

Modern Operating System Exercise 1

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Problem 1

a) The Gantt charts are drawn as follows.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
FCFS																			
	P_1										P_2	P_3	P_4	P_5					
nonpreemptive SJF																			
	P_1										P_2	P_4	P_3	P_5					
preemptive SJF																			
	P_1	P_2	P_3	P_4	P_5							P_1							
nonpreemptive priority																			
	P_1										P_2	P_5					P_3	P_4	
preemptive priority																			
	P_1	P_2	P_1			P_5						P_1				P_3	P_4		
RR (quantum=1)																			
	P_1	P_1	P_2	P_1	P_3	P_4	P_1	P_3	P_5	P_1	P_5	P_1	P_5	P_1	P_5	P_1	P_5	P_1	P_1
RR (quantum=3)																			
	P_1			P_2	P_3	P_1			P_4	P_5			P_1			P_5		P_1	

b) In this question, waiting time can be simplified as the difference between turnaround time and burst time.

Use $(t_{w1}, t_{w2}, t_{w3}, t_{w4}, t_{w5})$ to indicate the waiting time from processes P1 to P5 respectively. Here are the calculation results for each case.

- FCFS: $(t_{w1}, t_{w2}, t_{w3}, t_{w4}, t_{w5}) = (0, 8, 8, 9, 8)$, the average waiting time is $6.6ms$.
- nonpreemptive SJF: $(t_{w1}, t_{w2}, t_{w3}, t_{w4}, t_{w5}) = (0, 8, 9, 7, 8)$, the average waiting time is $6.4ms$.
- preemptive SJF: $(t_{w1}, t_{w2}, t_{w3}, t_{w4}, t_{w5}) = (9, 0, 1, 0, 0)$, the average waiting time is $2ms$.
- nonpreemptive priority: $(t_{w1}, t_{w2}, t_{w3}, t_{w4}, t_{w5}) = (0, 8, 13, 14, 5)$, the average waiting time is $8ms$.
- preemptive priority: $(t_{w1}, t_{w2}, t_{w3}, t_{w4}, t_{w5}) = (6, 0, 13, 14, 0)$, the average waiting time is $6.6ms$.
- RR (quantum=1): $(t_{w1}, t_{w2}, t_{w3}, t_{w4}, t_{w5}) = (9, 0, 3, 1, 6)$, the average waiting time is $3.8ms$.
- RR (quantum=3): $(t_{w1}, t_{w2}, t_{w3}, t_{w4}, t_{w5}) = (9, 1, 1, 5, 7)$, the average waiting time is $4.6ms$.

Table 1: the Average Waiting Time(AWT) of Different Algorithm

Algorithm	FCFS	np ¹ SJF	p ² SJF	np ¹ priority	p ² priority	RR(q=1)	RR(q=3)
AWT(ms)	6.6	6.4	2	8	6.6	3.8	4.6

¹ np means nonpreemptive.

² p means preemptive

- c) Use $(t_{t1}, t_{t2}, t_{t3}, t_{t4}, t_{t5})$ to indicate the turnaround time from processes P1 to P5 respectively. Here are the calculation results for each case.

- FCFS: $(t_{t1}, t_{t2}, t_{t3}, t_{t4}, t_{t5}) = (10, 9, 10, 10, 13)$, the average turnaround time is $10.4ms$.
- nonpreemptive SJF: $(t_{t1}, t_{t2}, t_{t3}, t_{t4}, t_{t5}) = (10, 9, 11, 8, 13)$, the average turnaround time is $10.2ms$.
- preemptive SJF: $(t_{t1}, t_{t2}, t_{t3}, t_{t4}, t_{t5}) = (19, 1, 2, 1, 5)$, the average turnaround time is $5.8ms$.
- nonpreemptive priority: $(t_{t1}, t_{t2}, t_{t3}, t_{t4}, t_{t5}) = (10, 9, 15, 15, 10)$, the average turnaround time is $11.8ms$.
- preemptive priority: $(t_{t1}, t_{t2}, t_{t3}, t_{t4}, t_{t5}) = (16, 1, 15, 15, 5)$, the average turnaround time is $10.4ms$.
- RR (quantum=1): $(t_{t1}, t_{t2}, t_{t3}, t_{t4}, t_{t5}) = (19, 1, 5, 2, 11)$, the average turnaround time is $7.6ms$.
- RR (quantum=3): $(t_{t1}, t_{t2}, t_{t3}, t_{t4}, t_{t5}) = (19, 2, 3, 6, 12)$, the average turnaround time is $8.4ms$.

