COMP2432 Operating Systems
Assignment 4

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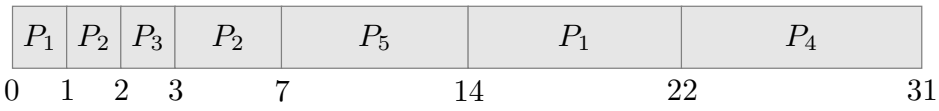
Question 1 CPU Scheduling

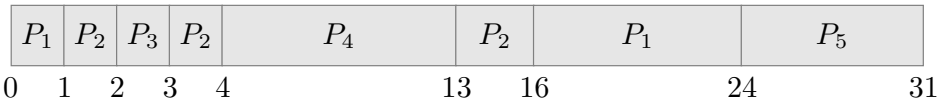
(a) The gantt chart of SRT:



The waiting time and turnaround time of each process:

Process	Waiting time	Turnaround time
P1	13	22
P2	1	6
P3	0	1
P4	18	27
P5	2	9

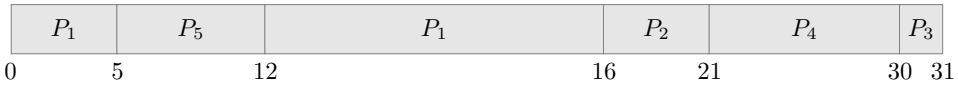
(b) The gantt chart of priority scheduling with preemption under Linux convention:



The waiting time and turnaround time of each process:

Process	Waiting time	Turnaround time
P1	15	24
P2	10	15
P3	0	1
P4	0	9
P5	19	26

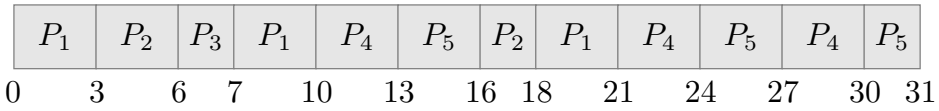
(c) The gantt chart of priority scheduling with preemption under Windows convention:



The waiting time and turnaround time of each process:

Process	Waiting time	Turnaround time
P1	7	16
P2	15	20
P3	28	29
P4	17	26
P5	0	7

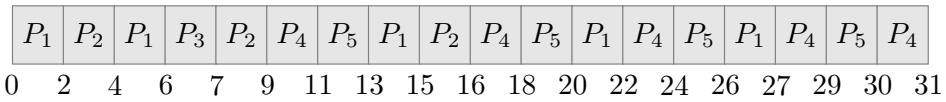
(d) The gantt chart of round robin scheduling with time quantum of 3:



The waiting time and turnaround time of each process:

Process	Waiting time	Turnaround time
P1	12	21
P2	12	17
P3	4	5
P4	17	26
P5	19	26

(e) The gantt chart of round robin scheduling with time quantum of 2:



The waiting time and turnaround time of each process:

Process	Waiting time	Turnaround time
P1	18	27
P2	10	15
P3	4	5
P4	18	27
P5	18	25

(f) The total weighted waiting time for SRT scheduling:

Weighting factor	Process	Waiting time
0.9	P1	11.7
	P2	0.9
	P3	0
	P4	18
	P5	2
0.8	P1	10.4
	P2	0.8
	P3	0
	P4	18
	P5	2

The total weighted waiting time for priority scheduling with preemption under Linux convention:

Weighting factor	Process	Waiting time
0.9	P1	13.5
	P2	8.19
	P3	0
	P4	0
	P5	19
0.8	P1	12
	P2	6.56
	P3	0
	P4	0
	P5	19

The total weighted waiting time for priority scheduling with preemption under Windows convention:

Weighting factor	Process	Waiting time
0.9	P1	6.3
	P2	15
	P3	28
	P4	17
	P5	0
0.8	P1	5.6
	P2	15
	P3	28
	P4	17
	P5	0

The total weighted waiting time for round robin scheduling with time quantum of 3:

Weighting factor	Process	Waiting time
0.9	P1	10.08
	P2	11
	P3	4
	P4	15.63
	P5	17.63
0.8	P1	8.32
	P2	10
	P3	4
	P4	14.32
	P5	15.32

The total weighted waiting time for round robin scheduling with time quantum of 2:

Weighting factor	Process	Waiting time
0.9	P1	13.7394
	P2	8.56
	P3	4
	P4	15.5831
	P5	15.927
0.8	P1	10.2784
	P2	7.24
	P3	4
	P4	13.5056
	P5	14.096

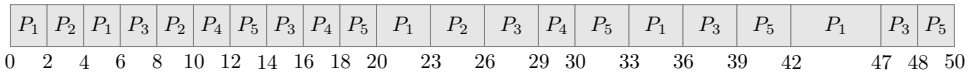
The total weighted waiting time for round robin scheduling with time quantum of 1:

Weighting factor	Process	Waiting time
0.9	P1	10.5431
	P2	9.3853
	P3	2
	P4	14.3514
	P5	12.8102
0.8	P1	5.7931
	P2	7.2848
	P3	2
	P4	11.0646
	P5	10.3306

Observation: the adaptation of the criterion of the total weighted waiting time highlights the influence of the response time. The smaller the weighting factor, the more the response time is emphasized. Meanwhile, the method of reducing the response time by reducing time quantum or increasing the number of preemptions may also increase the weighted time, even though the response time of the process are notably decremented, and such a trade-off should be considered.

