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Course Code: CSE 4501

Course Name: Operating System

Date: 12-Sep-21

Final Exam

5^{th} Semester

Ans. to Q.no. 1

$$\tau_0 = \lceil \frac{120}{10} \rceil = 12$$

$$\tau_1 = 0.5 \times 6 + 0.5 \times 12 = \lceil 9 \rceil = 9$$

$$\tau_2 = 0.5 \times 5 + 0.5 \times 9 = \lceil 7 \rceil = 7$$

$$\tau_3 = 0.5 \times 5 + 0.5 \times 7 = \lceil 6 \rceil = 6$$

$$\tau_4 = 0.5 \times 10 + 0.5 \times 6 = \lceil 8 \rceil = 8$$

$$\tau_5 = 0.5 \times 4 + 0.5 \times 8 = \lceil 6 \rceil = 6$$

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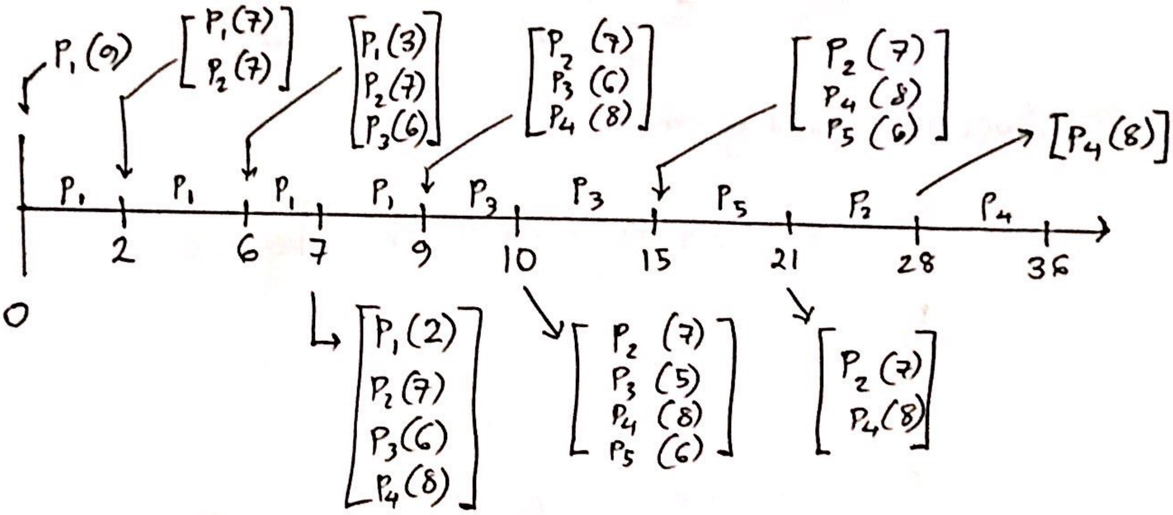
Process	Arrival Time	Priority	Predicted Burst
P_1	0	3	9
P_2	2	1	7
P_3	6	4	6
P_4	7	5	8
P_5	10	2	6

(i) Shortest Remaining Job



~~Average~~ Waiting Time is

$$P_1 = (0-0) = 0$$
$$P_2 = (21-2) + (2-2) = 19$$
$$P_3 = (9-6) + (6-6) = 3$$
$$P_4 = (7-7) + (28-7) = 21$$
$$P_5 = (10-10) + (15-10) = 5$$

