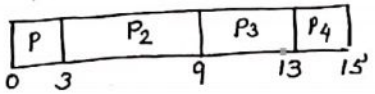
CHAPTER-5

Problems ~~chapter 5~~

1. Consider the following set of processes that arrive at time 0, with the length of the CPU burst given in msecs. If the processes arrive in the order P_1, P_2, P_3 & P_4. Draw Gantt chart for FCFS. obtain waiting time for each process, find avg waiting time, turnaround time of each processes and avg turn around time.

Process	Burst time
P_1	3
P_2	6
P_3	4
P_4	2

Soln: (i) Gantt chart



(ii) waiting time

Process	waiting time
P_1	0
P_2	3
P_3	9
P_4	13

(iii) Avg waiting time

$$\text{Avg wait time} = \frac{\text{waiting time of all processes}}{\text{NO of processes}}$$

$$= \frac{0+3+9+13}{4}$$

$$= 25/4$$

$$= 6.25 \text{ msecs}$$

(iv) Turnaround time:

It is obtained by subtracting the time the process entered the system from the terminated. Entered time is '0' for all processes

Process	T.A time (Burst time + waiting time)
P_1	3+0 = 3
P_2	6+3 = 9
P_3	4+9 = 13
P_4	2+13 = 15

(v) Avg TAT (Turn Around Time)

$$= \frac{3+9+13+15}{4}$$

$$= 10 \text{ msecs}$$

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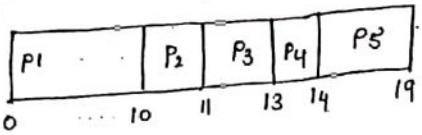
(2) Consider the following set of processes, with the length of the CPU burst given in msecs:

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

The processes are assumed to have arrived in the order P_1, P_2, P_3, P_4, P_5 all time '0'.

(i) Draw gantt chart that illustrates the exec of these processes. using FCFS.
(ii) what is the TAT?
(iii) what is the waiting time of each process?
(iv) what is avg waiting time?

(i) Gantt chart :



(ii) waiting time

Process	W.T
P_1	0
P_2	10
P_3	11
P_4	13
P_5	14

(iv) Avg waiting time:

$$= \frac{0+10+11+13+14}{5}$$

$$= 9.6 \text{ msecs}$$

(ii) TAT

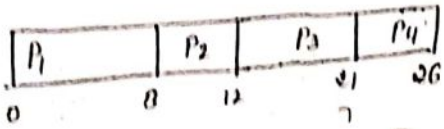
Process	TAT (B.T+W.T)
P_1	10+0 = 10
P_2	1+10 = 11
P_3	2+11 = 13
P_4	1+13 = 14
P_5	5+14 = 19

Average TAT = $\frac{10+11+13+14+19}{5}$ = 13.4 msecs

3) Solve the following example calculate average TAT and avg waiting time. using FCFS.

Process	Arrival Time	Burst time
P_1	0	8
P_2	1	4
P_3	2	9
P_4	3	6

(i) Gantt chart:



(ii) Waiting Time:

Process	Waiting Time (Alloted − Arrival)
P_1	0 − 0 = 0
P_2	8 − 1 = 7
P_3	12 − 2 = 10
P_4	21 − 3 = 18

(iii) Average waiting time

$\frac{0+7+10+18}{4} = 8.75$ msecs.

(iv) Turn Around Time (TAT) Burst time + Waiting time

Process	TAT
P_1	8+0 = 8
P_2	4+7 = 11
P_3	9+10 = 19
P_4	6+18 = 23

(v) Average TAT:

$= \frac{8+11+19+23}{4}$

$= 61/4$

$= 15.25$ msecs.

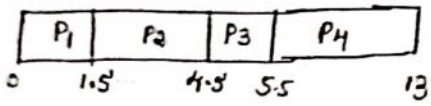
4) The following processes arrive for exec at times indicated below: (July/Aug 2017)

(10M)

Process	Arrival Time	Burst time
P_1	0	1.5
P_2	1.5	3
P_3	3	1
P_4	3	7.5

Draw Gantt chart and calculate average waiting time. (use FCFS)

