

CPU scheduling

CPU scheduling is a process which allows one process to use the CPU while the another process is on wait due to unavailability of resources (I/O, any Computer hardware, CPU programs etc).

The main aim of CPU scheduling is to make the system fast, fair, and efficient.

Different CPU scheduling?

In our study we will consider following CPU scheduling algorithm:

- First come first serve (FCFS) scheduling
- Shortest Job First (SJF) scheduling
- Round Robin (RR) scheduling

Why CPU scheduling?

To get the best performance from the system CPU scheduling is used.

Throughput:

Throughput is the total number of processes completed per unit of time. For better CPU utilization throughput should be maximized.

CPU utilization:

CPU utilization is finding out is CPU executing any process or its idle.

Turnaround time:

Turnaround time means total time taken by the process till its entering inside the CPU to the end of its execution. For better CPU utilization turnaround time must be minimized.

Waiting time:

Waiting time means time taken by the process after its entering inside the CPU and not in execution. For better CPU utilization waiting time must be minimized.

Load average:

Load average is the average of number of processes waiting in queue for their turn to get execution. For better CPU utilization load average must be minimized.

Response time:

Response time is the amount of time when the process enters inside the CPU and gets its execution starting. For better CPU utilization response time must be minimized.

So,

Response time = time of arrival to the time of starting execution.

FCFS SCHEDULING

First come first serve (FCFS) scheduling:

FCFS (First come first served) is an operating system process scheduling algorithm that automatically executes queued requests and processes by the order of their arrival.

With first come first served, what comes first is executed first, the next request in line will be executed once the request before it is complete.

FCFS is also known as:

FIFO (First in first out)

FCFC (First come first choice)

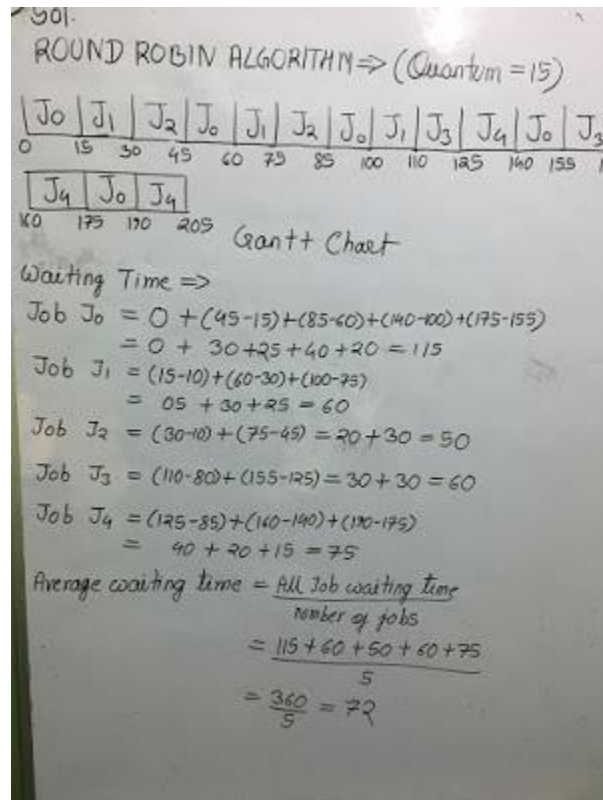
- Jobs are executed on first come, first serve basis.
- Easy to understand and implement.
- Average waiting time is high so poor in performance.

For example:

