King Saud University
Department of Computer Science
CSC227: Operating Systems
Tutorial No. 5

Q 1.
Consider the following set of processes, with the length of the CPU-burst time given in milliseconds:

Process	Burst Time	Priority
P1	10	3
P2	1	1
P3	2	3
P4	1	4
P5	5	2

The processes are assumed to have arrived in the order P1, P2, P3, P4, P5, all at time 0.

a) Draw four Gantt charts illustrating the execution of these processes using FCFS, SJF, a non-pre-emptive priority (a smaller priority number implies a higher priority), and RR (quantum = 1) scheduling.
b) What is the turnaround time of each process for each of the scheduling algorithms in part a?
c) What is the waiting time of each process for each of the scheduling algorithms in part a?
d) Which of the schedules in part a results in the minimal average waiting time (over all processes)?

a) Gantt charts

FCFS

P1	P2	P3	P4	P5
10	11	13	14	19

SJF

P2	P4	P3	P5	P1
1	2	4	9	19

Priority

P2	P5	P1	P3	P4
1	6	16	18	19

RR

P1	P2	P3	P4	P5	P1	P3	P5	P1	P5	P1	P5	P1	P5	P1	P1	P1	P1	P1
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

b)

c) <u>Turnaround time</u>

Turnaround time = Finish time – Arrival time

Process	FCFS	SJF	Priority	RR
P1	10	19	16	19
P2	11	1	1	2
P3	13	4	18	7
P4	14	2	19	4
P5	19	9	6	14

d) <u>Waiting time</u>

e) Waiting time = Finish time – Burst time

Process	FCFS	SJF	Priority	RR
P1	0	9	6	9
P2	10	0	0	1
P3	11	2	16	5
P4	13	1	18	3
P5	14	4	1	9

f) SJF has the smallest average waiting time = 3.2

Q 2.

Suppose that the following processes arrive for execution at the times indicated. Each process will run the listed amount of time. In answering the questions, use non-preemptive scheduling and base all decisions on the information you have at the time the decision must be made.

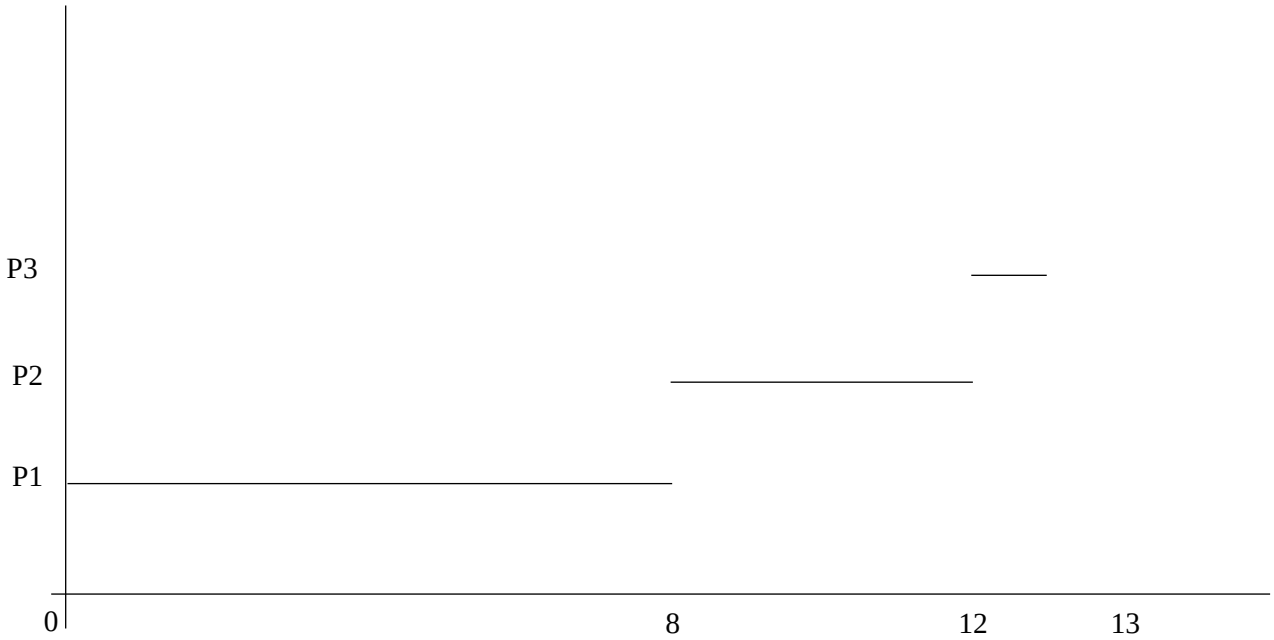
Process	Arrival Time	Burst Time
P1	0.0	8
P2	0.4	4
P3	1.0	1

