

OS TUTORIAL - 6

Banker's Algorithm

Consider the following snapshot of a system:

Process	Allocation			Max			Available		
	A	B	C	A	B	C	A	B	C
P ₀	1	1	2	4	3	3	2	1	0
P ₁	2	1	2	3	2	2			
P ₂	4	0	1	9	0	2			
P ₃	0	2	0	7	5	3			
P ₄	1	1	2	1	1	2			

a) Calculate the content of the need matrix

b) Is the system in safe mode

c) Determine the total amount of resources of each type.

(a) Need = max - allocation

Process	Need		
	A	B	C
P ₀	3	2	1
P ₁	1	1	0
P ₂	5	0	1
P ₃	7	3	3
P ₄	0	0	0

(b) No. of processes = 5
 No. of resources = 3
 work = available

I) for P_0 ,

need = $\begin{smallmatrix} 3 & 2 & 1 \\ 3 & 3 & 0 \end{smallmatrix}$ & work = 2, 1, 0
 since need > work, P_0 must wait

II) for P_1 ,

need = 1, 1, 0 & work = 2, 1, 0
 Since need < work, P_1 must be kept in safe sequence.

$$\begin{aligned} \text{new allocation}_1 &= \text{allocation} + \text{need} \\ &= (2, 1, 2) + (1, 1, 0) \\ &= (3, 2, 2) \end{aligned}$$

$$\begin{aligned} \text{available} &= \text{available} - \text{need} \\ &= (2, 1, 0) - (1, 1, 0) \\ &= (1, 1, 0) \end{aligned}$$

III) for P_2 ,

need = (5, 0, 1) & work = 4, 2, 2
 since need > work, P_2 must wait.

IV) for P_3 ,

need = 7, 3, 3 & work = 4, 2, 2
 since need > work, P_3 must wait.

V) for P_4 ,

$$\text{need} = 0, 0, 0 \quad \& \quad \text{work} = 4, 2, 2$$

since $\text{need} < \text{work}$, P_4 must be kept in safe sequence.

$$\begin{aligned} \text{available} &= \text{available} - \text{need} \\ &= (4, 2, 2) - (0, 0, 0) \\ &= (4, 2, 2) \end{aligned}$$

$$\begin{aligned} \text{available for next process after execution of } P_4 \text{ is,} \\ \text{new allocation} + \text{available} \\ &= (1, 1, 2) + (4, 2, 2) \\ &= (5, 3, 4) \end{aligned}$$

VI) for P_0 ,

need $<$ work

$$\begin{aligned} \text{new allocation} &= \text{allocation} + \text{need} \\ &= (1, 1, 2) + (3, 2, 1) \\ &= (4, 3, 3) \end{aligned}$$

$$\begin{aligned} \text{Available} &= \text{available} - \text{need} \\ &= (5, 3, 4) - (3, 2, 1) \\ &= (2, 1, 3) \end{aligned}$$

After execution of P_0 ,

$$\begin{aligned} \text{available} &= \text{available} + \text{new allocation} \\ &= (2, 1, 3) + (4, 3, 3) \\ &= (6, 4, 6) \end{aligned}$$

VII) for P_2 ,

need $<$ work

$$\begin{aligned} \text{new allocation} &= \text{allocation} + \text{need} \\ &= (4, 0, 1) + (5, 0, 1) \\ &= (9, 0, 2) \end{aligned}$$

$$\begin{aligned} \text{available} &= \text{available} - \text{need} \\ &= (6, 4, 6) - (5, 0, 1) \\ &= (1, 4, 5) \end{aligned}$$

After execution of P_2 ,

$$\begin{aligned} \text{available} &= \text{available} + \text{new allocation} \\ &= (1, 4, 5) + (9, 0, 2) \\ &= (10, 4, 7) \end{aligned}$$

VIII) for P_3 ,

need $<$ work,

new allocation = allocation + need

$$= (0, 2, 0) + (7, 3, 3)$$

$$= (7, 5, 3)$$

Available = available - need

$$= (10, 8, 7) - (7, 5, 3)$$

$$= (3, 1, 4)$$

after execution of P_3 ,

available = available + new allocation

$$= (3, 1, 4) + (7, 5, 3)$$

$$= (10, 6, 7)$$

The system is in safe mode.

Safe sequence: $P_1 \rightarrow P_4 \rightarrow P_0 \rightarrow P_2 \rightarrow P_3$

(c) Total number of ~~matrix~~ resources of each type,

= total available resource

= allocated resources + available

$$= (8, 5, 7) + (2, 1, 0)$$

$$= (10, 6, 7)$$