Tutorial 6 - CPU Scheduling (Chapter 5)

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Questions:

1. What are the different scheduling queues maintained by the operating System?

2. What is the difference between Dispatch Latency and Context Switching?

3. Suppose that the following processes arrive for execution at the times indicated. Each process will run for the amount of time listed. In answering the questions, use non-preemptive scheduling, and base all decisions on the information you have at the time the decision must be made.

Process	Arrival Time	Burst Time
P1	0.0	8
P2	0.4	4
P3	1.0	1

    a) What is the average turnaround time for these processes with the FCFS scheduling algorithm?
    b) What is the average turnaround time for these processes with the SJF scheduling algorithm?
    c) The SJF algorithm is supposed to improve performance but notice that we chose to run process P1 at time 0 because we did not know that two shorter processes would arrive soon. Compute what the average turnaround time will be if the CPU is left idle for the first unit and then SJF scheduling is used. Remember that processes P1 and P2 are waiting during this idle time, so their waiting time may increase. This algorithm could be known as future-knowledge scheduling.

4. Suppose that a scheduling algorithm (at the level of short-term CPU scheduling) favors those processes that have used the least processor time in the recent past. Why will this algorithm favor I/O-bound programs and yet not permanently starve CPU-bound programs?

5. Consider the following set of processes, with the length of the CPU burst time 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, 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)?

4. 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.
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?

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

5. Consider a system implementing multilevel queue scheduling. What strategy can a computer user employ to maximize the amount of CPU time allocated to the user's process?

6. Consider a preemptive priority scheduling algorithm based on dynamically changing priorities. Larger priority numbers imply higher priority. When a process is waiting for the CPU (in the ready queue, but not running), its priority changes at a rate α; when it is running, its priority changes at a rate β. All processes are given a priority of 0 when they enter the ready queue. The parameters α and β can be set to give many different scheduling algorithms.
a. What is the algorithm that results from $\beta > \alpha > 0$?
b. What is the algorithm that results from $\alpha < \beta < 0$?

7. Explain the differences in how much the following scheduling algorithms discriminate in favor of short processes:

a. FCFS
b. RR
c. Multilevel feedback queues