of\ processes\ executed}{Total\ scheduling\ duration}$$

For the following process scenario calculate the throughput if process execution is done using:

1. FCFS algorithm
2. SJ algorithm

Process	Arrival Time	Burst Time
P1	0	4
P2	0	3
P3	0	1
P4	0	5

Question 5

Consider a CPU performance metric *throughput* which is calculated as:

$$Throughput = \frac{Number\ of\ processes\ executed}{Total\ scheduling\ duration}$$

For the following process scenario calculate the throughput if process execution is done using:

1. FCFS algorithm
2. SJ algorithm

Process	Arrival Time	Burst Time
P1	0	3
P2	3	6
P3	4	4
P4	5	2
P5	6	1
P6	3	3

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Question 6

Consider 4 processes A, B, C and D. All arrived at time 0 in the given order. The processes needed 5ns, 3ns, 9ns and 10ns respectively for their CPU burst to complete. What is the average waiting time of processes if executed in FCFS order?

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Question 7

Consider the following process scenario.

How much average waiting time can be saved using SRTF execution as compared to SJF execution?

Process	Arrival Time	Burst Time
P1	6	1
P2	2	4
P3	0	9
P4	5	6
P5	3	2
P6	1	8
P7	4	7

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Happy Learning.!