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CS433
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Written Homework #3

6.11) Discuss how the following pairs of scheduling criteria conflict in certain settings.

a. CPU utilization and response time

CPU utilization should be maximized and response time should be minimized. Minimizing context switching leads to maximizing cpu utilization. If tasks need to wait a long time, it increases response time.

b. Average turnaround time and maximum waiting time

Using SJF scheduling can minimize the average turnaround time, yet it could lead to starvation of jobs with high bursts times if jobs with lower burst times kept being added.

c. I/O device utilization and CPU utilization

CPU utilization can be maximized by scheduling cpu-bound tasks with the largest cpu-bursts without context switching and I/O device utilization can be maximized by scheduling i/o bound tasks that are ready with context switching**.**

6.14) Consider the exponential average formula used to predict the length of the next CPU burst. What are the implications of assigning the following values to the parameters used by the algorithm?

a. a = 0 and T0 = 100 milliseconds

Using the exponential average formula... it can be predicted that the length for the next CPU burst is equal to 100 milliseconds. The most recent behaviors of processes have little to no effect on the next cpu burst.

b. A = 0.99 and T0 = 10 milliseconds

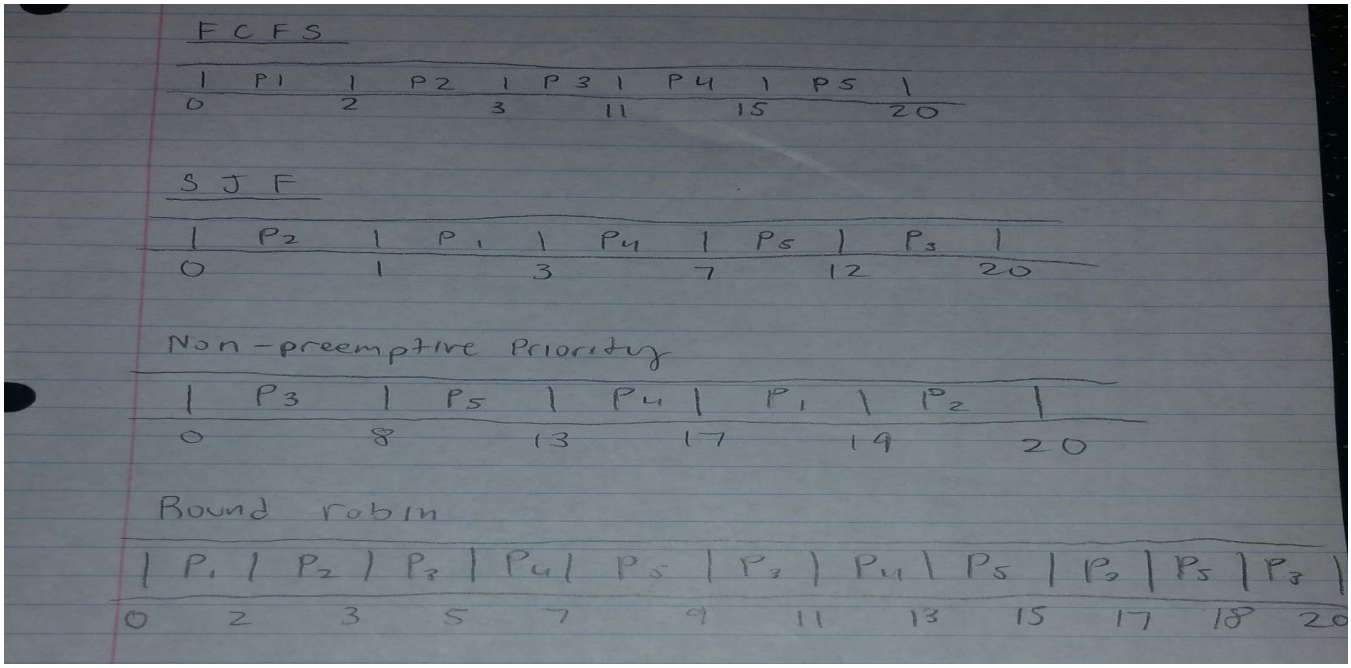
Using the exponential average formula... it can be predicted that the length for the next CPU burst is equal to 10 milliseconds. The most recent behaviors of processes has more importance than past behaviors of processes for the next cpu burst.

6.16) Consider the following set of processes, with the length of the CPU burst given in milliseconds:

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

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

a. Draw four Gantt charts that illustrate the execution of these processes using the following scheduling algorithms: FCFS, SJF, nonpreemptive 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?

