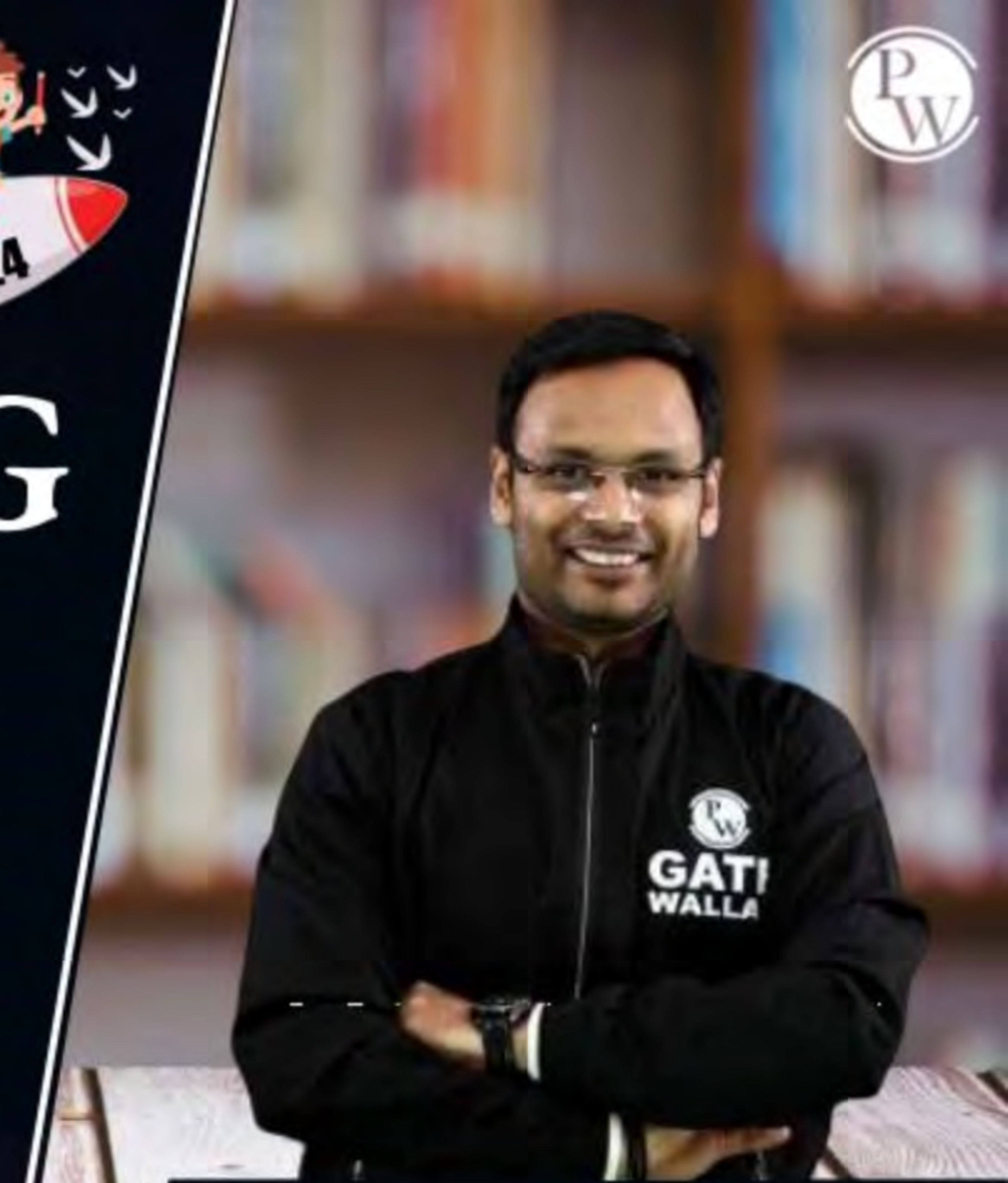
CS & IT ENGINEERING

Operating System



Deadlock

Lecture - 03

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Recap of Previous Lecture

Topic Deadlock

Topic Deadlock Prevention

Topic Deadlock Avoidance

Topics to be Covered

Topic Deadlock Avoidance

Topic Banker's Safety Algorithm

Topic Banker's Resource Request Algorithm

Topic : Deadlock Avoidance

In deadlock avoidance, the request for any resource will be granted if the resulting state of the system doesn't cause deadlock in the system.

Topic : Banker's Algorithm

The banker's algorithm is a resource allocation and deadlock avoidance algorithm that tests for safety

Banker's algo :-

1. safety algo ⇒ it checks whether system is in safe state or not.

2. Resource Request Algo

Banker's Algo :-

Requirement :- Every process must announcement the max. no. of instances of each resource before the process starts execution.

It is practically not possible.

Hence banker's algo is not implemented practically.

