THEORY ASSIGNMENT 1

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(1) Given

$$Prioritynumber = \left(base + \frac{\text{recent CPU usage } U}{2} \right)$$

where higher the priority, lower the priority number, and
- base = 60
- U for P1 = 40
- U for P2 = 18
- U for P3 = 10

What will be their new priorities? Furthermore, does the scheduler raise or lower the relative priority of a CPU bound process?

The new priorities:
- P1: $60 + \frac{40}{2} = 80$
- P2: $60 + \frac{18}{2} = 69$
- P3: $60 + \frac{10}{2} = 65$

Clearly, U is high for a CPU bound process. Since the prioriity number is linear in U, the scheduler decreases the priority of CPU bound processes.

(2) Question 4.19 from the 10th edition of the book on the page EX-9 of the book

Output:
CHILD: value = 5PARENT: value = 0
- Line C: "CHILD: value = 5"
- Line P: "PARENT: value = 0"

(3) Question 5.17 from the 10th edition of the book on the page EX-13 of the book

Process	Burst time	Priority
P_1	5	4
P_2	3	1
P_3	1	2
P_4	7	2
P_5	4	3

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

P_1	P_2	P_3	P_4	P_5

0 5 8 9 16 20

- SJF:

P_3	P_2	P_5	P_1	P_4

0 1 4 8 13 20

- NPP:

P_1	P_5	P_3	P_4	P_2

0 5 9 10 17 20

- RR:

P_1	P_2	P_3	P_4	P_5	P_1	P_2	P_4	P_5	P_1	P_4

0 2 4 5 7 9 11 12 14 16 17 20

(b) What is the turnaround time of each prcess for each algorithm?
  (i) FCFS:
    (A) P1: 5
    (B) P2: 8
    (C) P3: 9
    (D) P4: 16
    (E) P5: 20
  (ii) SJF:
    (A) P1: 13
    (B) P2: 4
    (C) P3: 1
    (D) P4: 20
    (E) P5: 8
  (iii) NPP:
    (A) P1: 5
    (B) P2: 20
    (C) P3: 10
    (D) P4: 17
    (E) P5: 9
  (iv) RR:
    (A) P1: 17
    (B) P2: 12
    (C) P3: 5
    (D) P4: 20
    (E) P5: 16

(c) What is the waiting time of each process for each of these scheduling algorithms?
  (i) FCFS:
    (A) P1: 0
    (B) P2: 5
    (C) P3: 8
    (D) P4: 9

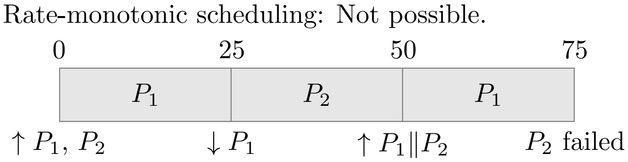
- (E) P5: 16
- (ii) SJF:
  - (A) P1: 8
  - (B) P2: 1
  - (C) P3: 0
  - (D) P4: 13
  - (E) P5: 4
- (iii) NPP:
  - (A) P1: 0
  - (B) P2: 17
  - (C) P3: 9
  - (D) P4: 10
  - (E) P5: 5
- (iv) RR:
  - (A) P1: 12
  - (B) P2: 9
  - (C) P3: 4
  - (D) P4: 13
  - (E) P5: 12

(d) Which of the algorithms results in the minimum average waiting time (over all processes)? Average waiting times:
- (i) FCFS: 7.6
- (ii) SJF: 5.2
- (iii) NP: 8.2
- (iv) RR: 10

Clearly, SJF results in minimum average waiting time.

(4) Question 5.24 from the 10th edition of the book on the page EX-14 of the book
- (a) FCFS: A running process's priority increases faster than any ready ones and always remains nonnegative, and therefore, there is no preemption. Processes execute in order of arrival.
- (b) LIFO: The priority can never increase, and so the highest priority process is one that arrived most recently. Moreover, $\beta > \alpha$, so a pocess can only be preempted and placed in the ready queue (or rather, ready stack) upon the arrival of a new process, and will even then have he highest priority among all waiting processes (i.e. top of stack).

(5) Question 5.35 from the 10th edition of the book on the page EX-16 of the book Consider processes P_1 and P_2, where $p_1 = 50$, $t_1 = 25$ and $p_2 = 75$, $t_2 = 30$. Let $\|P_i$ denote the preemptive shift of a process P_i to the ready queue.
- (a) Rate-monotonic scheduling: Not possible.



(b) EDF scheduling: Possible.

0–25	25–55	55–80	80–110	110–135	135–150
P_1	P_2	P_1	P_2	P_1	$-$

$\uparrow P_1, P_2$ $\downarrow P_1$ $50 \downarrow P_2$ $75 \downarrow P_1$ 100 $\downarrow P_2$ $\downarrow P_1$ $\uparrow P_1, P_2$

$\uparrow P_1$ $\uparrow P_2$ $\uparrow P_1$

The above 150 time units repeat forever, and the processor remains idle during the last 15 time units.