

# Operating System: Deadlock Detection & Recovery

By: Vishvadeep Gothi



# VISHVADEEP GOTHI SIR

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in GATE**



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Mtech BITS Pilani in Data  
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To Unlock, Use code

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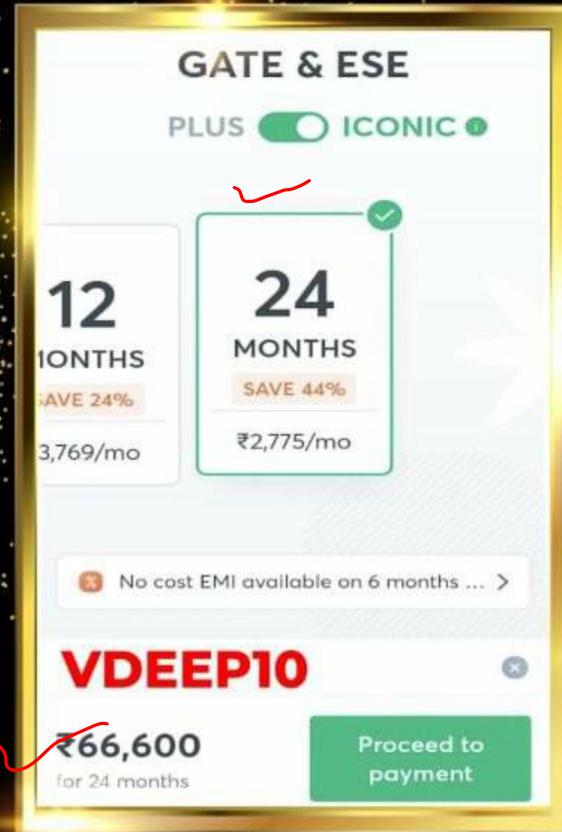
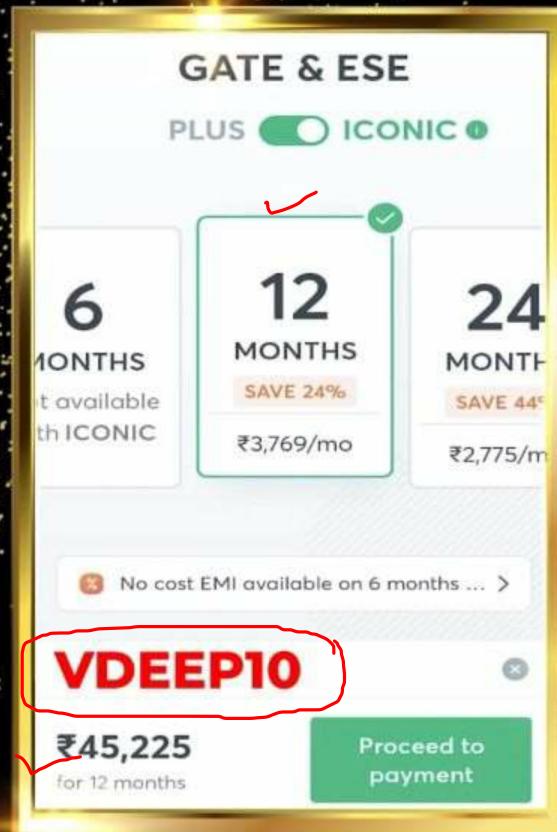
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# Recovery From Deadlock

1. Make Sure that deadlock never occur
  - Prevent the system from deadlock or avoid deadlock
2. Allow deadlock, detect and recover
3. Pretend that there is no any deadlock



# Deadlock Detection

1. When all resources have single instance
2. When resources have multiple instances

*wait-for-graph*

*L→ detect<sup>n</sup> algo*

# Deadlock Detection

When all resources have single instance:

Deadlock detection is done using [wait-for-graph](#)



