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HW02

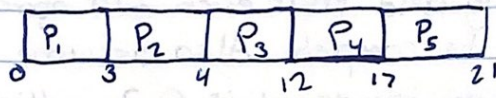
1. Why is it important for the scheduler to distinguish I/O bound programs from CPU-bound programs?
You can make better use of the CPUs resources by giving higher priority to I/O bound programs and allow them to execute ahead of the CPU-bound programs.

2.

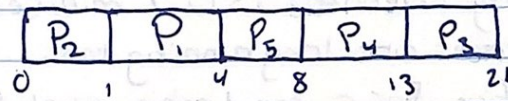
a.

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

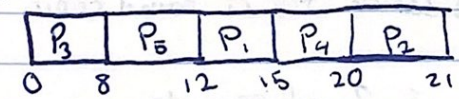
FCFS:



SJF:



Non-Preemptive:



RR (quantum = 2): | $P_{1(1)}$ | P_2 | $P_{3(6)}$ | $P_{4(3)}$ | $P_{5(2)}$ | P_1 | $P_{3(4)}$ |
0 2 3 5 7 9 10 12

| $P_{4(1)}$ | P_5 | $P_{3(2)}$ | P_4 | P_3 |
14 16 18 19 21

b. FCFS: $P_1 = 3$, $P_2 = 4$, $P_3 = 12$, $P_4 = 17$, $P_5 = 21$
SJF: $P_1 = 4$, $P_2 = 1$, $P_3 = 21$, $P_4 = 13$, $P_5 = 8$
Non-Preemptive: $P_1 = 15$, $P_2 = 21$, $P_3 = 8$, $P_4 = 20$, $P_5 = 12$
RR: $P_1 = 10$, $P_2 = 3$, $P_3 = 21$, $P_4 = 19$, $P_5 = 16$

c. FCFS: $P_1 = 0$, $P_2 = 3$, $P_3 = 4$, $P_4 = 12$, $P_5 = 17$
SJF: $P_1 = 1$, $P_2 = 6$, $P_3 = 13$, $P_4 = 8$, $P_5 = 4$
Non-Preemptive: $P_1 = 12$, $P_2 = 20$, $P_3 = 0$, $P_4 = 15$, $P_5 = 8$
RR: $P_1 = 7$, $P_2 = 2$, $P_3 = 13$, $P_4 = 14$ $P_5 = 12$

d. FCFS: $(0 + 3 + 4 + 12 + 17) / 5 = 7.2$
SJF: $(1 + 0 + 13 + 8 + 4) / 5 = 5.2$
Non-Preemptive: $(12 + 20 + 0 + 15 + 8) / 5 = 11$
RR: $(7 + 2 + 13 + 14 + 12) / 5 = 9.6$
=> SJF has the minimum average wait time

3. Consider a system running ten I/O-bound tasks and one CPU-bound task. Assume 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 the context-switching overhead is 0.2 milliseconds and that all processes are long running tasks. Describe the cpu utilization for a round robin scheduler when:

a. The quantum is 2 milliseconds.

$$\frac{10 \cdot \text{I/O (time)} + 1 \cdot \text{CPU (time)}}{10 \cdot \text{I/O (time)} + 1 \cdot \text{CPU (time)} + 10 \cdot \text{Context (time)}}$$

$$\frac{10 \cdot 1 + 1 \cdot 2}{10 \cdot 1 + 1 \cdot 2 + 10 \cdot 0.2} = \frac{10 + 2}{10 + 2 + 2} = \frac{12}{14} = 85.7\%$$ CPU utilization

b. $$\frac{10 \cdot 1 + 1 \cdot 10}{10 \cdot 1 + 1 \cdot 10 + 10 \cdot 0.2} = \frac{10 + 10}{10 + 10 + 2} = \frac{20}{22} = 90.9\%$$ cpu utilization