Topic : Banker's Algorithm

already allocated to process

max no. of instances of resource needed to process for execution

Process	Allocation	Max	Available
P1	1	3	1
P2	5	8	
P3	3	4	
P4	2	7	

no. of available instances of resource in system

$$\text{available} = \text{Total no. of instances} - \sum_{i=}^{n} \text{Allocation}_i$$

Topic : Banker's Algorithm

no. of needed instances to completely execute the process

↓

Process	Allocation	Max	Available	Need = Max − Allocation
P1	1	3	~~1~~	2
P2	5	8	After P3 ⇒ 4	3
P3	3	4	After P1 ⇒ 5 After P2 ⇒ 10	1
P4	2	7	After P4 ⇒ 12	5

find one process P_i for which $Need_i \leq Available$

1. P_3 is such process.

After P_3 ⇒ $Available = Available + Allocation_3$

$= 1 + 3$

$= 4$

2. P1 has $need_1 \le available$

after P1 $\Rightarrow$ Available $= 4+1=5$

3. P2 has $need_2 \le available$

after P2 $\Rightarrow$ available $= 5+5 = 10$

4. P4 has $need_4 \le available$

after P4 $\Rightarrow$ available $= 10+2 = 12$

All process can finish hence

$\Downarrow$

system is in safe state

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safe sequence

<P3, P1, P2, P4>

or

<P3, P2, P1, P4>

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multiple safe sequences are possible.

Topic : Banker's Algorithm

Safe

Process	Allocation	Max	Available	Need
	A B C	A B C	A B C	A B C
P_0	0 1 0	7 5 3	3 3 2	7 4 3 ✓
P_1	2 0 0	3 2 2	After P1 5 3 2	1 2 2 ✓
P_2	3 0 2	9 0 2	After P3 7 4 3	6 0 0
P_3	2 1 1	2 2 2	After P0 7 5 3	0 1 1 ✓
P4	0 0 2	4 3 3	After P2 10 5 5	4 3 1
			After P4 10 5 7	

available

After P1, P3 ⇒ 7 4 3

⇓

which is greater than or equal to need of all remaining processes P0, P2, P4.

Hence we can conclude here itself that system is in safe state.

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safe sequne ⇒ P1, P3, (P0, P2, P4)!

⇒ P3, P1, (P0, P2, P4)!

Topic : Banker's Algorithm

1. Allocation:
2. Max:
3. Need:
4. Available:

Topic : Banker's Algorithm

1. Let Work and Finish be vectors of length 'm' and 'n' respectively.
   Initialize: Work = Available
   Finish[i] = false; for i=1, 2, 3, 4….n
2. Find an i such that both (a) Finish[i] = false
   (b) Needi <= Work
   if no such i exists goto step (4)
3. Work = Work + Allocation[i]
   Finish[i] = true goto step (2)
4. If Finish [i] = true for all i
   then the system is in a safe state

#Q. safe or not

Process	Allocation A B C D	Max A B C D	Available A B C D	Need A B C D
P1	0 0 1 2	0 0 1 2	~~1 5 2 0~~	0 0 0 0
P2	1 0 0 0	1 7 5 0	P1 1 5 3 2	0 7 5 0
P3	1 3 5 4	2 3 5 6	P3 2 8 8 6	1 0 0 2
P4	0 6 3 2	0 6 5 4		0 0 2 2
P5	0 0 1 4	0 6 5 6		0 6 4 2

safe state <P1, P3, P2, P4, P5>

Topic : Banker's Algorithm

Resource Request Algo

Process	Allocation	Max	Available	Need
	A B C	A B C	A B C	A B C
P_0	~~0 1 0~~ 1 1 2	7 5 3	~~3 3 2~~ 2 3 0	~~7 4 3~~ 6 4 1
P_1	2 0 0	3 2 2		1 2 2
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

Unsafe state because no any process has $Need_i \le available$

$\Downarrow$

hence request Rejected

[NAT]

(Rejected)

#Q. What will happen if process P0 requests one additional instance of resource type A and two instances of resource type C ?

$Request_0 \langle 1, 0, 2 \rangle$

1. if $Request_i \leq Need_i$ then goto step 2
else invalid request

2. if $Request_i \leq Available$ then goto step 3
process will wait

3. $Available = Available - Request_i$
$Allocation_i = Allocation_i + Request_i$
$Need_i = Need_i - Request_i$

4. Run safety algo.
If safe then grant request.
Else request rejected

Topic : Banker's Algorithm

H.W.

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 2	4 3 3	

[NAT]

#Q. What will happen if process P3 requests one additional instance of resource type B ?

$$request_3 = \langle 0, 1, 0 \rangle$$

2 mins Summary

Topic Deadlock Avoidance

Topic Banker's Safety Algorithm

Topic Banker's Resource Request Algorithm

Happy Learning

THANK - YOU