

# Solution Assignment # 2

Fall 2009

**Question 2:**

**Marks: 10**

Suppose there are number of process running on a system. New process in this system arrives at an average of ten processes per minute. Each process requires an average of 4 seconds of service time. Estimate the fraction of time the CPU is busy in a system with a single processor.

**Solution:**

Total time to arrive for 10 processes = 1 Minute = 60 seconds

Time to arrive for 1 process =  $60/10 = 6$  seconds

Time to Each process stays in CPU = 6 seconds.

Service time for 1 process = 4 seconds

Hence fraction of CPU busy time = Service time / staying time

$$= 4/6$$

$$= 0.66$$

$$\text{In \%} = 0.66 * 100/100 = 66\%$$

So the CPU is busy for 66% of the total time.

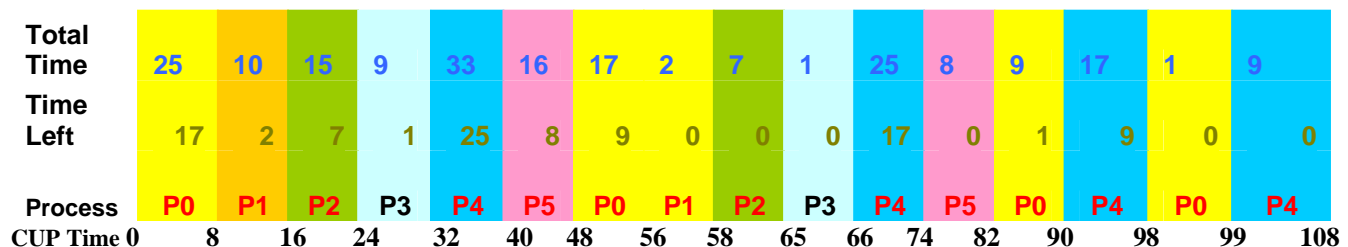
**Question 2:**

**Marks: 10**

The Round Robin algorithm has been applied on the following processes with quantum size=8 milliseconds. You have to answer the question given below related with processes. Calculate the average waiting time and average turnaround time for each process by using round robin algorithm?

Process	CPU burst time (milliseconds)	Arrival time (milliseconds)
P0	25	0
P1	10	5
P2	15	7
P3	9	8
P4	33	10
P5	16	10

**Gantt chart:**



**Turn around time for Process = (Finish Times - Arrival Times)**

$$\text{Turn around time for P0} = 99 - 0 = 99$$

$$\text{P1} = 58 - 5 = 53$$

$$\text{P2} = 65 - 7 = 58$$

$$\begin{aligned}
 P3 &= 66 - 8 = 58 \\
 P4 &= 108 - 10 = 98 \\
 P5 &= 82 - 10 = 72
 \end{aligned}$$

$$\begin{aligned}
 \text{Average turnaround time} &= (99 + 53 + 58 + 58 + 98 + 72) / 6 \\
 &= 438 / 6 \\
 &= 73 \text{ milliseconds}
 \end{aligned}$$

$$\text{Waiting time} = (\text{Turnaround time} - \text{CPU time} - \text{Arrival time})$$

$$\begin{aligned}
 P0 &= 99 - 25 - 0 = 74 \\
 P1 &= 58 - 10 - 5 = 43 \\
 P2 &= 65 - 15 - 7 = 43 \\
 P3 &= 66 - 9 - 8 = 49 \\
 P4 &= 108 - 33 - 10 = 65 \\
 P5 &= 82 - 16 - 10 = 56
 \end{aligned}$$

$$\begin{aligned}
 \text{Average waiting time} &= (74 + 43 + 43 + 49 + 65 + 56) / 6 \\
 &= 330 / 6 \\
 &= 55 \text{ milliseconds}
 \end{aligned}$$

**Question 3:**

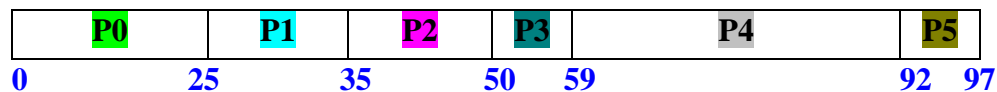
**Marks: 10**

Suppose you have to apply FCFS and SJF (non-preemptive) scheduling algorithms on the following given processes. Considering all the processes arrives in the ready queue within time 0 seconds. Calculate the average waiting time for each algorithm. You have to identify that which of these two algorithms is better reference to waiting time?

Process	CPU burst time (seconds)
P0	25
P1	10
P2	15
P3	9
P4	33
P5	5

**Solution:**

**Gantt chart for FCFS Algorithm:**

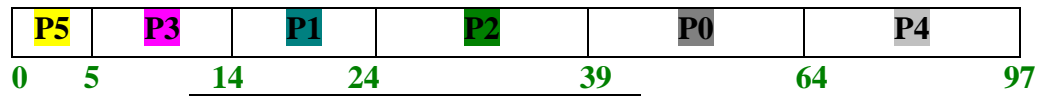


Process	Waiting time (Seconds)
P0	0
P1	25
P2	35
P3	50
P4	59
P5	92

$$\begin{aligned}\text{Total Waiting Time} &= (0+25+35+50+59+92) \\ &= 261 \text{ seconds}\end{aligned}$$

$$\text{Average waiting time} = 261/6 = 43.5 \text{ second.}$$

### Gantt chart for SJF Algorithm:



Process	Waiting time (Seconds)
P5	0
P3	5
P1	14
P2	24
P0	39
P4	64

$$\begin{aligned}\text{Total Waiting Time} &= (0+5+14+24+39+64) \\ &= 146 \text{ Seconds}\end{aligned}$$

$$\text{Average Waiting Time} = 24.3 \text{ Seconds}$$

**Conclusion:** In case of SJF scheduling algorithm each process waits for 24.3 seconds only while in case of FCFS scheduling algorithm each process waits for 43.5 seconds. Hence with reference to their average waiting time SJF Algorithm is better than FCFS algorithm.