Operating Systems
Digital Assignment (theory)

21BCB0107
B2+TB2
Shivam Dane
BCSE303L

Q1) Suppose a new process in a system arrives at an average of six processes per minute and each such process requires an average of 8 seconds of service time. Estimate the fraction of time the CPU is busy in a system with a single processor.

Sol) To estimate the fraction of time the CPU is busy in a system with a single processor, we need to consider the arrival rate and service time.

It is given that:
Average arrival rate of processes (λ) = 6 processes per minute
Average service time (s) = 8 seconds per process

To calculate the fraction of time the CPU is busy, we can use the following:

$$\text{CPU utilization} = \frac{\left(\text{Average arrival rate of processes} \times \text{Average service time}\right)}{60}$$

where CPU utilization represents the fraction of time the CPU was busy.

sub. values

$$\text{CPU utilization} = \frac{\left(6 \text{ processes/min} \times 8 \text{ sec/min}\right)}{60 \text{ seconds/min}} = \frac{48}{60}$$

$$\therefore \text{CPU utilization} = \frac{48}{60} \approx 0.8$$

Therefore, in a system with a single processor, the fraction of time the CPU is estimated to be busy is approximately 0.8 or 80%.

Q2) Assume you have the following jobs to execute with one processor, with the jobs arriving in the order listed here:

i	T(pi)	Arrival time
0	80	0
1	20	10
2	10	10
3	20	80
4	50	85

(a) Suppose a system uses RR scheduling with a quantum of 15. Create a Gantt chart illustrating the execution of these processes?

(b) What is the turnaround time for process p3?

(c) what is the average wait time for the processes?

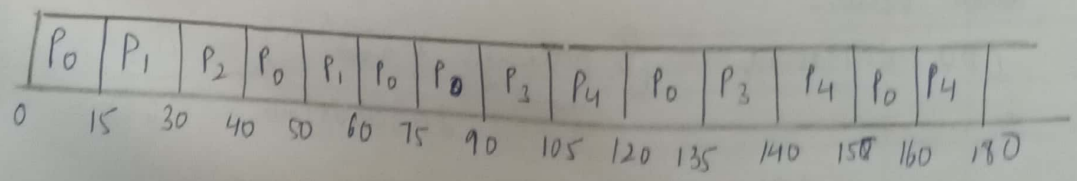
sol) Assume you have the following jobs to executed with one processor, with the jobs arriving in the order listed Below above:

In the given problem there are 5 jobs named P0, P1, P2, P3, and P4.

The time quantum = 15.

P0	P1	P2	P0	P1	P0	P0	P3	P4	P0	P3	P4	P0	P4

Gantt Chart



(b) TAT for P_3 = completion time of P_3 − Arrival time of P_3

= 140 − 80

$TAT_{[P3]} = 60$

(c)

Processes	TAT	Burst	WT (TAT − Burst)
P_0	160	80	80
P_1	50	20	30
P_2	30	10	20
P_3	60	20	40
P_4	95	50	45

∴ Average WT = $\frac{80+30+20+40+45}{5} = 43$

(3). Consider the following example:

Process	CPU time
P_1	3
P_2	5
P_3	2
P_4	4

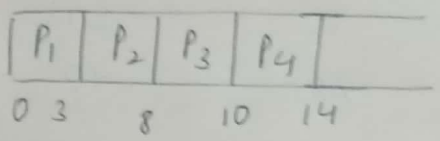
(i) Using FCFS & Round Robin (1ms Time slice) algorithm find the average waiting time and average turnaround time if the order is P1, P2, P3, P4 and plot the Gantt chart.

(ii) Using SJF algorithm find the average waiting time and average turnaround time and plot the gantt chart.

Q ① using FCFS

Processes	Burst	completion	TAT	WT
P_1	3	3	3	0
P_2	5	8	8	3
P_3	2	10	10	8
P_4	4	14	14	10

Gantt chart:



Average TAT = $\frac{3+8+10+14}{4} = 8.75$

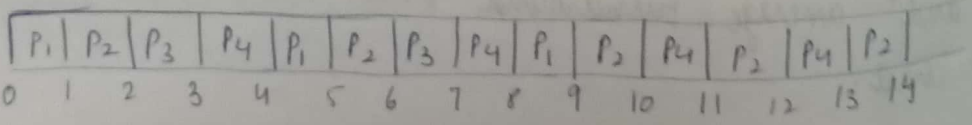
Average WT = $\frac{0+3+8+10}{4} = 5.25$

using Round Robin,

Processes	Burst
P_1	3
P_2	5
P_3	2
P_4	4

Time ~~qu~~ quantum = 1 ms

Gantt chart:



Process	Burst	completion	TAT	WT
P_1	3	9	9	6
P_2	5	14	14	9
P_3	2	7	7	5
P_4	4	13	13	9

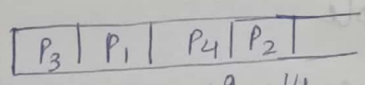
$$\text{Avg. TAT} = \frac{9+14+7+13}{4} = 10.75$$

$$\text{Avg. WT} = \frac{6+9+5+9}{4} = 7.25$$

(ii) SJF

Processes	Burst
P_1	3
P_2	5
P_3	2
P_4	4

Gantt chart :



Process	Burst	completion	TAT	WT
P_1	3	5	5	2
P_2	5	14	14	9
P_3	2	2	2	0
P_4	4	9	9	5

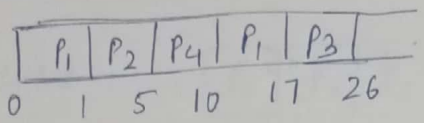
$$\text{Average TAT} = \frac{5+14+2+9}{4} = 7.5$$

$$\text{Avg. WT} = \frac{2+9+0+5}{4} = 4$$

4) Using preemptive SJF algo. find the Avg WT and plot gantt chart.

Process	Arrival	Burst
P_1	0	8
P_2	1	4
P_3	2	9
P_4	3	5

Gantt chart:



Process	Arrival	Burst	completion	TAT	WT
P_1	0	8	17	17	9
P_2	1	4	5	4	0
P_3	2	9	26	24	15
P_4	3	5	10	7	2

Average waiting time $= \frac{9+0+15+2}{4} = 6.5$

Q5) Consider the following example

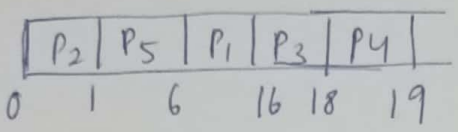
Process	Burst time	Priority
P_1	10	3
P_2	1	1
P_3	2	3
P_4	1	4
P_5	5	2

Apply priority based scheduling algorithm to find the average waiting time and plot the Gantt chart.

Sol)

Process	Burst	priority
P_1	10	3
P_2	1	1
P_3	2	3
P_4	1	4
P_5	5	2

gantt chart:



Process	Burst	Completion	TAT	WT
P_1	10	16	16	6
P_2	1	1	1	0
P_3	2	18	18	16
P_4	1	19	19	18
P_5	5	6	6	1

$\therefore$ Average. $WT = \frac{6+0+16+18+1}{5} = 8.2$