$$\text{Avg} = \frac{0+19+3+21+5}{5} = 9.6 \text{ ms.}$$

Ans: 9.6 ms

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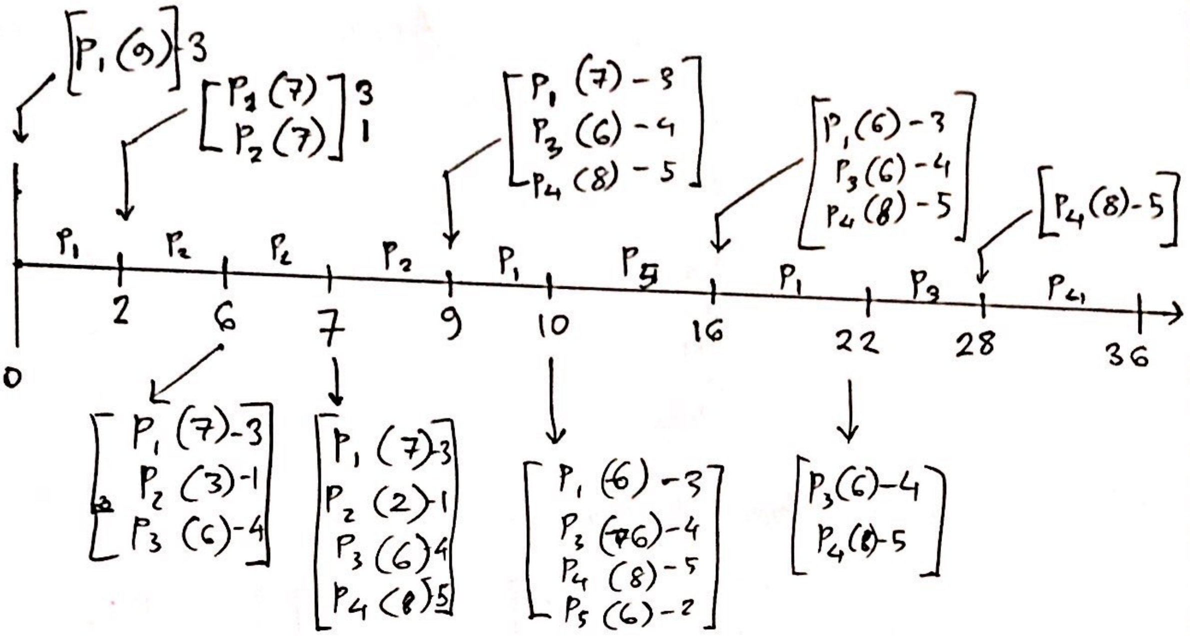
(ii)



Average Waiting time is

$$P_1 = (0-0) + (9-2) + (16-10) = \cancel{14}\ 13$$

$$P_2 = (2-2) = 0$$

$$P_3 = (6-6) + (22-6) = 16$$

$$P_4 = (7-7) + (28-7) = 21$$

$$P_5 = (10-10) = 0$$

$$\text{Avg.} = \frac{13+16+21+0+0}{5} = 10 \text{ ms. (Ans)}$$

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Ans. to Q.no. 1(b)

If the raundrobin time is ~~too~~ too small, then there will be more context switching and it will increase avg turnarand time.

If raund robin time is too big, then too less context switching will make the queue act as a First Come First Serve Queue.

Ex P_1 ~~o~~ has 50 ms burst time and P_2 has 10 ms burst time.

If $q = 1$ ms ~~then~~ and context switching is $\tau = 0.1$ ms then

$\longrightarrow P_1$ takes $(50\ \cancel{ms} + 10 + 0.1 \times 20) = 62$ ms. time.

because there were 20 context switches.

On the other hand $q = 50$ ms, will make P_2 wait for 50 ms. and causes conveyer belt effect.

~~Ans to Q.no. 3(a)~~

~~First fit~~

Process - Size(KB)	Partion Size (KB)	Memory Usage
1) 115	300	
2) 500	600	
3) 358	750	
4) 200		
5) 375		

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Ans. to. Q no. 3(a)

The partitions are 300 KB, 600 KB, 350 KB, 200 KB, 750 KB and 125 KB.

The first-fit will be when the first partition that can fit the process will be chosen.

First-fit (Process Size)	Chosen Partition Size	Memory Usage
1) 115 KB	300 KB	$\frac{115}{300} = 38.33\%$
2) 500 KB	600 KB	$\frac{500}{600} = 83.33\%$
3) 358 KB	600 KB	$\frac{358}{600} = 59.67\%$
4) 200 KB	300 KB	$\frac{200}{300} = 66.67\%$
5) 375 KB	600 KB	$\frac{375}{600} = 62.5\%$

Average memory usage $= \frac{38.33 + 83.33 + \dots 62.5}{5}$

$= 62.1\%$

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Best-fit [Sorted Partition - 125, 200, 300, 350, 600, 750]

Difference between process size and partition will be lowest.

Process Size	Chosen Partition Size	Memory Usage
1) 115 KB	125 KB	$\frac{115}{125} = 92\%$
2) 500 KB	600 KB	$\frac{500}{600} = 83.33\%$
3) 358 KB	600 KB	$\frac{358}{600} = 59.67\%$
4) 200 KB	200 KB	$200/200 = 100\%$
5) 375 KB	600 KB	$375/600 = 62.5\%$

$$\text{Average memory usage} = \frac{92\% + 83.33\% + \ldots 62.5\%}{5}$$

$$= 79.5\%$$

Worst fit: Differance between process and partition size is the highest.

