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1) Consider the following snapshot of a system:

Process	Allocation			Max			Available		
	X	Y	Z	X	Y	Z	X	Y	Z
P0	0	1	0	7	5	3	3	3	2
P1	2	0	0	3	2	2			
P2	3	0	2	9	0	2			
P3	2	1	1	2	2	2			
P4	0	0	2	4	3	3			

a) What is the content of the matrix need?

Ans) ∴ Need = MAX - Allocation.

P0 = 753 - 010 = 7, 4, 3

P1 = 322 - 200 = 1, 2, 2

P2 = 902 - 302 = 6, 0, 0

P3 = 222 - 211 = 0, 1, 1

P4 = 433 - 002 = 4, 3, 1

Process	Need		
	X	Y	Z
P0	7	4	3
P1	1	2	2
P2	6	0	0
P3	0	1	1
P4	4	3	1

b) Check the system for a safe state.

Ans)

Applying the Banker's Algorithm:

Available Resources of X, Y and Z 3, 3, and 2

Now we check if each type of resource request is available for each process.

Step 1: For Process P0:

Need <= Available

7, 4, 3 <= 3, 3, 2 Condition is false

Step 2: For Process P1:

1, 2, 2 <= 3, 3, 2 Condition true

New Available = Available + Allocation.

(3, 3, 2) + (2, 0, 0) = 5, 3, 2

Step 3: For Process P2:

6, 0, 0 <= 5, 3, 2 Condition is false.

~~New Available resource = Available + Allocation~~

Step 4: For process P3:

0, 1, 1 <= 5, 3, 2 Condition is true.

New Available Resource = Available + Allocation.

5, 3, 2 + 2, 1, 1 = 7, 4, 3

Step 5: For process P4:

4, 3, 1 <= 7, 4, 3 Condition is true.

New available resource = Available + Allocation.

7, 4, 3 + 0, 0, 2 = 7, 4, 5

Now, we again examine each type of resource request for processes. P0 and P2.

Step 6: For process P0:

7, 4, 3 <= 7, 4, 5 Condition is true.

New Available Resource = Available + Allocation.

7, 4, 5 + 0, 1, 0 = 7, 5, 5.

Step 7: For process P2:

6, 0, 0 <= 7, 5, 5 Condition is true.

New Available Resource = Available + Allocation.

7, 5, 5 + 3, 0, 2 = 10, 5, 7

Hence, we execute the Banker's algorithm to find the Safe state and the Safe sequence like <P1, P3, P4, P0, P2>

c) If a request from process p1 arrives for (1, 0, 2), can the request to granted immediately?

c) Ans) Check Request <= Available

i.e (1,0,2) <= (3,3,2), which is true.

Assume the resources are granted to P1.

Here, Available = (3,3,2) - (1,0,2) = (2,3,0)

∴ Need = Max - Allocation

P_0 = (7,5,3) - (0,1,0) = 7,4,3

P_1 = (3,2,2) - (3,0,2) = 0,2,0

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

Content of the Need matrix is as follows:

	Need		
Process	X	Y	Z
P0	7	4	3
P1	0	2	0
P2	6	0	0
P3	0	1	1
P4	4	3	1

Hence, we have to execute the Bankes's algorithm to find the safe state and the safe sequence like above. Then only above request will be granted P1 immediately.