Homework 5

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5.4 Consider the following set of processes, with the length of the CPU burst time given in milliseconds:

Process	Burst Time	Priority
P_1	2	2
P_2	1	1
P_3	8	4
P_4	4	2
P_5	5	3

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

a. Draw four Gantt charts that illustrate the execution of these processes using the following scheduling algorithms: FCFS, SJF, non-preemptive priority (a larger priority number implies a higher priority), and RR (quantum = 2).

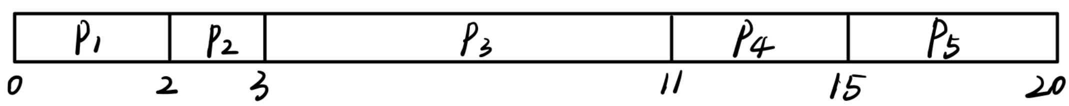
b. What is the turnaround time of each process for each of the scheduling algorithms in part a?

c. What is the waiting time of each process for each of these scheduling algorithms?

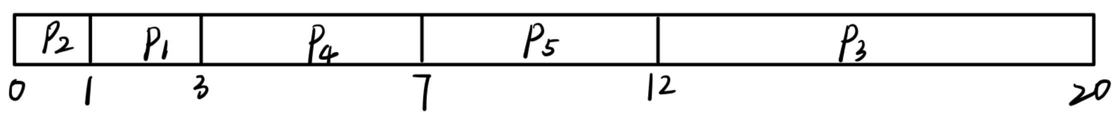
d. Which of the algorithms results in the minimum average waiting time (over all processes)?

a.

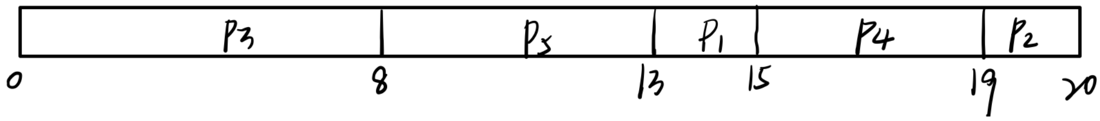
FCFS:



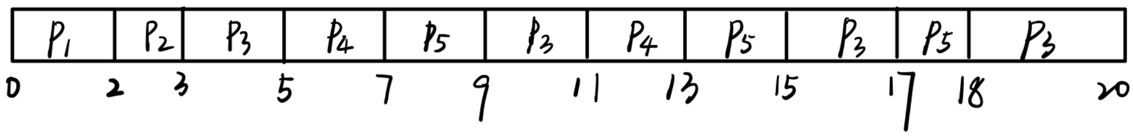
SJF:



non-preemptive priority:



RR:



b.

turnaround time	P_1	P_2	P_3	P_4	P_5
FCFS	2	3	11	15	20
SJF	3	1	20	7	12
non-preemptive priority	15	20	8	19	13
RR	2	3	20	13	18

C.

waiting time	P_1	P_2	P_3	P_4	P_5
FCFS	0	2	3	11	15
SJF	1	0	12	3	7
non-preemptive priority	13	19	0	15	8
RR	0	2	12	9	13

d.

FCFS各进程的平均waiting time为$(0+2+3+11+15)/5=6.2$；

SJF各进程的平均waiting time为$(1+0+12+3+7)/5=4.6$；

non-preemptive priority各进程的平均waiting time为$(13+19+0+15+8)/5=11$；

RR各进程的平均waiting time为$(0+2+12+9+13)/5=7.2$；

因此SJF和non-preemptive priority各进程的平均waiting time最短。

5.5 The following processes are being scheduled using a preemptive, round-robin scheduling algorithm.

Process	Priority	Burst	Arrival
P_1	40	20	0
P_2	30	25	25
P_3	30	25	30
P_4	35	15	60
P_5	5	10	100
P_6	10	10	105

Each process is assigned a numerical priority, with a higher number indicating a higher relative priority. In addition to the processes listed below, the system also has an idle task (which consumes no CPU resources and is identified as P_{idle}). This task has priority 0 and is scheduled whenever the system has no other available processes to run. The length of a Practice Exercises time quantum is 10 units. If a process is preempted by a higher-priority process, the preempted process is placed at the end of the queue.