Table 2: the Average Turnaround Time(ATT) of Different Algorithm

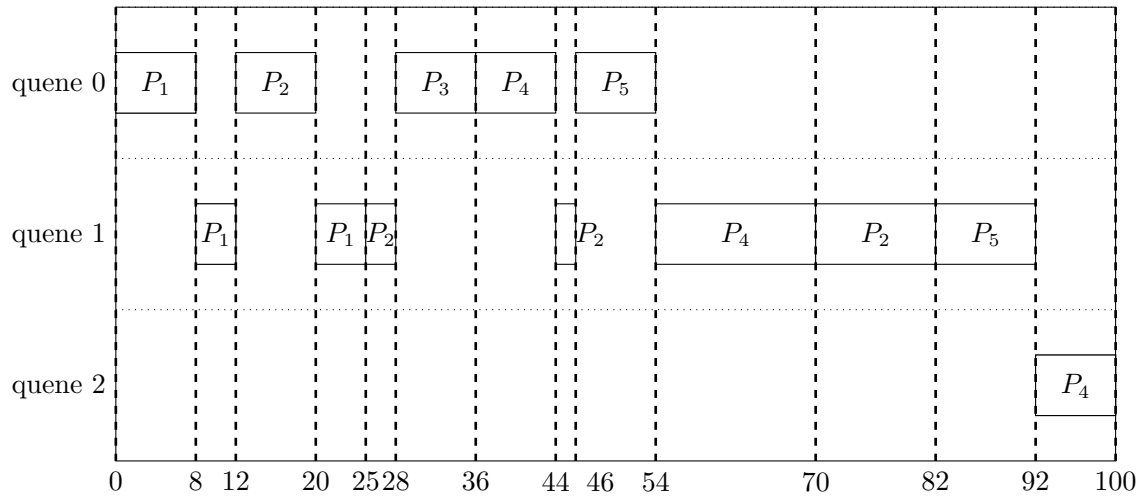
Algorithm	FCFS	np ¹ SJF	p ² SJF	np ¹ priority	p ² priority	RR(q=1)	RR(q=3)
ATT(ms)	10.4	10.2	5.8	11.8	10.4	7.6	8.4

¹ np means nonpreemptive.

² p means preemptive

Problem 2

a) The Gantt chart is drawn as follows.



b) The turnaround time is equal to the difference between the completion bursting time and the arrival time, and the waiting time is equal to the difference between the turnaround time and the burst time.

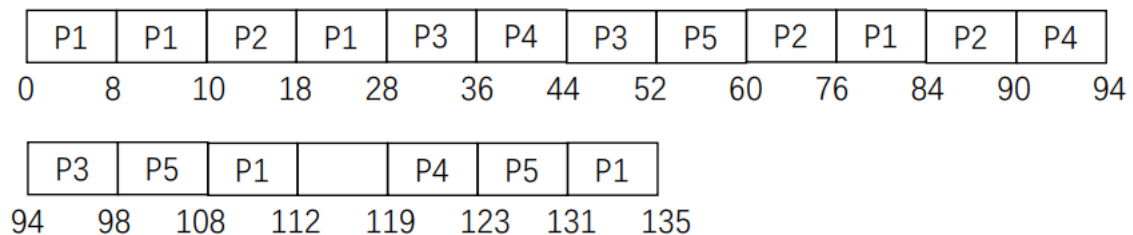
Use $(t_{w1}, t_{w2}, t_{w3}, t_{w4}, t_{w5})$ and $(t_{t1}, t_{t2}, t_{t3}, t_{t4}, t_{t5})$ to indicate the waiting and burst time from processes P1 to P5 respectively.

- $(t_{w1}, t_{w2}, t_{w3}, t_{w4}, t_{w5}) = (8, 45, 0, 32, 28)$, the average waiting time is $22.6ms$.
- $(t_{t1}, t_{t2}, t_{t3}, t_{t4}, t_{t5}) = (25, 70, 8, 64, 46)$, the average turnaround time is $42.6ms$

Problem 3

a) The Gantt chart is drawn as follows.

(The original answer is wrong, here are the solution from TA)



b) The turnaround time is equal to the difference between the completion bursting time and the arrival time, and the waiting time is equal to the difference between the turnaround time and the burst time.

- the average waiting time is $52.4ms$.
- the average turnaround time is $91.8ms$

Problem 4

The **(b).Shortest job first** and **(d).Priority** algorithm could result in starvation.

In the preemptive SJF algorithm, if new processes with shorter burst time arrive continuously and gaplessly, The existing processes in the ready queue that have long burst time will be unable to excute for a long time or permanently.

In preemptive priority algorithm, if new processes with higher priority arrive continuously and gaplessly, The existing processes in the ready queue that have low priority will be unable to excute for a long time or permanently.

As for the FCFS and Round Robin algorithm, the number of processes that arrive earlier is finite. Because there is no preemption, the new process only needs to wait for the processes in front of the queue to finish their burst time or complete their allocated time quantum. So that the FCFS and Round Robin could't result in starvation.