a) What is the average turnaround time for these processes with the FCFS scheduling algorithm?

b) What is the average turnaround time for these processes with the SJF scheduling algorithm?

c) The SJF algorithm is supposed to improve performance, but notice that we chose to run process P1 at time 0 because we did not know that two shorter processes would arrive soon. Compute what the average turnaround time will be if the CPU is left idle for the first 1 unit and then SJF scheduling is used. Remember that processes P1 and P2 are waiting during this idle time, so their waiting time may increase. This algorithm could be known as future-knowledge scheduling.

Q2 a)

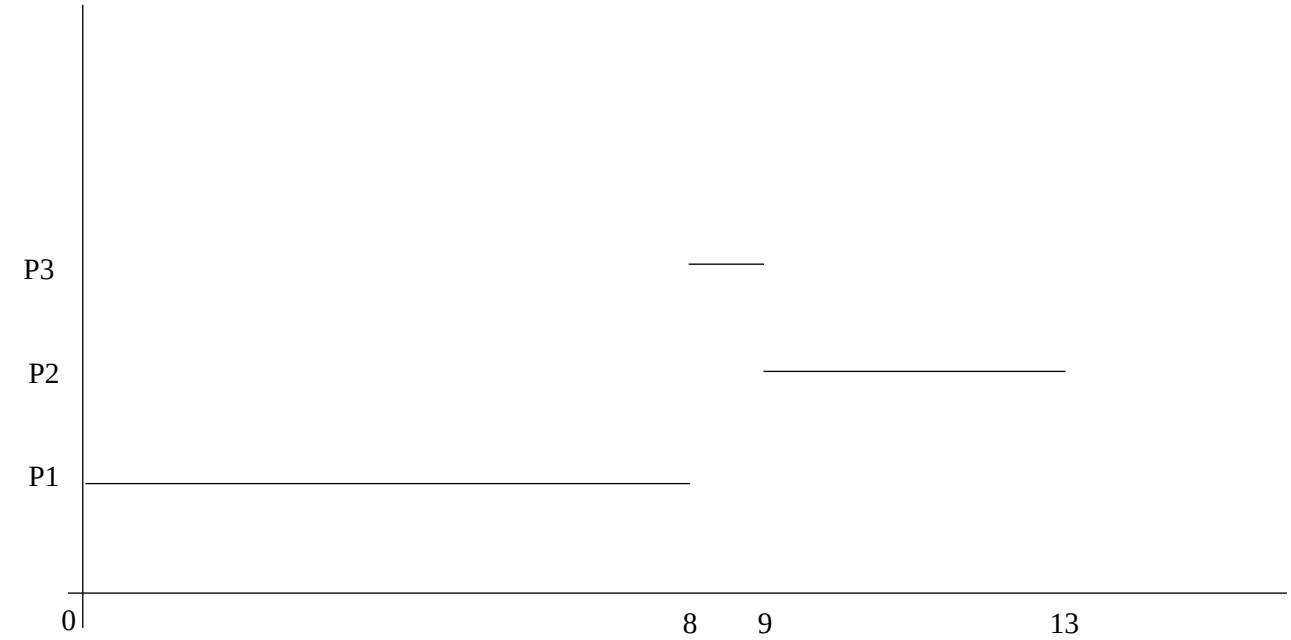


Turnaround time = Finish time – Arrival time

TT1 = 8 – 0 = 8, TT2 = 12 - 0.4 = 11.6, TT3 = 13 – 1 = 12

$\Rightarrow$ TTavg = 31.6/3 = 10.53

Q2 b)

