Md. Farhan Ishraq
1800491120

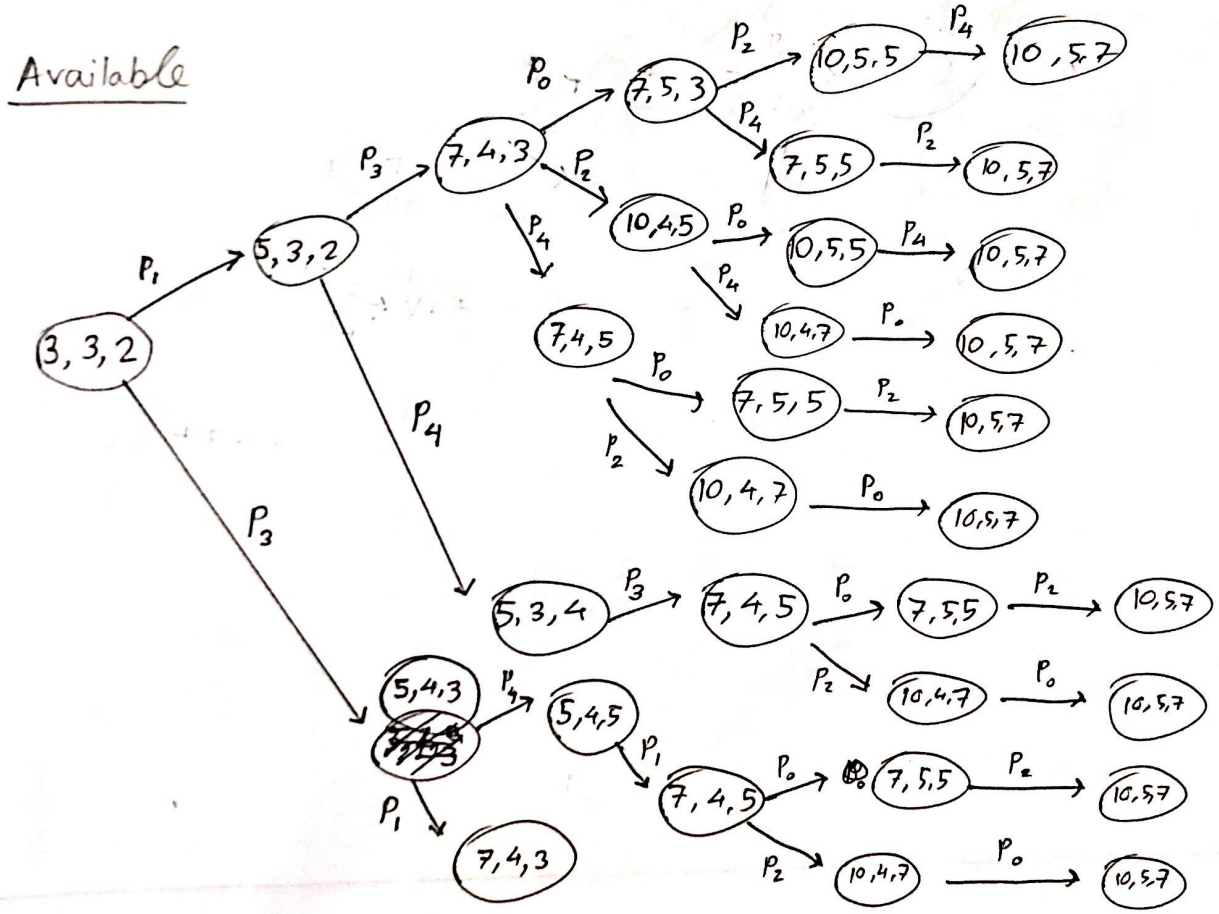
Ans. to Q. no. 1

We construct the need matrix

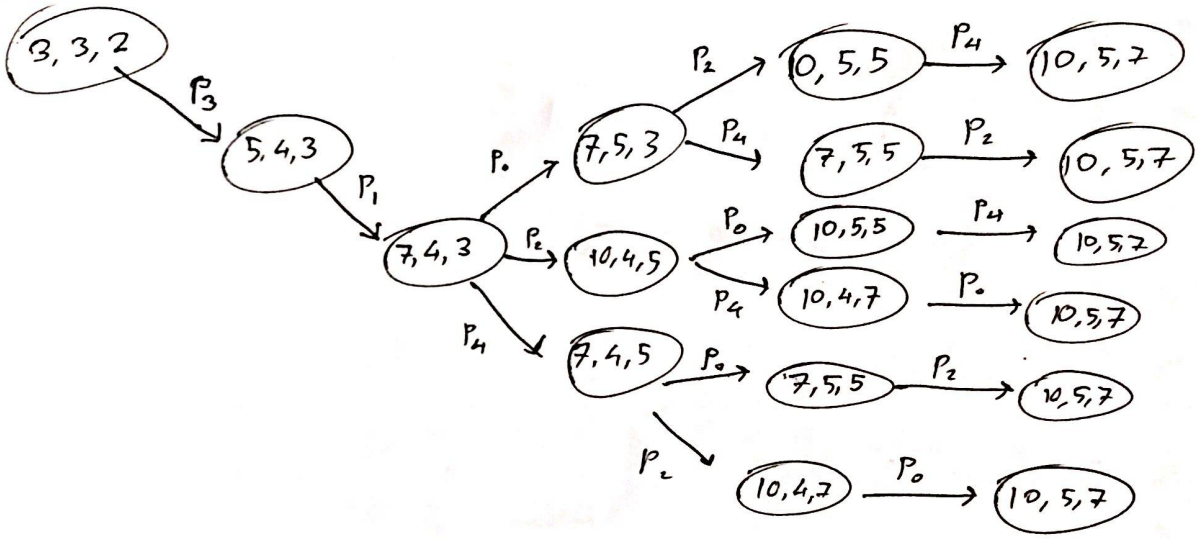
Need = Max - Allocation

	Max			Allocation			Need		
	A	B	C	A	B	C	A	B	C
P_0	7	5	3	0	1	0	7	4	3
P_1	3	2	2	2	0	0	1	2	2
P_2	9	0	2	3	0	2	6	0	0
P_3	2	2	2	2	1	1	0	1	1
P_4	4	3	3	0	0	2	4	3	1

Ans.to Q.no. 1



Md. Farhan Ishmam
180041120



Md Farhan Ishmam
1800411120

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Let, us consider the first safe sequence.

$< P_1, P_3, P_0, P_2, P_4 >$

Step-1:

Initially the available vector is $(3, 3, 2)$ equals work.

We check the finish of P_1. Finish [1] == false
and, $Need_1 \leq Work$ } satisfied
Because $(1, 2, 2) \leq (3, 3, 2)$

Then, we update the matrices

	Finish	~~Need~~ Work
P_0	False	
P_1	True	~~$(3, 3, 2) + Allocation_1$~~
P_2	False	$Work + Allocation_1$
P_3	False	$= (3, 3, 2) + (2, 0, 0)$
P_4	False	$= (5, 3, 2)$

Step-2

Work is $(5, 3, 2)$

We check conditions for P_3

Finish [3] == false
and $Need_3 \leq Work$ } satisfied
because $(0, 1, 1) \leq (5, 3, 2)$

180041120
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We update the matrices

	Finish
P_0	F
P_1	T
P_2	F
P_3	T
P_4	F

$Work = Work + Allocation_3$
$= (5,3,2) + (2,1,1)$
$= (7,4,3)$

Step-3: We pick P_0.

We check condition, finish[0] == false
and $Need_0 \leq work$
$(7,4,3) \leq (7,4,3)$
} satisfied

We update matrices

	Finish
P_0	T
P_1	T
P_2	F
P_3	T
P_4	F

$Work = Work + Allocation_0$
$= (7,4,3) + (0,1,0)$
$= (7,5,3)$

Md. Farhan Ishmam
1800411120

Step-4

For P_2, we check conditions,

$$\left.\begin{aligned} &Finish[2] == false \\ &Need_2 \leq Work \\ &\therefore (6,0,0) \leq (7,5,3) \end{aligned}\right\} \text{satisfied.}$$