# Wait For Graph

It is created from resource allocation graph

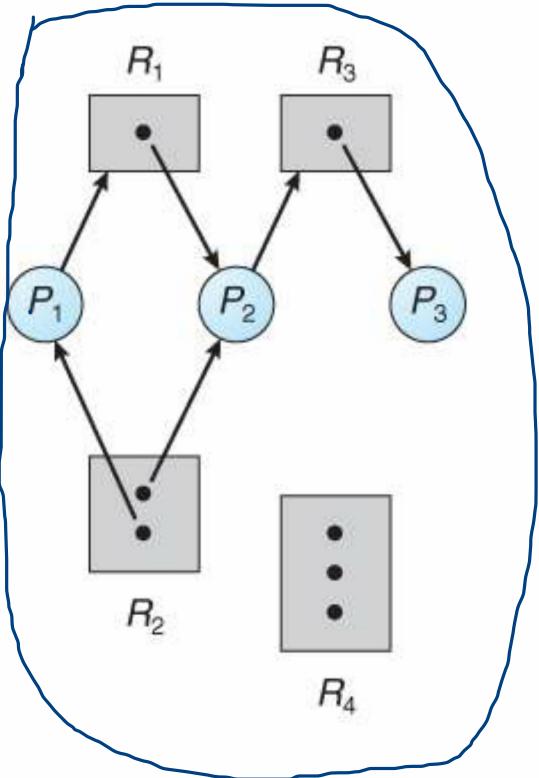


Req. edge : process to resource



Allocat'n edge : instance to process

# Wait For Graph



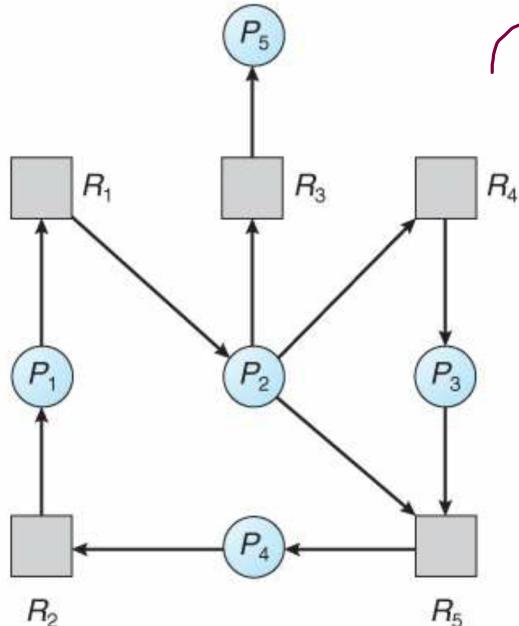
# Wait For Graph

Vertices  $\Rightarrow$  only process

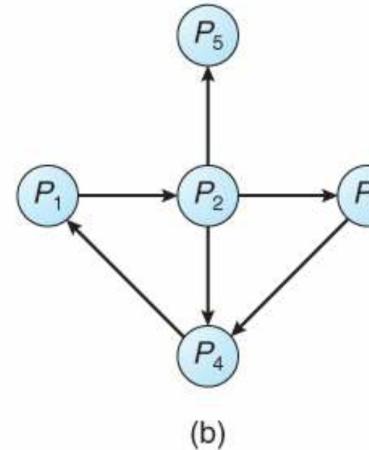
edge:- from  $p_i$  to  $p_j$

process  $p_i$  is waiting for a resource which is held by  $p_j$ .

deadlock



resource allocation graph



wait-for-graph

Wait for graph:-

If a cycle exists then  $\Rightarrow$  deadlock

Processes deadlocked  $\Rightarrow$

$p_1, p_2, p_3, p_4$

↓  
part of cycle.

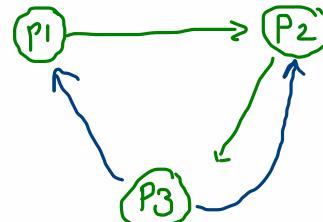
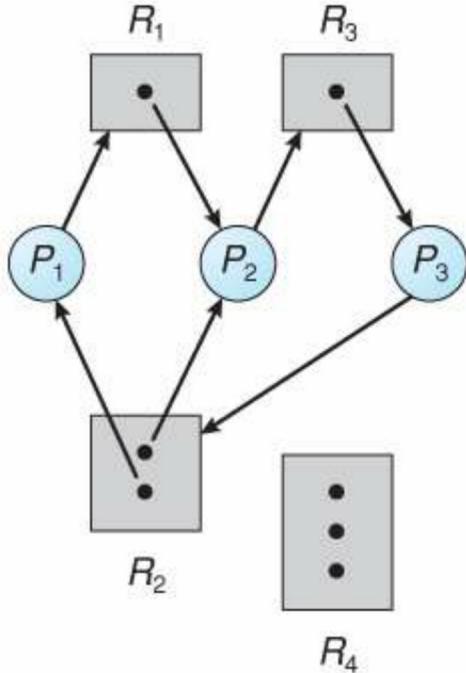
$p_5$  can completely execute.

