CSCI 3453: Operating System Concepts
HW Assignment # 4
Due Date: March 7, 2021 @ 11:55 PM

1) A CPU-scheduling algorithm determines an order for the execution of its scheduled processes. Given n processes to be scheduled on one processor, how many different schedules are possible? Give a formula in terms of n.
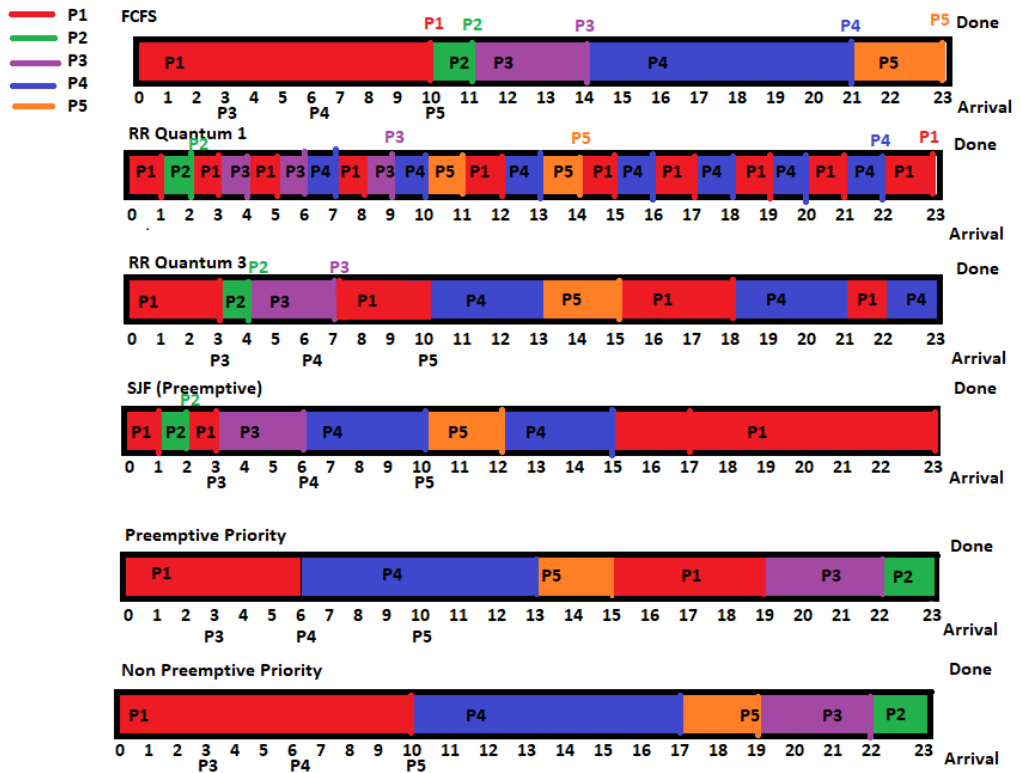
   n!

2) Many CPU-scheduling algorithms are parameterized. For example, the RR algorithm requires a parameter to indicate the quantum time. Multilevel queues require parameters to define the number of queues, the scheduling algorithm for each queue, the criteria used to move processes between queues, and so on.

   Theses algorithms are thus really sets of algorithms (for example, the set of RR algorithms for all times slices, and so on). One set of algorithms may include another (for example, the FCFS algorithm is the RR algorithm with an infinite time quantum). What (if any) relation holds between the following pairs of algorithm sets?
   1) Priority and SJF
       • Shortest job has highest priority
   2) Multilevel feedback queues and FCFS
       • Lowest level of feedback queue is FCFS
   3) Priority and FCFS
       • FCFS assigns priority in terms of longest existence in ready queue
   4) RR and SJF
       • None

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

Process	Arrival Time	CPU Burst Time	Priority
P1	0	10	2
P2	1	1	4
P3	3	3	2
P4	6	7	0
P5	10	2	1

1) Draw six Gantt charts that illustrate the execution of these processes using the following scheduling algorithms: FCFS, preemptive SJF, RR (quantum 1), RR (quantum=3), preemptive priority (a smaller priority number implies a higher priority), and non-preemptive priority (a smaller priority number implies a higher priority).

Legend: P1, P2, P3, P4, P5

FCFS

| P1 | P2 | P3 | P4 | P5 |

Labels above: P1 P2 (at ~9-10), P3 (at ~13), P4 (at ~20), P5 Done

Timeline: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 Arrival

Below labels: P3 (at 3), P4 (at 6), P5 (at 10)

RR Quantum 1

Segments: P1 P2 P1 P3 P1 P3 P4 P1 P3 P4 P5 P1 P4 P5 P1 P4 P1 P4 P1 P4 P1 P4 P1

Labels above: P2, P3, P5, P4, P1 Done

Timeline: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 Arrival

RR Quantum 3

Segments: P1 P2 P3 P1 P4 P5 P1 P4 P1 P4

Labels above: P2, P3, Done

Timeline: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 Arrival

Below labels: P3 (at 3), P4 (at 6), P5 (at 10)

SJF (Preemptive)

Segments: P1 P2 P1 P3 P4 P5 P4 P1

Labels above: P2, Done

Timeline: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 Arrival

Below labels: P3 (at 3), P4 (at 6), P5 (at 10)

Preemptive Priority

Segments: P1 P4 P5 P1 P3 P2

Labels: Done

Timeline: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 Arrival

Below labels: P3 (at 3), P4 (at 6), P5 (at 10)

Non Preemptive Priority

Segments: P1 P4 P5 P3 P2

Labels: Done

Timeline: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 Arrival

Below labels: P3 (at 3), P4 (at 6), P5 (at 10)

2) What is the turnaround time of each process for each of the
   scheduling algorithm in part (a)?
   completion - arrival = turnaround

	FCFS	RR(Q1)	RR(Q3)	SJF	p-Priority	non-Priority
P1	10	23	22	23	19	10
P2	10	1	3	1	22	22
P3	11	6	4	3	19	19
P4	15	16	17	9	7	11
P5	13	4	5	2	5	9

3) What is the waiting time of each process for each of the scheduling
   algorithms in part (a)?
   turnaround - burst = waiting time

	FCFS	RR(Q1)	RR(Q3)	SJF	p-Priority	non-Priority
P1	0	13	12	13	9	0
P2	9	0	2	0	21	21
P3	8	3	1	0	19	16
P4	8	9	10	2	0	4
P5	11	2	3	0	3	7

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FirstName_LastName_HW4

Rubric for Grading:

Description	Points
Question 1	10
Question 2	20
Question 3	90
Total Points	**120**