CPU Scheduling

→ The Process have different times :-

(1) Arrival Time (AT) → The Time when the process is arrived in the ready state.

(2) Burst Time (BT) → The Time required by the process for its execution.

(3) Completion Time (CT) → The time when the process completed its execution.

(4) Turnaround Time (TAT) → It is the time interval from the time of submission of a process to the time of the completion of the process.

$$TAT = CT - AT$$

(5) Waiting Time → The time difference between turnaround time and Burst time.

OR

The time spent by a process waiting in the ready queue for getting the CPU.

$$WT = TAT - BT$$

(6) Response time → The time difference b/w the 1st response and arrival time.

CPU Scheduling Algorithms

FCFS

- FCFS stands for First come first serve.
- In this, the process that arrives first, executed first.
- FCFS is non-pre-emptive in Nature.
- In FCFS, first process will get the CPU first, other processes can get CPU only after the current process has finished its execution. Now, suppose the first process has large burst time, and other processes

have less burst time, then the processes will have to wait more unnecessarily, this will result in more average waiting time. This effect is called as CONVOY EFFECT.

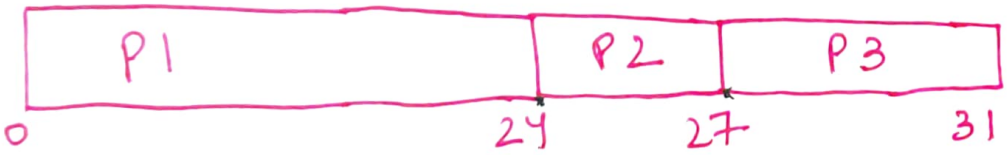
Convoy effect is a phenomenon associated with the FCFS algorithm, in which whole O.S slows down due to few slow processes.

Example of FCFS

Process	Burst Time
P1	24
P2	3
P3	4

- Calculate Average waiting Time.
- Calculate Avg. Turn Around Time

Gantt chart → is a horizontal bar chart to demonstrate CPU scheduling.



Waiting Time

P1 = 0
P2 = 24
P3 = 27

$\frac{0+24+27}{3}$ =

Turn Around Time

P1 = 24
P2 = 27
P3 = 31

⇒ $\frac{24+27+31}{3}$ =

CPU Scheduling

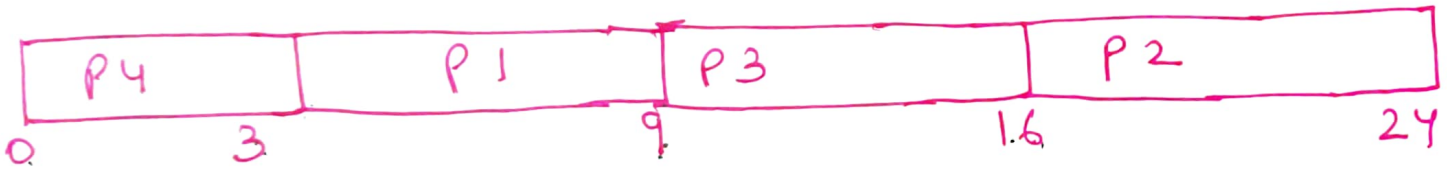
SJF

- SJF stands for Shortest Job first.
- In this, the process that has the shortest burst time, executes first.
- SJF is both Preemptive and non-preemptive.
- SJF may cause starvation, if Shorter processes keep coming. This problem is solved by aging.