Ans: Gantt chart



Average waiting time:

$$\frac{(0-0)+(1.5-1.5)+(4.5-3)+(5.5-3)}{4}$$

$$= \frac{0+0+1.5+2.5}{4}$$

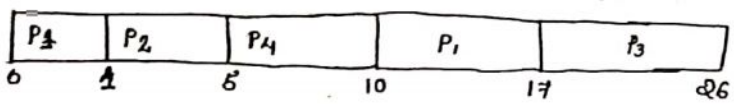
$$= 1 \text{ msec}.$$

ATAT: $\frac{(1.5+0)+(3+0)+(1+1.5)+(7.5+2.5)}{4} = \frac{1.5+3+4.5+10}{4} = 4.75$ msec

5) For the following problem, find out average wait time using SRTF

	A.T	B.T
P_1	0	8
P_2	1	4
P_3	2	9
P_4	3	5

Gantt chart:



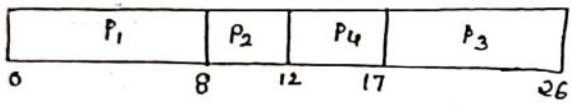
Process P_1 is started at time 0, since it is the only process in the Q. Process P_2 arrives at time 1. The remaining time for process P_1 (7 ms) is larger than the time required by process P_2 (4 ms). So process P_1 is preempted and process P_2 is scheduled.

∴ Average waiting time : $\frac{(10-1)+(1-1)+(17-2)+(5-3)}{4} = 6.5$ msecs

(ATAT = 13 msecs)

Non preemptive scheduling: (same problem as above)

Gantt chart:



Wait time:

Process	W.T (Alloted - Arrival)
P_1	0 - 0 = 0
P_2	8 - 1 = 7
P_3	17 - 2 = 15
P_4	12 - 3 = 9

Average wait time

$= \frac{0+7+15+9}{4}$

$= 7.75$ msec //

TAT:

Process	TAT (B.T + W.T)
P_1	8+0 = 8
P_2	4+7 = 11
P_3	9+15 = 24
P_4	5+9 = 14

Average ~~wait time~~ TAT

$\frac{8+11+24+14}{4}$

$= 14.25$ msecs //

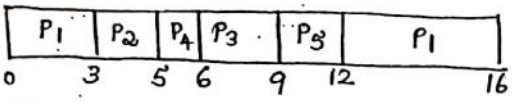
(6) Consider the following set of processes with the length of the CPU burst time given in msecs. (Jan/Feb-2005, 10m)

Process	Arrival Time	Burst time
P_1	0	7
P_2	3	2
P_3	4	3
P_4	4	1
P_5	5	3

(i) Draw Gantt chart illustrating SRTF (Shortest Remaining Time First).

(ii) Compute waiting time, AWT, TAT and ATAT.

Soln: SRTF ⇒ Preemptive SJF



Waiting time

Process	W.T
P_1	12-3 = 9
P_2	3-3 = 0
P_3	6-4 = 2
P_4	5-4 = 1
P_5	9-5 = 4

Turn Around Time

Process	TAT
P_1	7+9 = 16
P_2	2+0 = 2
P_3	3+2 = 5
P_4	1+1 = 2
P_5	3+4 = 7

$$AWT = \frac{9+0+2+1+4}{5}$$

$$= 16/5$$

$$= 3.2 \text{ msecs.}$$

$$ATAT = \frac{16+2+5+2+7}{5}$$

$$= 6.4 \text{ msecs.}$$

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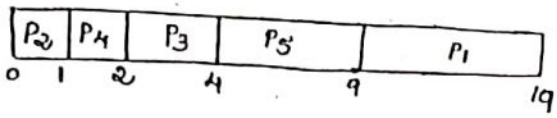
(7) For the following set of processes find the average waiting time and TAT using Gantt chart (SJF)

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

Gantt chart:



Wait time

P_1	9
P_2	0
P_3	2
P_4	1
P_5	4

Average wait time: $\frac{9+0+2+1+4}{5} = \frac{16}{5} = 3.2$ msec.

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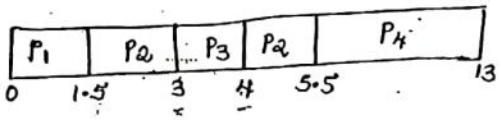
(8) Following processes arrive for exec at times indicated:

Draw Gantt chart and calculate AWT for SRTF scheduling.