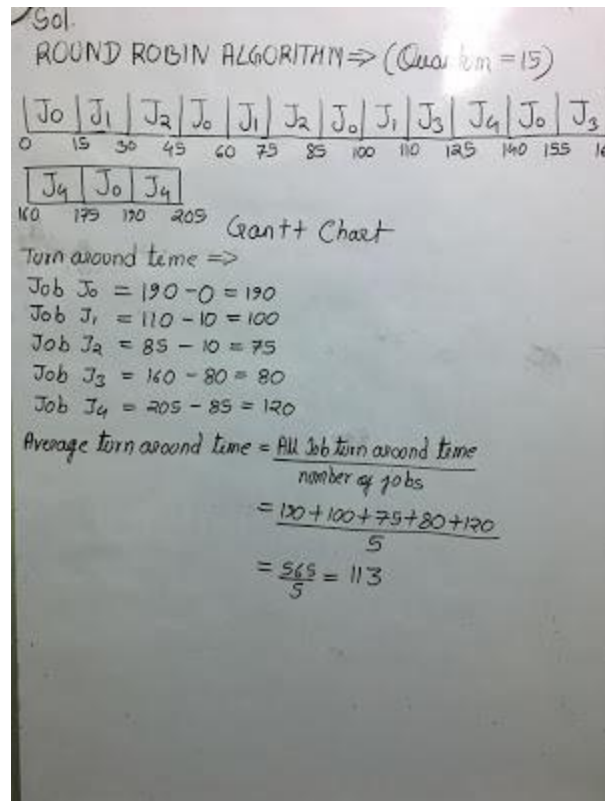
Job	Execution Time	Arrival Time
0	75	0
1	40	10
2	25	10
3	20	80
4	45	85

For Example:
RR: Quantum=15

Job	Execution Time	Arrival Time
0	75	0
1	40	10
2	25	10
3	20	80
4	45	85



RR: Average waiting time calculation



RR: Average turnaround time calculation

Suppose that the given ahead processes arrive for execution at time indicated-

Process	Arrival Time	Burst Time
P1	0.0	8
P2	0.4	4
P3	1.0	1

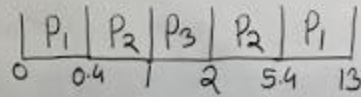
Calculate average turnaround time, average waiting time and throughput-

- (i) FCFS
- (ii) SRTF
- (iii) Preemptive SJF

Ans.

SRTF: Shortest remaining time first,

SRTF \Rightarrow Shortest remaining time first



Gantt Chart

Waiting time \Rightarrow

$$P_1 = (0-0) + (5.4-0.4) = 0.5$$

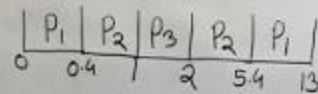
$$P_2 = (0.4-0.4) + (2-1) = 0.1$$

$$P_3 = (1-1) = 0$$

$$\text{Average waiting time} = \frac{0.5 + 0.1 + 0}{3} = 0.2$$

SRTF: Average waiting time

SRTF \Rightarrow Shortest remaining time first



Gantt Chart

Turn around time \Rightarrow

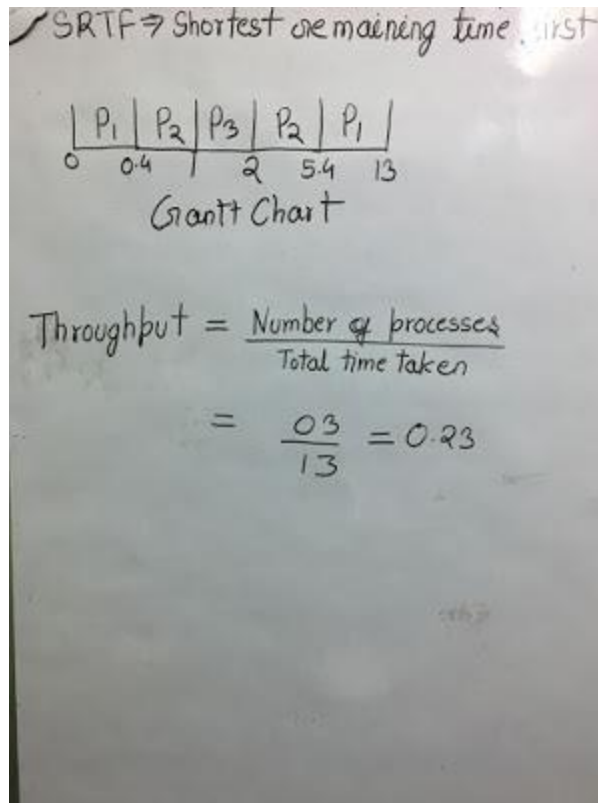
$$P_1 = 13 - 0 = 13$$

$$P_2 = 5.4 - 0.4 = 0.5$$

$$P_3 = 2 - 1 = 1$$

$$\begin{aligned} \text{Total turn around time} &= \frac{13 + 0.5 + 1}{3} \\ &= \frac{14.5}{3} = 4.83 \end{aligned}$$