Question 2 Multi-level Scheduling

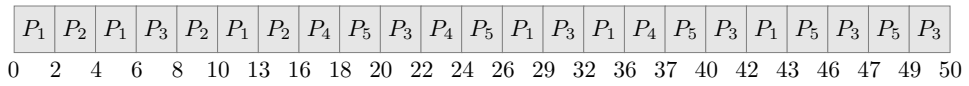
(a) The gantt chart of the fixed priority scheduling with the 3 queues:



The waiting time and turnaround time of each process:

Process	Waiting time	Turnaround time
P1	32	47
P2	18	25
P3	35	46
P4	21	26
P5	32	44

(b) The gantt chart of the time slicing scheduling with the 3 queues:

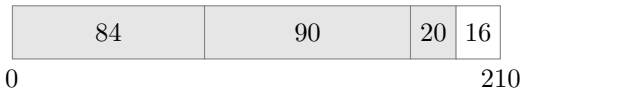


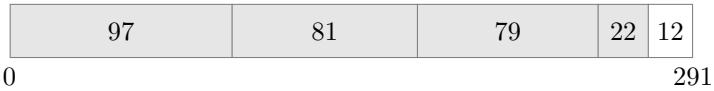
The waiting time and turnaround time of each process:

Process	Waiting time	Turnaround time
P1	34	43
P2	10	15
P3	47	48
P4	24	33
P5	37	44

Question 3 Contiguous Memory Allocation

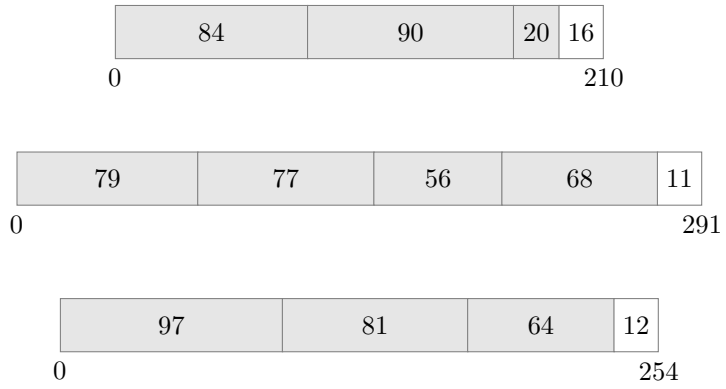
(a) Memory allocation using first-fit algorithm:





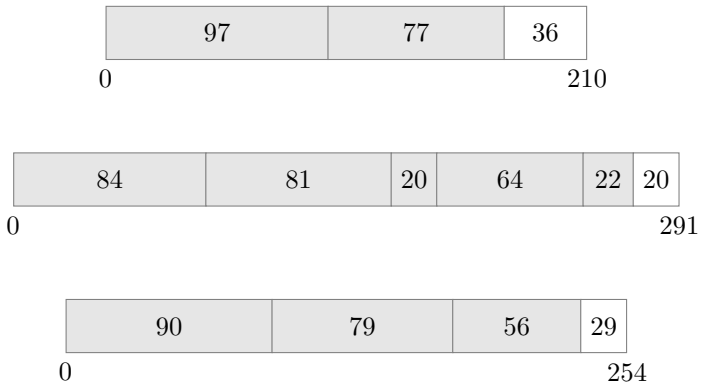
The request of 68K can not be satisfied.

(b) Memory allocation using best-fit algorithm:



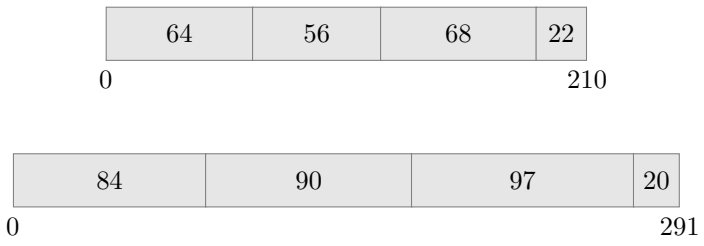
The requests of 38K and 22K can not be satisfied.