Process	A.T	B.T
P_1	0	1.5
P_2	1.5	3 1.5
P3	3	1.
P_4	3	75

⇒ Gantt chart:



Wait time:

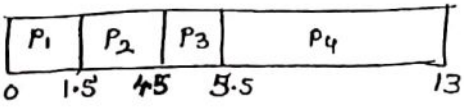
Process	W.T
P_1	0
P_2	4-3 = 1 ((1.5-1.5)+(4-3))
P_3	3-3 = 0
P_4	5.5-3 = 2.5

AWT = $\frac{0+1+0+2.5}{4}$

= 0.875 msec.

Nonpreemptive scheduling:

Gantt chart:



AWT = $\frac{(0-0)+(1.5-1.5)+(4.5-3)+(5.5-3)}{4} = \frac{0+0+1.5+2.5}{4} = 1$ msec

9. Consider the following set of processes with CPU burst time in msec.

Process	Arrival Time (ms)	Burst time
P_0	0	6
P_1	1	3
P_2	2	1
P_3	3	4

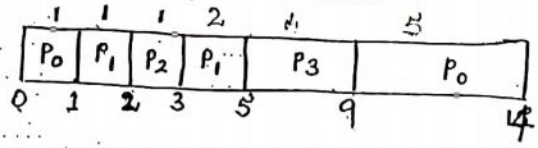
(i) Draw the Gantt chart illustrating the execution of above processes using SRTF and non-preemptive SJF.

(ii) Find the TAT for each processes for SRTF & SJF, hence show that SRTF is faster than SJF.

[Jan/Feb-2008, 10M]

→ (i) SRTF (Shortest Remaining Time First):

Gantt chart:



Wait time: $\frac{P1 + P2 + P3 + P4}{4} = \frac{[(0-0)+(9-1)] + (3-2)+(2-2)+(5-3)}{4}$

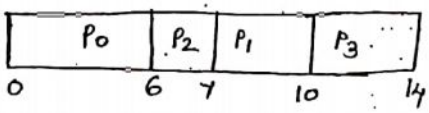
AWT $= \frac{8+1+0+2}{4} = 2.75$ ms //

TAT: P0 ⇒ 6+8 = 14
P1 ⇒ 3+1 = 4
P2 ⇒ 1+0 = 1
P3 ⇒ 4+2 = 6

ATAT = 25/4 = 6.25 msec.

(ii) Non-preemptive SJF

Gantt chart:



Wait time: For $P_0 \Rightarrow 0$
$P_1 \Rightarrow 7-1 = 6$
$P_2 \Rightarrow 6-2 = 4$
$P_3 \Rightarrow 10-3 = 7$

AWT $= \frac{0+6+4+7}{4} = 4.25$ ms //

TAT: For $P_0 \Rightarrow 6+0 = 6$.
$P_1 \Rightarrow 3+6 = 9$
$P_2 \Rightarrow 1+4 = 5$
$P_3 \Rightarrow 4+7 = 11$

ATAT $= \frac{6+9+5+11}{4} = 7.75$ ms //.

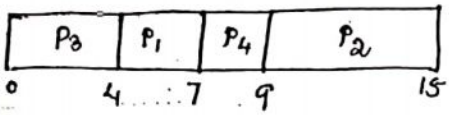
Above calculations show, SRTF is faster than SJF //.

10. Consider the following processes which are arrived at time 0. Draw Gantt chart, find wait time and TAT using priority scheduling.

(low value → high priority)

process	Burst time	Priority
P_1	3	2
P_2	6	4
P_3	4	1
P_4	2	3

(i) Gantt chart:



(ii) wait time

P_1	4
P_2	9
P_3	0
P_4	7

$AWT = \frac{4+9+0+7}{4}$

$= 5$ msecs

(iii) Turnaround time

P_1	3+4 = 7
P_2	6+9 = 15
P_3	4+0 = 4
P_4	7+2 = 9

$ATAT = \frac{7+15+4+9}{4}$

$= 8.75$ msecs.

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11. Consider the following set of processes with the length of the CPU burst time given in msecs.

Process	Arrival Time	B.T	Priority
P_1	0	7	3
P_2	3	2	2
P_3	4	3	1
P_4	5	1	1
P_5	8	3	3

(i) Draw Gantt charts illustrating preemptive priority and RR (time slice = 1ms)

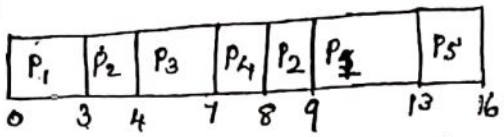
(ii) Compute wait time & TAT

(iii) Find out the time of which there are max. no of processes in the Ready Q in the above scenario.