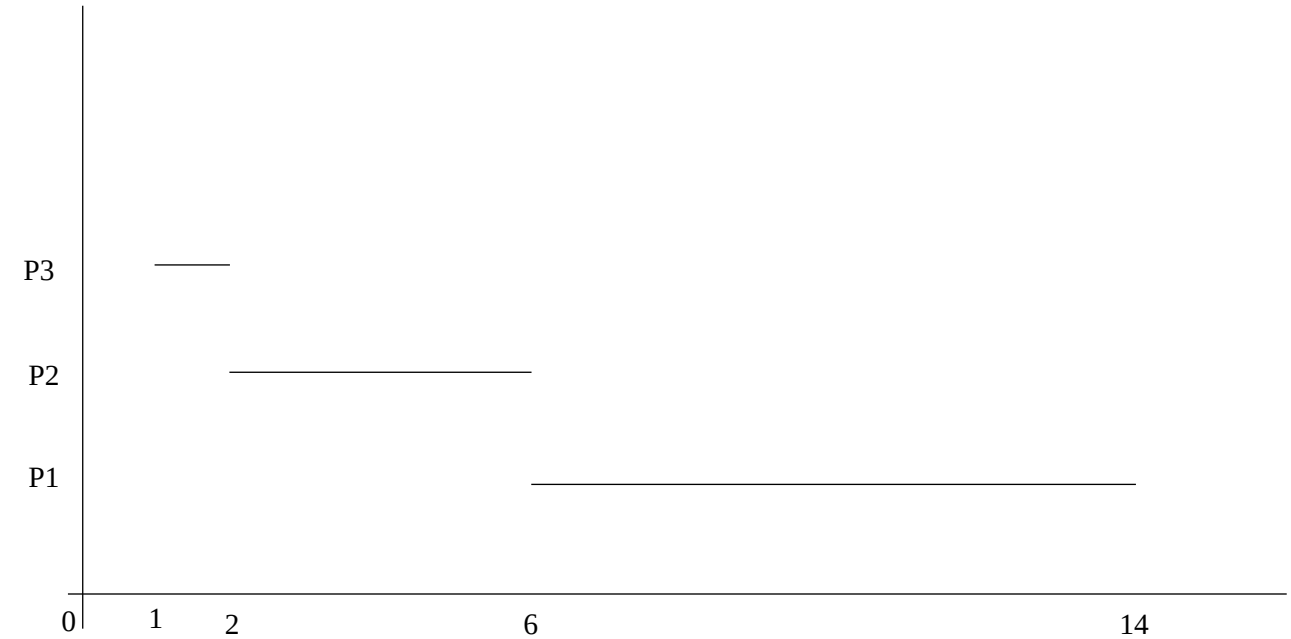


Turnaround time = Finish time – Arrival time

TT1 = 8 – 0 = 8, TT2 = 13 - 0.4 = 12.6, TT3 = 9 – 1 = 8

$\Rightarrow TT_{avg} = 28.6/3 = 9.53$

Q2 c



TT1 = 14 – 0 = 14, TT2 = 6 - 0.4 = 5.6, TT3 = 2 – 1 = 1

$\Rightarrow$ TTavg = 20.6/3 = 6.67

Q 3.

Given the following jobs and using Round Robin Scheduling,

Process	Arrival Time	Burst Time
P1	0	6
P2	5	2
P3	8	10
P4	13	4
P5	15	7

a) Show an X-Y diagram the scheduling of processes if quantum=2

b) What is the average turnaround time?

c) Now solve it for FCFS scheduling.

Q 4.

Let us consider a pre-emptive priority-based CPU scheduling, where 0 is the highest priority.

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

a) Draw an X-Y diagram showing the scheduling of the 5 jobs.

b) Compute the average waiting time.

c) What is the major problem with priority scheduling? What is the solution of the problem?