Process Size	Chosen Partition Size	Memory Usage
1) 115 KB	750 KB	$115/750 = 15.33\%$
2) 500 KB	750 KB	$500/750 = 66.67\%$
3) 358 KB	750 KB	$358/750 = 47.73\%$
4) 200 KB	750 KB	$200/750 = 26.67\%$
5) 375 KB	750 KB	$375/750 = 50\%$

$$\text{Average memory Usage} = \frac{15.33 + 66.67 + 47.33 + 26.67 + 50}{5}$$

$$= 41.28\%$$

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The most efficient algorith is best fit, then first fit and then worst fit in terms of memory usage

Best Fit > First Fit > Worst Fit (Ans.)

Ans. to Q.no. 3(b)

Complete H/W solution can be achieved if all ~~4~~ 3 conditions of critical section problems are satisfied.

- mutual exclusion
- ~~b~~ progress
- bounded waiting

The complete solution is Test and set

```
Bool waiting [n] = False;
Bool Lock = False;
do {
    wait [i] = true;
    key = true;
    while (wait [i] and key){
        key = test And Set (&lock)
    }
    wait [i] = false; //Access critical section.
    j = (1+i) % n;
    while (j != i and wait[j] != true){
        j = (1+i) % n
    }
```

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```
    if (j==i){
        lock = false;
    }
    else{
        wait[i] = false;
    }
    //Complete remainder section
} while (true);
```

Let's assume a process $i=0$ and $i=1$, both will start with wait and lock as false. Then when critical section needs to be accessed by P_0 then the key becomes false ~~true~~ and it goes out of loop and accesses critical section. But P_1 can not access at that time. Mutual exclusion is fulfilled. In the code block where j is used, we ensure ~~progress is done as one access~~ bounded wait and progress is fulfilled.

Thus it is complete hardware solution.

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Ans to Q no. 3(c)

Conditions for deadlock are –

i) Mutual exclusion
ii) Hold and wait
iii) Non-preemptive
iv) Circular wait

All ~~for~~ 4 conditions must hold simultaneously for deadlock to occur.

Ans to Q no. 2(i)

(+)

For the safe state of the ~~the~~ processes, we need to have a path that ensures completion of all the processes

The need matrix is
(Max – Allocation)

	A	B	C
P_1	8	5	3
P_2	3	1	1
P_3	4	3	2
P_4	0	2	1
P_5	4	3	1

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Step by step execution

(i) Available vector is $(3,3,3)$; Work = available

We pick one process where

need ~~available work~~ $\leq$ work

Let's pick P_2.

$$(3,1,1) \leq (3,3,3)$$

Update

$$\text{work} = (3,3,3) + \cancel{(3,1,1)}\ (2,0,1)$$
$$= \cancel{(0,2,2)}\ (5,3,4)$$

(ii) Work = $\cancel{(0,2,2)}$ $(5,3,4)$

P_3 is need $\leq$ work.

$$\cancel{(0,2,1) \leq}$$
$$(4,3,2) \leq (5,3,4)$$

Pick P_3 and update work =

$$(5,3,4) + (3,2,2)$$
$$= (8,5,6).$$

(iii) We pick $P_1 \leq$ work

$$(8,5,3) \leq (8,5,6)$$

Update work = $(8,5,6) + (0,1,0)$

$$= (8,6,6).$$

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(iv) Pick P_4 where

$(0,2,1) \le (8,6,6)$

Update work $= (8,6,6) + (2,1,4)$

$= (10,7,10)$

(v) Pick P_5 where

$(4,3,1) \le (10,7,10)$

Update

work $= (10,7,10) + (2,1,0)$

$= (12,8,10)$.

Work is equal to total resources.

We take $\langle P_2, P_3, P_1, P_4, P_5 \rangle$ and get safe state.

$\therefore$ System is in safe state.

Ans. to Q.no. 2 (ii)

for t_0 $P_4 (0,1,0)$ and $P_2 (1,1,1)$

We check req $\le$ available.

$(0,1,0) \le (3,3,3)$

for P_4 need is $(0,2,1)$ > request.

So, the request will be granted for P_4 (Ans.)

available $= (3,3,3) - (0,1,0)$

$= (3,2,3)$

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For P_2, the request is $(1,1,1)$

The need of P_2 is $(3,1,1)$

need $\geq$ request

And request is

$(1,1,1) \leq (3,2,3)$

So, request will be granted for P_2 (Ans.)

(iii)

Snapshot at t_1 is

Process	Available	Allocation	Max
P_1		0,1,2	8,6,3
P_2		4,0,1	5,1,2
P_3	(0,1,0)	4,3,3	7,5,4
P_4		2,1,4	2,3,5
P_5		~~4,3,1~~ 2,1,0	6,4,1

Yes, system is in deadlock.