(Jan/Feb-2005, 10M)

(i) Preemptive Priority:

Gantt chart



Wait Time & TAT

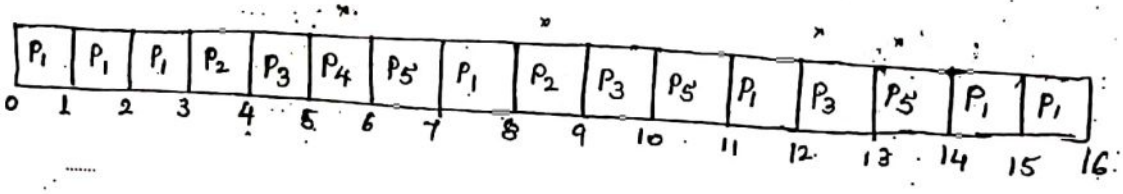
Process	W.T.	T.A.T
P_1	9-3=6	7+6=13
P_2	8-4=4	2+4=6
P_3	4-4=0	3+0=3
P_4	7-5=2	2+1=3
P_5	13-5=8	3+8=11

$AWT = \frac{6+4+0+2+8}{5} = 4$ msecs

$TAT = \frac{13+6+3+3+11}{5} = 7.2$ msecs

(ii) Round Robin Scheduling:

Gantt chart:



Wait Time & TAT:

Process	W.T	T.A.T
P_1	9	9+7=16
P_2	4	4+2=6
P_3	6	6+3=9
P_4	5	5+1=6
P_5	5	5+3=8

Wait time's calculation:

$P_1 \Rightarrow (14-12)+(11-8)+(7-3)=9$

$P_2 \Rightarrow (8-4)=4$

$P_3 \Rightarrow (12-10)+(9-5)=6$

$P_4 \Rightarrow 5$

$P_5 \Rightarrow (13-11)+(10-7)=5$

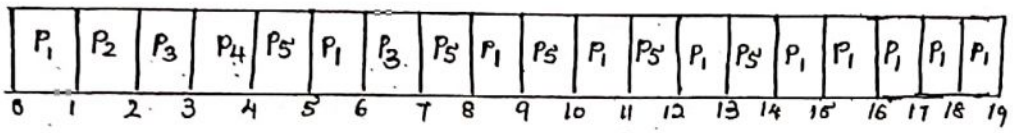
$A.W.T = \frac{9+4+6+5+5}{5} = 5.8$ msecs

$ATAT = \frac{16+6+9+6+8}{5} = 9$ msecs.

(13) Solve using RR scheduling time slice = 1ms

Process	B.T
P_1	10
P_2	1
P_3	2
P_4	1
P_5	5

(i) Gantt chart:



(ii) Wait Time:

$P_1 = 0 + (14-13) + (12-11) + (10-9) + (8-6) + (5-1) = 9$

$P_2 = 1 + (\quad) = 1$

$P_3 = 2 + (6-3) = 5$

$P_4 = 3$

$P_5 = 4 + (13-12) + (11-10) + (9-8) + (7-5) = 9$

AWT

$\frac{9+5+1+3+9}{5}$

$= 5.4$ units

(iii) TAT

$P_1 = 10+9 = 19$

$P_2 = 1+1 = 2$

$P_3 = 2+5 = 7$

$P_4 = 1+3 = 4$

$P_5 = 5+9 = 14$

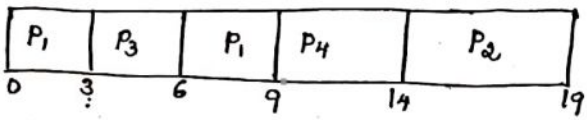
ATAT

$\frac{19+2+7+4+14}{5} = 9.2$ ms

(14) Solve the following using preemptive priority algm. (Higher value specifies higher priority)

Process	A.T	B.T	Priority
P_1	0.0	6	4
P_2	3.0	5	2
P_3	3.0	3	6
P_4	5.0	5	3

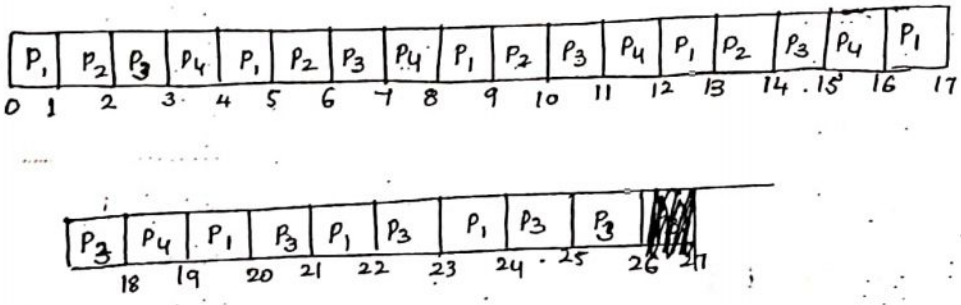
⇒ Gantt chart:



(12) Solve using RR time slice = 1 ms

Process	A.T	B.T
P_1	0	8
P_2	1	4
P_3	2	9
P_4	3	5

(i) Gantt chart



Wait time

$P_1 = 0 + (23-22) + (21-20) + (19-17) + (16-13) + (12-9) + (8-5) + (4-1) = 16$

$P_2 = (1-1) + (13-10) + (9-6) + (5-2) = 9$

$P_3 = (2-2) + 1 + 1 + 2 + 2 + 3 + 3 + 3 = 15$

$P_4 = (3-3) + 2 + 3 + 3 + 3 = 11$

T.AT = W.T + B.T

$P_1 = 16 + 8 = 24$

$P_2 = 9 + 4 = 13$

$P_3 = 15 + 9 = 24$

$P_4 = 11 + 5 = 16$

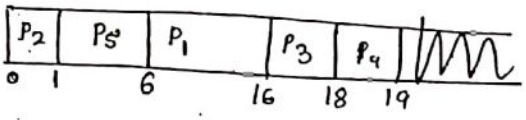
$ATAT = \frac{24 + 13 + 24 + 16}{4}$

$= 19.25$ ms

15. Solve using priority scheduling

Process	B.T	Priority
P_1	10	3
P_2	1	1
P_3	2	3
P_4	1	4
P_5	5	2

Gantt chart:



W.T & TAT

	W.T	TAT
P_1	6	16
P_2	0	1
P_3	16	18
P_4	18	19
P_5	1	6

$AWT = \frac{6+16+18+1}{5}$

$= \frac{41}{5}$

$= 8.2$ ms //

$ATAT = \frac{16+1+18+19+6}{5}$

$= \frac{60}{5}$

$= 8$ ms

⇒ continuation of problem 14

wait time for each processes:

$P_1 = (0-0)+(6-3) \Rightarrow 3$

$P_2 = 14-3 \Rightarrow 11$

$P_3 = 3-3 \Rightarrow 0$

$P_4 = 9-5 \Rightarrow 4$

A WT

$\frac{3+11+0+4}{4}$

$= 4.5$ msecs

Turn around time & ATAT

$P_1 \Rightarrow 6+3 = 9$

$P_2 \Rightarrow 5+11 = 16$

$P_3 \Rightarrow 3+0 = 3$

$P_4 \Rightarrow 5+4 = 9$

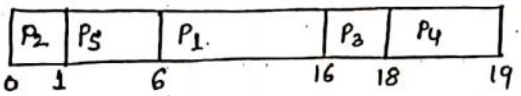
$ATAT = \frac{9+16+3+9}{4}$

$= 9.25$ msecs

(16) Solve using Priority scheduling

Process	B.T	Priority
P_1	10	3
P_2	1	1
P_3	2	4
P_4	1	5
P_5	5	2

Gantt chart:



W.T & TAT

	W.T	TAT
P_1	6	16
P_2	0	1
P_3	16	18
P_4	18	19
P_5	1	6

AWT

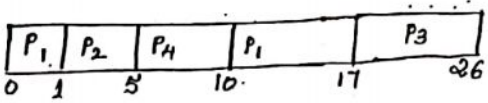
$$\frac{6+0+16+18+1}{5} = \frac{41}{5} = 8.2 \text{ ms}$$

$$ATAT = \frac{16+1+18+19+6}{5} = \frac{60}{5} = 12 \text{ ms}.$$

14. Solve the following problem using SRTF scheduling algm: calculate WT

Process	A.T	B.T
P_1	0	8
P_2	1	4
P_3	2	9
P_4	3	5

Gantt chart:



Wait time:

$P_1 \Rightarrow 0 + (10-1) = 9$

$P_2 \Rightarrow 0$

$P_3 \Rightarrow 17-2 = 15$

$P_4 \Rightarrow 5-3 = 2$

AWT:

$$\frac{9+0+15+2}{4}$$

$= 6.5$ secs.

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