SRTF: Total turn around time



SRTF: Throughput

Assume you have the following jobs to execute with one processor-

Job	Execution Time	Arrival Time
0	75	0
1	40	10
2	25	10
3	20	80
4	45	85

Suppose FCFS and Round-Robin algorithms are used. Time quantum of 15. Draw Gantt chart and calculate waiting and average turnaround time.

Ans.

FCFS: First come first serve,

FCFS (First come first served) is an operating system process scheduling algorithm that automatically executes queued requests and processes by the order of their arrival.

With first come first served, what comes first is executed first, the next request in line will be executed once the request before it is complete.

FCFS is also known as:

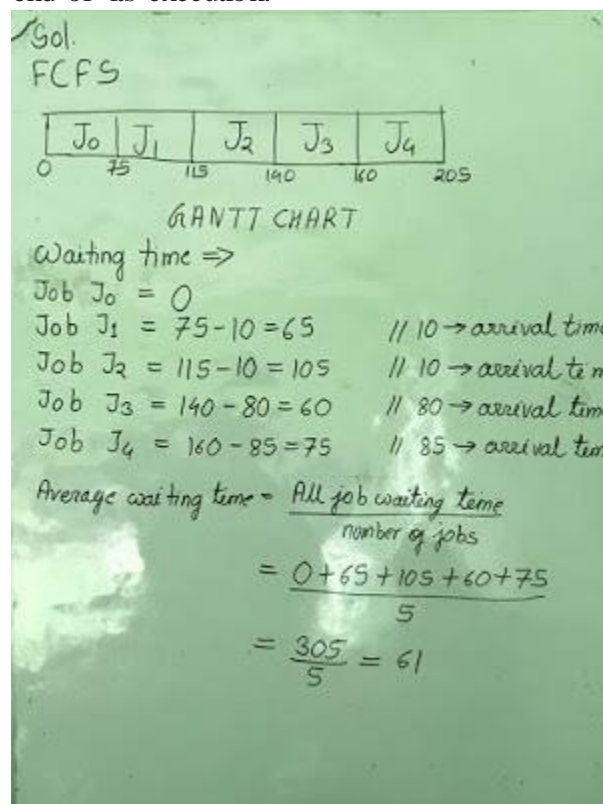
FIFO (First in first out)

FCFS (First come first choice)

In above question execution will be in their arrival order. That will be Job0, Job1, Job2, Job3, Job4. See below the solution.

Waiting time: Waiting time here means time taken by the process after its entering and not in execution.

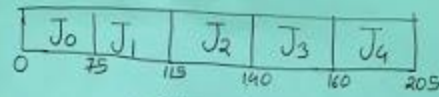
Turnaround time: Here turnaround time means total time taken by the process from entering inside the CPU to the till end of its execution.



FCFS: Average time calculation

Sol.

FCFS



GRANTT CHART

Turn around time \Rightarrow

$$\text{Job } J_0 = 75$$

$$\text{Job } J_1 = \text{Dispatch time} - \text{arrival time} = 115 - 10 = 105$$

$$\text{Job } J_2 = 140 - 10 = 130$$

$$\text{Job } J_3 = 160 - 80 = 80$$

$$\text{Job } J_4 = 205 - 85 = 120$$

$$\text{Average turn around time} = \frac{\text{All turn around times}}{\text{number of jobs}}$$

$$= \frac{75 + 105 + 130 + 80 + 120}{5}$$

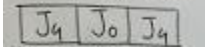
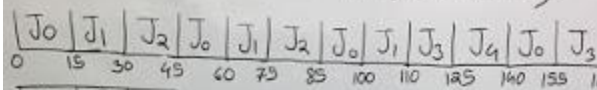
$$= \frac{510}{5} = 102$$

FCFS: Total Turnaround time calculation

RR: Round Robin,

Sol.