(c) Memory allocation using worst-fit algorithm:



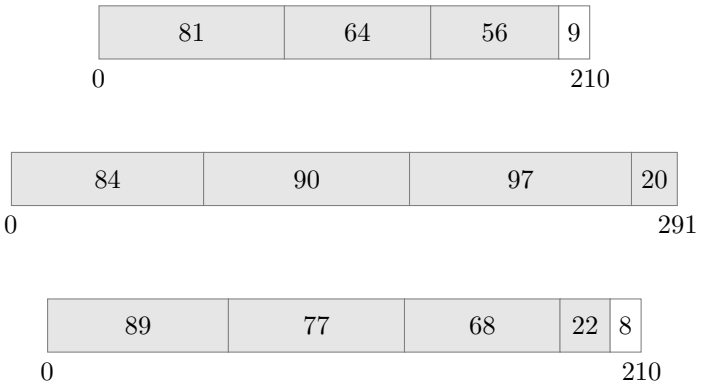
The requests of 68K and 38K can not be satisfied.

(d) One possible optimal allocation is as follows:



The piece of 38K can not be allocated, while the utilization is 97.74%.

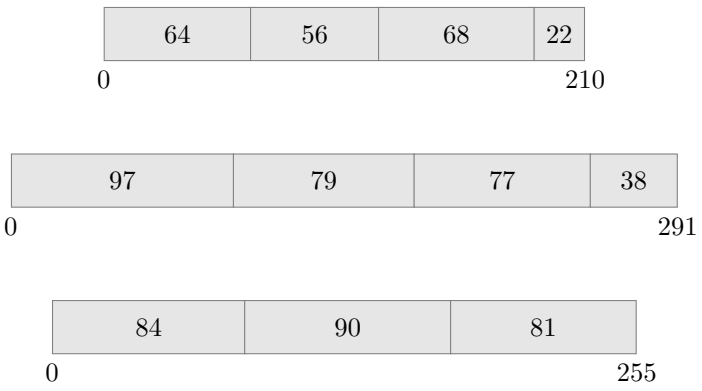
Another possible optimal allocation is as follows:



The piece of 38K can not be allocated, while the utilization is 97.74%.

The utilization of the first-fit, best-fit and worst-fit algorithms are 92.58%, 94.83% and 88.74% respectively.

(e) In the situation of 210K, 291K and 255K, there is a possible improvement in the utilization. The allocation is as follows:



The request of 20K can not be satisfied. The utilization is 100%.

(f) If there are at most 9 tasks for each kind of task, the situation is as follows:

S	x	y	z
800	0	8	7
775	9	4	5
570	0	7	6

(g) If there are no upper limit on the number of each type, the situation is as follows:

S	x	y	z
800	0	8	7
775	23	2	5
570	1	0	11

(h) If there are at most 9 and at least 1 tasks for each kind of task, the situation is as follows:

S	x	y	z
800	8	8	2
775	9	4	5
570	9	4	3

Question 4 Segmentation According to the given situation, there are 8 holes of size 11, 545, 297, 275, 755, 398, 451 and 568 respectively in the memory.

(a) Since the segments of the size 55, 103, 212 and 72 are in the hole of the size 545, the segment of the size 604 is in the hole of the size 755, and the segment of the size 352 is in the hole of the size 398, the segment table of the first-fit algorithm is as follows:

Segment	Base	Length
P0	1356	55
P1	3146	604
P2	1411	103
P3	1514	212
P4	1726	72
P5	4036	352
P6	2432	304

(b) Since the segments of the size 212 and 72 are in the hole of the size 297, the segments of the size 55 and 103 are in the hole of the size 275, the segment of the size 604 is in the hole of the size 604, and the segment of the size 352 is in the hole of the size 398, the segment table of the best-fit algorithm is as follows:

Segment	Base	Length
P0	2736	55
P1	3146	604
P2	2791	103
P3	2135	212
P4	2347	72
P5	4036	352
P6	2432	304

(c) Since the segments of the size 55 and 604 are in the hole of the size 755, the segments of the size 103, 72 and 352 are in the hole of the size 579, and the segment of the size 212 is in the hole of the size 545, the segment table of the worst-fit algorithm is as follows:

Segment	Base	Length
P0	3146	55
P1	3201	604
P2	6221	103
P3	1356	212
P4	6324	72
P5	6396	352
P6	2432	304

(d) The table is as follows:

Allocation algorithm for P2		FF	BF	WF
Logical address	Physical address for P1	Physical address for P2		
(0,44)	3055	1400	2780	3190
(1,231)	2132	3377	3377	3431
(2,82)	5760	1493	2873	6303
(3,199)	2631	1713	2334	1555
(4,56)	4490	1782	2403	6379
(5,304)	1315	4340	4340	5525
(6,135)	Invalid	2567	2567	2567