We update

	Finish
P_0	T
P_1	T
P_2	T
P_3	T
P_4	F

$Work = Work + Allocation_2$
$= (7,5,3) + (3,0,2)$
$= (10,5,5)$

Step-5

For P_4, we check,

$$Finish[4] == false$$
$$Need_4 \leq Work$$
$$\therefore (4,3,1) \leq (10,5,5)$$

We update

	Finish
P_0	T
P_1	T
P_2	T
P_3	T
P_4	T

$Work = Work + Allocation_4$
$= (10,5,5) + (0,0,2)$
$= (10,5,7)$

As, all the processes have finished, system is in a safe state. (Ans)

Md. Farhan Ishmam
1800411120

Ans. to Q.no. 2

(a) $Req_1 = (1, 0, 2)$

We check, $request_1 \leq available$.

Here, $(1,0,2) \leq (3,3,2)$.

The request can be granted as the condition is fulfilled.

The new snapshot is given below:

t_1

	Allocation	Max	Need
P_0	0, 1, 0	7, 5, 3	7, 4, 3
P_1	3, 0, 2	3, 2, 2	0, 2, 0
P_2	3, 0, 2	9, 0, 2	6, 0, 0
P_3	2, 1, 1	2, 2, 2	0, 1, 1
P_4	0, 0, 2	4, 3, 3	4, 3, 1

$$\begin{aligned} Available &= Available - Request_1 \\ &= (3, 3, 2) - (1, 0, 2) \\ &= (2, 3, 0) \end{aligned}$$

Then, we check if the system is in a safe state or not. If it is in a safe state, then resource can be granted.

(Ans)

Md. Farhan Ishraam
1800411120

Ans. to Qno. 3

(a) $Req_4 = (3, 3, 0)$

We check, $request_4 \leq available$

$\Rightarrow (3, 3, 0) \leq (2, 3, 0)$

But, this is false.

So, req_4 will not be granted (Ans.)

(b) $Req_3 = (0, 3, 0)$

We check, $request_3 \leq available$

$(0, 3, 0) \leq (2, 3, 0)$

This is true.

So, req_3 will be granted if after granting the resources, the system is in a safe state. (Ans.)

Md. Farhan Ishmam
1800411120

(c) $req_2 = (0, 0, 2)$

We check, $request_2 \leq available$.

$\Rightarrow (0, 0, 2) \leq (2, 3, 0)$

This is false and hence, the request won't be granted. (Ans.)