ROUND ROBIN ALGORITHM \Rightarrow (Quantum = 15)



Grantt Chart

Waiting Time \Rightarrow

$$\text{Job } J_0 = 0 + (45 - 15) + (85 - 60) + (140 - 100) + (175 - 155) = 0 + 30 + 25 + 40 + 20 = 115$$

$$\text{Job } J_1 = (15 - 10) + (60 - 30) + (100 - 75) = 05 + 30 + 25 = 60$$

$$\text{Job } J_2 = (30 - 10) + (75 - 45) = 20 + 30 = 50$$

$$\text{Job } J_3 = (110 - 80) + (155 - 125) = 30 + 30 = 60$$

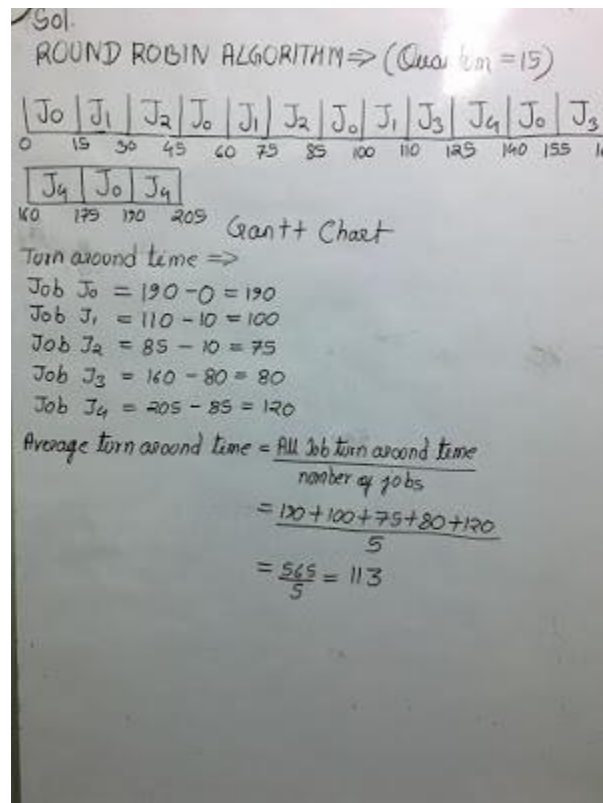
$$\text{Job } J_4 = (125 - 85) + (140 - 110) + (190 - 175) = 40 + 30 + 15 = 85$$

$$\text{Average waiting time} = \frac{\text{All Job waiting time}}{\text{number of jobs}}$$

$$= \frac{115 + 60 + 50 + 60 + 85}{5}$$

$$= \frac{360}{5} = 72$$

RR: Average waiting time calculation



RR: Total Turnaround time calculation

Consider the ahead processes with arrival time and execution time as indicated.

Process	Arrival Time	Burst Time
P1	0.0	8
P2	0.4	4
P3	1.0	1

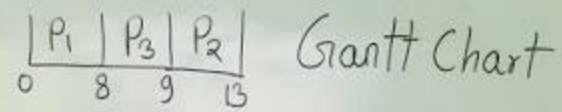
Calculate average turnaround time using-

- (i) FCFS
- (ii) SJF non-preemptive
- (iii) SJF non-preemptive

Ans.

SJF non-preemptive:

SJF (Non preemptive) \Rightarrow



Waiting time \Rightarrow

$$P_1 = 0$$

$$P_2 = (9 - 0.4) = 8.6$$

$$P_3 = (8 - 1) = 7$$

$$\begin{aligned}\text{Average waiting time} &= \frac{0 + 8.6 + 7}{3} \\ &= \frac{15.6}{3} \\ &= 5.2\end{aligned}$$

SJF (Non-preemptive): Average waiting time calculation