Banker's Algorithm

Q. Solve the following using Banker's Algorithm.
Consider the system with 5 processes, P_0 to P_4 and resource type A, B, C.
Find need matrix and find out whether resultant system state is safe or not From given snapshot

	Allocation			MAX			Available		
	A	B	C	A	B	C	A	B	C
P_0	0	1	0	7	5	3	3	3	2
P_1	2	0	0	3	2	2			
P_2	3	0	2	9	0	2			
P_3	2	1	1	2	2	2			
P_4	0	0	2	4	3	3			

Need Matrix

Need = Max - Allocation

Process	A	B	C
P_0	7	4	3
P_1	1	2	2
P_2	6	0	0
P_3	0	1	1
P_4	4	3	1

Need ≤ Available

P_0 7 4 3 ≤ 3 3 2 → False Not satisfied

P_1 1 2 2 ≤ 3 3 2 → True satisfied

Available = Available + Allocation

= 3 3 2 + 2 0 0

= 5 3 2

P_2 6 0 0 ≤ 5 3 2 → False Not satisfied

P_3 0 1 1 ≤ 5 3 2 → True satisfied

Available = Available + Allocation

= 5 3 2 + 2 1 1

= 7 4 3

P_4 4 3 1 ≤ 7 4 3 → True satisfied

Available = Available + Allocation

= 7 4 3 + 0 0 2

= 7 4 5

P_0 7 4 3 ≤ 7 4 5 → True satisfied

Available = Available + Allocation

= 7 4 5 + 0 1 0

= 7 5 5

P_2 6 0 0 $\leq$ 7 5 5 → True Satisfied

Available = Available + Allocation

= 7 5 5 + 2 0 2

= 10 5 7

Safe Sequence

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

Q. Consider the following snapshot of a system.

i] What is the content of matrix need ?

ii] Is the system in safe state ?

Process	Allocation				MAX				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
P_1	0	0	1	4	0	6	5	6	1	6	2	0
P_2	0	6	3	2	0	6	5	2				
P_3	0	0	1	2	0	0	1	2				
P_4	1	0	0	0	1	7	5	0				

Need Matrix

Need = Max - Allocation

Process	A	B	C	D
P_1	0	6	4	2
P_2	0	0	2	0
P_3	0	0	0	0
P_4	0	7	5	0

Need $\leq$ Available

P_1 0 6 4 2 $\leq$ 1 6 2 0 → True Satisfy

Available = Available + Allocation

= 1 6 2 0 + 0 0 1 4

= 1 6 3 4

P_2 0 0 2 0 $\leq$ 1 6 3 4 → True Satisfy

Available = Available + Allocation

= 1 6 3 4 + 0 6 3 2

= 1 12 6 6

P_3 0 0 0 0 $\leq$ 1 12 6 6 → True satisfied

Available = Available + Allocation

= 1 12 6 6 + 0 0 1 2

= 1 12 7 8

P_4 0 7 5 0 $\leq$ 1 12 7 8 → True satisfied

Available = Available + Allocation

= 1 12 7 8 + 1 0 0 0

= 2 12 7 8

Safe State

< P_1 , P_2 , P_3 , P_4 >

Q. Solve the following using Bankers's Algorithm

Find out whether resultant system state is safe or not

i] Find Need matrix

ii] Find out system state is safe.

iii] If P_1 makes a request P_1 (1, 0, 2) is the resulting state safe?

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

Need Matrix

Need = Max - Allocation

Process	A	B	C
P_0	7	4	3
P_1	1	2	2
P_2	6	0	0
P_3	0	1	1
P_4	4	3	2

Need ≤ Available

P_0 7 4 3 ≤ 3 3 2 → False Not Satisfied

P_1 1 2 2 ≤ 3 3 2 → True Satisfied

Available = Available + Allocation

= 3 3 2 + 2 0 0

= 5 3 2

P_2 6 0 0 ≤ 5 3 2 → False Not Satisfied

P_3 0 1 1 ≤ 5 3 2 → True Satisfied

Available = Available + Allocation

= 5 3 2 + 2 1 1

= 7 4 3

P_4 4 3 2 ≤ 7 4 3 → True Satisfied

Available = Available + Allocation

= 7 4 3 + 0 0 1

= 7 4 4

P_0 7 4 3 ≤ 7 4 4 → True satisfied

Available = Available + Allocation

= 7 4 4 + 0 1 0

= 7 5 4

P_2 6 0 0 $\leq$ 7 5 4 → True satisfied

Available = Available + Allocation

= 7 5 4 + 3 0 2

= 10 5 6

Safe sequence

< P_1, P_3, P_4, P_0, P_2 >

Addition Request

P_1 = (1, 0, 2)

Request ≤ Need

1 0 2 ≤ 1 2 2

Request ≤ Available

1 0 2 ≤ 3 3 2

Available = Available − Request

= 3 3 2 − 1 0 2

= 2 3 0

Allocation = Allocation + Request

= 2 0 0 + 1 0 2

= 3 0 2

Need = Need - Request

= 1 2 2 - 1 0 2

= 0 2 0

New Need Matrix

Process	A	B	C
P_0	7	4	3
P_1	0	2	0
P_2	6	0	0
P_3	0	1	1
P_4	4	3	1

Process	Allocation			Need			Available		
	A	B	C	A	B	C	A	B	C
P_0	0	1	0	7	4	3	2	3	0
P_1	3	0	2	0	2	0			
P_2	3	0	2	6	0	0			
P_3	2	1	1	0	1	1			
P_4	0	0	1	4	3	2			