FCFS
P1 = 2 ms
P2 = 3 ms
P3 = 11 ms
P4 = 15 ms
P5 = 20 ms

SJF
P1 = 3 ms
P2 = 1 ms
P3 = 20 ms
P4 = 7 ms
P5 = 12 ms

Non-preemptive priority
P1 = 19 ms
P2 = 20 ms

P3 = 8 ms
P4 = 17 ms
P5 = 13 ms

Round-Robin
P1 = 2 ms
P2 = 3 ms
P3 = 20 ms
P4 = 13 ms
P5 = 18 ms

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

FCFS
P1 = 0 ms
P2 = 2 ms
P3 = 3 ms
P4 = 11 ms
P5 = 15 ms

SJF
P1 = 1 ms
P2 = 0 ms
P3 = 12 ms
P4 = 3 ms
P5 = 7 ms

Non-preemptive priority
P1 = 17 ms
P2 = 19 ms
P3 = 0 ms
P4 = 13 ms
P5 = 8 ms

Round-Robin
P1 = 0 ms
P2 = 2 ms
P3 = 12 ms
P4 = 9 ms
P5 = 13 ms

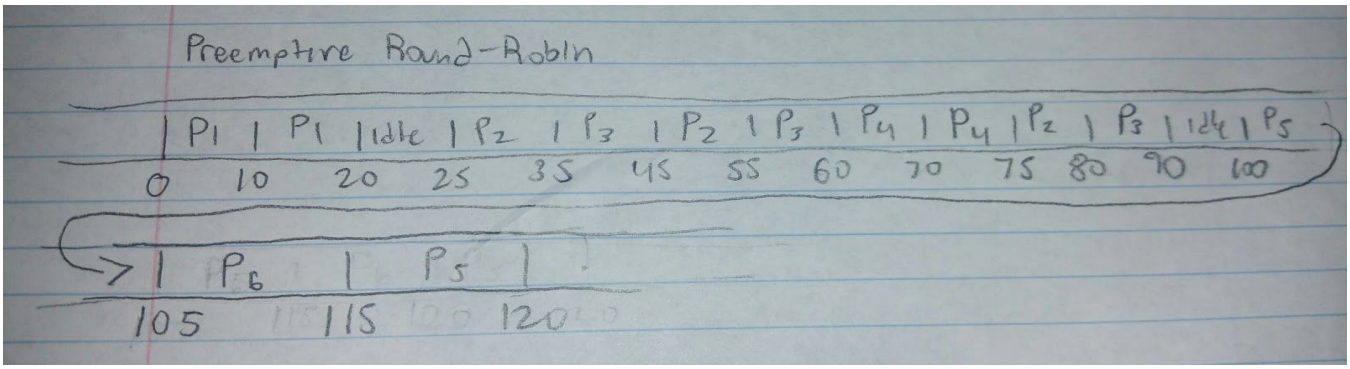
d. Which of the algorithms results in the minimum average waiting time (over all processes)?

SJF algorithm results in the minimum average wait time of 23/5 = 4.6

6.17) The following processes are being scheduled using a preemptive, round robin scheduling algorithm. 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 Pidle). This task has priority 0 and is scheduled whenever the system has no other available processes to run. The length of a 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.

Thread	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

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



b. What is the turnaround time for each process?

P1 = 20 ms
P2 = 55 ms
P3 = 60 ms
P4 = 15 ms
P5 = 20 ms
P6 = 10 ms

c. What is the waiting time for each process?

P1 = 30 ms
P2 = 35 ms
P3 = 35 ms
P4 = 0 ms
P5 = 10 ms
P6 = 0 ms

d. What is the CPU utilization rate?

CPU utilization rate can be calculated by subtracting cpu idle time from highest turn around time, then dividing it by highest turnaround time.

((120 - 15) / 120) x 100 = 87.5%

The CPU utilization rate is equal to 87.5%.

6.19) Which of the following scheduling algorithms could result in starvation?

a. First-come, first-served
b. Shortest job first
c. Round robin
d. Priority

The scheduling algorithms that could result in starvation is shortest job first and Priority scheduling because if jobs with lower burst times or higher priorities keep being added in the queue, the jobs with higher burst times or lower priorities will wait a long time for them to be executed.

6.21) Consider a system running ten I/O-bound tasks and one CPU-bound task. Assume that the I/O-bound tasks issue an I/O operation once for every millisecond of CPU computing and that each I/O operation takes 10 milliseconds to complete. Also assume that the context-switching overhead is 0.1 millisecond and that all processes are long-running tasks. Describe the CPU utilization for a round-robin scheduler when:

a. The time quantum is 1 millisecond

- The cpu utilization when the time quantuam is 1 ms is 91%.
- since (1.0 / 1.0 + 0.1) * 100 = 91%.

b. The time quantum is 10 milliseconds

- The cpu utilization when the time quantuam is 10 ms is is 94%.
- since (20.0 / 10.1 + 11.0 * 100 = 94%.