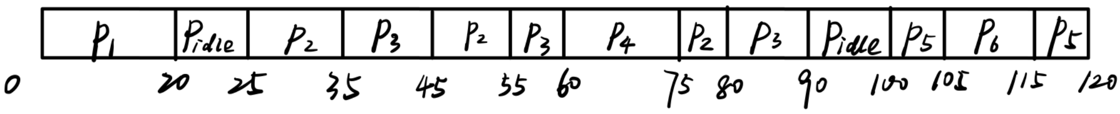
a. Show the scheduling order of the processes using a Gantt chart.

b. What is the turnaround time for each process?

c. What is the waiting time for each process?

d. What is the CPU utilization rate?

a. Gantt图如下：



b. 各进程的turnaround time见下表：

P_1	P_2	P_3	P_4	P_5	P_6
20	80-25=55	90-30=60	75-60=15	120-100=20	115-105=10

c. 各进程的waiting time见下表：

P_1	P_2	P_3	P_4	P_5	P_6
0	10+20=30	5+10+20=35	0	10	0

d. CPU利用率为：

$$\frac{120-5-10}{120} \times 100\% = 87.5\%$$

5.10 The traditional UNIX scheduler enforces an inverse relationship between priority numbers and priorities: the higher the number, the lower the priority. The scheduler recalculates process priorities once per second using the following function:

Priority = (recent CPU usage / 2) + base

where base = 60 and recent CPU usage refers to a value indicating how often a process has used the CPU since priorities were last recalculated.

Assume that recent CPU usage for process P_1 is 40, for process P_2 is 18, and for process P_3 is 10. What will be the new priorities for these three processes when priorities are recalculated? Based on this information, does the traditional UNIX scheduler raise or lower the relative priority of a CPU-bound process?

Priority(P_1) = 40/2 + 60 = 80；

Priority(P_2) = 18/2 + 60 = 69；

Priority(P_3) = 10/2 + 60 = 65；

通过将CPU usage的值减半后加上了基数，实际上减少了CPU usage在计算priority时的权重，降低了CPU-bound进程的相对优先级。

5.18 The following processes are being scheduled using a preemptive, priority-based, round-robin scheduling algorithm.

Process	Priority	Burst	Arrival
P_1	8	15	0
P_2	3	20	0
P_3	4	20	20
P_4	4	20	25
P_5	5	5	45
P_6	5	15	55

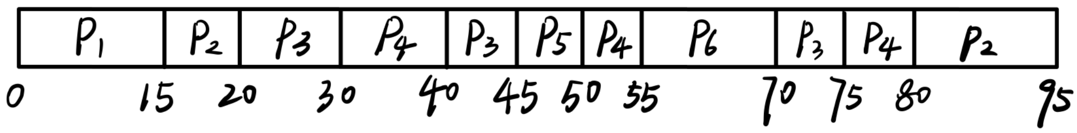
Each process is assigned a numerical priority, with a higher number indicating a higher relative priority. The scheduler will execute the highest priority process. For processes with the same priority, a round-robin scheduler will be used with a time quantum of 10 units. If a process is preempted by a higher-priority process, the preempted process is placed at the end of the queue.

a. Show the scheduling order of the processes using a Gantt chart.

b. What is the turnaround time for each process?

c. What is the waiting time for each process?

a.



b. 各进程的turnaround time见下表：

P_1	P_2	P_3	P_4	P_5	P_6
15	95	75-20=55	80-25=55	50-45=5	70-55=15

c. 各进程的waiting time见下表：

P_1	P_2	P_3	P_4	P_5	P_6
0	15+60=75	10+25=35	5+10+20=35	0	0

5.20 Which of the following scheduling algorithms could result in starvation?

a. First-come, first-served

b. Shortest job first

c. Round robin

d. Priority

b,d 可能会导致进程饿死，因为可能会不断有更短的或优先级更高的进程加入，导致进程一直无法执行。