Need ≤ Available

P_0 7 4 3 ≤ 2 3 0 → False Not satisfied

P_1 0 2 0 ≤ 2 3 0 → True Satisfied

Available = Available + Allocation

= 2 3 0 + 3 0 2

= 5 3 2

P_2 6 0 0 ≤ 5 3 2 → False Not satisfied

P_3 0 1 1 ≤ 5 3 2 → True Satisfied

Available = Available + Allocation

= 5 3 2 + 2 1 1

= 7 4 3

P_4 4 3 1 ≤ 7 4 3 → True satisfied

Available = Available + Allocation

= 7 4 3 + 0 0 1

= 7 4 4

P_0 7 4 3 ≤ 7 4 4 → True Satisfied

Available = Available + Allocation

= 7 4 4 + 0 1 0

= 7 5 4

P_2 6 0 0 $\leq$ 7 5 4 → True Satisfied

Available = Available + Allocation

= 7 5 4 + 3 0 2

= 10 5 6

Safe sequence

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

Q. Solve the following using Banker's algorithm

Process	Allocation				Max				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
P_0	0	0	1	2	0	0	1	2	1	5	2	0
P_1	1	0	0	0	1	7	5	0				
P_2	1	3	5	4	2	3	5	6				
P_3	0	6	3	2	0	6	5	2				
P_4	0	0	1	4	0	6	5	6				

i] What is the content of need matrix ?

ii] Is the system in safe state ?

iii] If the request from process P_1 arises for 0 4 2 0 Can the request be granted immediately ?

Need Matrix

Need = Max - Allocation

Process	A	B	C	D
P_0	0	0	0	0
P_1	0	7	5	0
P_2	1	0	0	2
P_3	0	0	2	0
P_4	0	6	4	2

Need ≤ Available

P_0 0000 ≤ 1520 → True, Satisfied

Available = Available + Allocation
= 1520 + 0012
= 1532

P_1 0750 ≤ 1532 → False Not satisfied

P_2 1002 ≤ 1532 → True Satisfied

Available = Available + Allocation
= 1532 + 1354
= 2886

P_3 0020 ≤ 2886 → True Satisfied

Available = Available + Allocation
= 2886 + 0632
= 21418

P_4 0642 ≤ 21418 → True satisfied

Available = Available + Allocation
= 21418 + 0014
= 21212

P_1 0 0 0 0 $\leq$ 2 14 12 12 → True Satisfied

Available = Available + Allocation

= 2 14 12 12 + 1 0 0 0

= 3 14 12 12

Safe sequence

< P_0, P_2, P_3, P_4, P_1 >

Addition Request

P_1 = (0 4 2 0)

Request $\leq$ Need

0 4 2 0 $\leq$ 0 7 5 0

Request $\leq$ Available

0 4 2 0 $\leq$ 1 5 2 0

Available = Available − Request

= 1 5 2 0 − 0 4 2 0

= 1 1 0 0

Allocation = Allocation + Request

= 1 0 0 0 + 0 4 2 0

= 1 4 2 0

Need = Need - Request

= 0 7 5 0 - 0 4 2 0

= 0 3 3 0

New Need Matrix

Process	A	B	C	D
P_0	0	0	0	0
P_1	0	3	3	0
P_2	1	0	0	2
P_3	0	0	2	0
P_4	0	6	4	2

Process	Allocation				Need				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
P_0	0	0	1	2	0	0	0	0	1	1	0	0
P_1	1	4	2	0	0	3	3	0				
P_2	1	3	5	4	1	0	0	2				
P_3	0	6	3	2	0	0	2	0				
P_4	0	0	1	4	0	6	4	2				

Need ≤ Available

P_0 0 0 0 0 ≤ 1 1 0 0 → True Satisfied

Available = Available + Allocation
= 1 1 0 0 + 0 0 1 2
= 1 1 1 2

P_1 0 3 3 0 ≤ 1 1 1 2 → False Satisfied

P_2 1 0 0 2 ≤ 1 1 1 2 → True Satisfied

Available = Available + Allocation
= 1 1 1 2 + 1 3 5 4
= 2 4 6 6

P_3 1 0 0 2 0 ≤ 2 4 6 6 → True Satisfied

Available = Available + Allocation
= 2 4 6 6 + 0 6 3 2
= 2 10 9 8

P_4 0 6 4 2 ≤ 2 10 9 8 → True Satisfied

Available = Available + Allocation
= 2 10 9 8 + 0 0 1 4
= 2 10 10 12

P_1 0 3 3 0 $\leq$ 2 1 0 1 0 1 2 → True satisfied

Available = Available + Allocation

= 2 10 12 12 + 1 4 2 0

= 3 14 12 12

Safe Sequence

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