Example of SJF
Non-preemptive mode

Process	Burst Time
P1	6
P2	8
P3	7
P4	3

- Calculate Average wating Time
- Calculate Avg. Turnaround Time



Waiting Time

P4 = 0
P1 = 3
P3 = 9
P2 = 16

$\frac{0+3+9+16}{4} \Rightarrow 7$

Turn Around Time

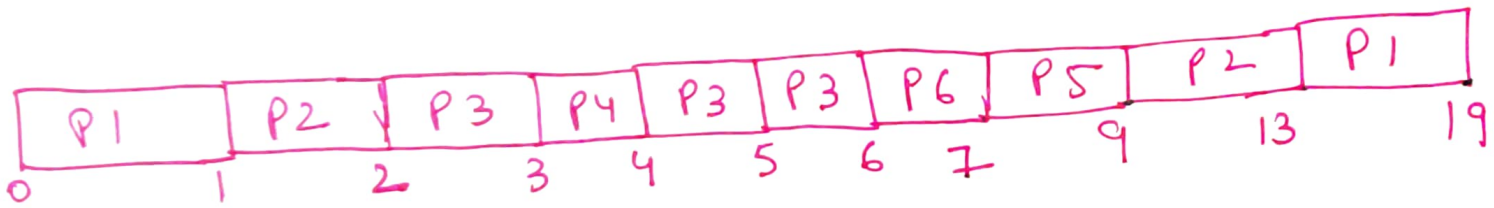
P4 = 3
P1 = 9
P3 = 16
P2 = 24

$\frac{3+9+16+24}{4} = 13$

Example of SJF

Preemptive Mode

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



C.T - A.T
Turnaround Time

P1 = 19 - 0 = 19
P2 = 13 - 1 = 12
P3 = 6 - 2 = 4
P4 = 4 - 3 = 1
P5 = 9 - 4 = 5
P6 = 7 - 5 = 2

$\frac{19+12+4+1+5+2}{6} = \frac{43}{6} = 7.1$

Waiting Time

P1 = 19 - 7 = 12
P2 = 12 - 5 = 7
P3 = 4 - 3 = 1
P4 = 1 - 1 = 0

TAT - B.T

P5 = 5 - 2 = 3
P6 = 2 - 1 = 1

$\frac{12+7+1+3+1}{6} = \frac{24}{6} = 4$

CPU Scheduling

RR

- RR stands for Round Robin Scheduling Algorithm.
- In this, each process is served by CPU for a fixed amount of time i.e known as time quantum.
- RR is cyclic in Nature, so there is no starvation.
- RR is preemptive in Nature.

Example of RR

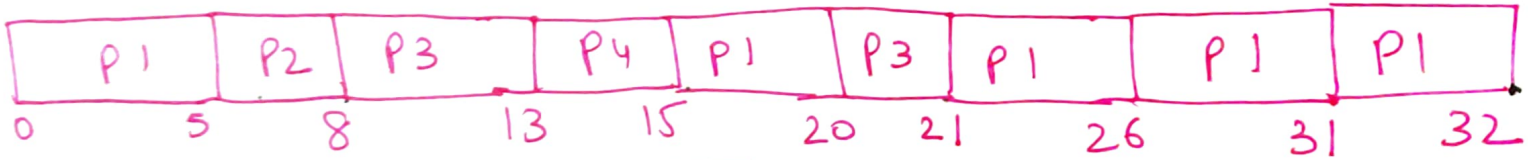
- Calculate Avg. Wait Time
- Calculate Avg. Turnaround Time

WT = TAT − BT

TAT = CT − AT

Process	Burst Time
P1	21 - 16 (11) - 6 (1)
P2	3 X
P3	6 - 1 X
P4	2 X

Time quantum → 5



TAT

P1 = 32 − 0 = 32

P2 = 8 − 0 = 8

P3 = 21 − 0 = 21

P4 = 15 − 0 = 15

$\frac{32+8+21+15}{4} = ?$

WT

P1 = 32 − 21 ⇒ 11

P2 = 8 − 3 ⇒ 5

P3 = 21 − 6 → 15

P4 = 15 − 2 ⇒ 13

$\frac{11+5+15+13}{4} = ?$

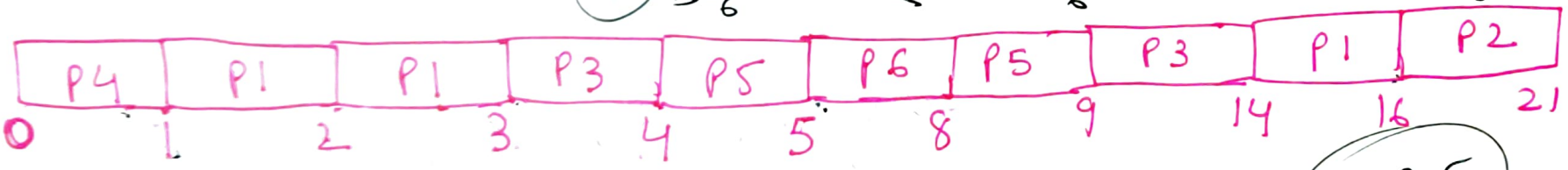
Example of Priority Scheduling Preemptive Mode

- Avg. W.T
- Avg. TAT

Process	AT	Priority	B.T
P1	1	5 x	4-3-2
P2	2	2	5
P3	3	6 x	8-5
P4	0	4	1 X
P5	4	7 x	2-1 X
P6	5	8	3 X

(9) $\Rightarrow \frac{54}{6}$

TAT = CT - AT	WT = TAT - BT
P1 = 16 - 1 = 15	P1 = 15 - 4 = 11
P2 = 21 - 2 = 19	P2 = 19 - 5 = 14
P3 = 14 - 3 = 11	P3 = 11 - 6 = 5
P4 = 1 - 0 = 1	P4 = 1 - 1 = 0
P5 = 9 - 4 = 5	P5 = 5 - 2 = 3
P6 = 8 - 5 = 3	P6 = 3 - 3 = 0
$\Leftarrow \frac{15+19+11+1+5+3}{6}$	$\frac{11+14+5+0+3+0}{6} = \frac{33}{6}$



Avg. TurnA.T = (9)

Avg. WT = 5.5