# Wait For Graph

If a resource category contains more than one instance, then the presence of a cycle in the resource-allocation graph indicates the possibility of a deadlock, but does not guarantee one.

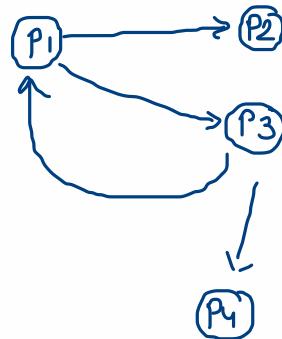
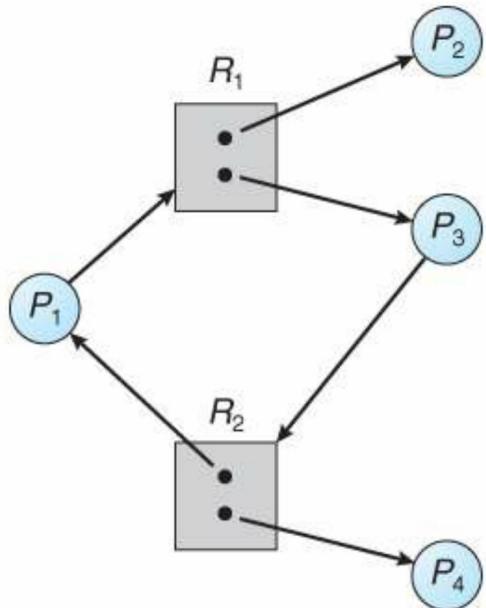


# Wait For Graph: Example



deadlock  $\Rightarrow$  yes

# Wait For Graph: Example



cycle  $\Rightarrow$  yes  
deadlock  $\Rightarrow$  no

# Deadlock Detection

When resources have multiple instance:

Deadlock detection is done using a specific algorithm



# Deadlock Detection Algorithm

	<u>Allocation</u>	<u>Request</u>	<u>Available</u>
	A B C	A B C	A B C
$P_0$	0 1 0	0 0 0	0 0 0
$P_1$	2 0 0	2 0 2	
$P_2$	3 0 3	0 0 0	
$P_3$	2 1 1	1 0 0	
$P_4$	0 0 2	0 0 2	

	available		
	A	B	C
after $p_0$	0	1	0
after $p_2$	3	1	3
after $p_1$	5	1	3
after $p_3$	7	2	4
after $p_4$	7	2	6

If all processes can execute  $\Rightarrow$  no deadlock.

# Deadlock Detection Algorithm

1. Let  $Work$  and  $Finish$  be vectors of length  $m$  and  $n$  respectively.  
Initialize  $Work = Available$ . For  $i=0, 1, \dots, n-1$ , if  $Request_i = 0$ , then  $Finish[i] = true$ ;  
otherwise,  $Finish[i] = false$ .
2. Find an index  $i$  such that both
  - a)  $Finish[i] == false$
  - b)  $Request_i \leq Work$If no such  $i$  exists go to step 4.
3.  $Work = Work + Allocation_i$   
 $Finish[i] = true$   
Go to Step 2.
4. If  $Finish[i] == false$  for some  $i$ ,  $0 \leq i < n$ ,  
then the system is in a deadlocked state.  
Moreover, if  $Finish[i] == false$  the process  $P_i$  is deadlocked.

# Detection-Algorithm Usage

When should the deadlock detection be done? Frequently, or infrequently?

# Detection-Algorithm Usage

1. Do deadlock detection after every resource allocation
2. Do deadlock detection only when there is some clue



# Recovery From Deadlock

There are three basic approaches to recovery from deadlock:

1. Inform the system operator and allow him/her to take manual intervention
2. Terminate one or more processes involved in the deadlock
3. Preempt resources.



# Process Termination

1. Terminate all processes involved in the deadlock
2. Terminate processes one by one until the deadlock is broken



# Process Termination



Many factors that can go into deciding which processes to terminate next:

1. Process priorities.
2. How long the process has been running, and how close it is to finishing.
3. How many and what type of resources is the process holding
4. How many more resources does the process need to complete
5. How many processes will need to be terminated
6. Whether the process is interactive or batch



# Resource Preemption

Important issues to be addressed when preempting resources to relieve deadlock:

1. Selecting a victim
2. Rollback
3. Starvation



# Next Class

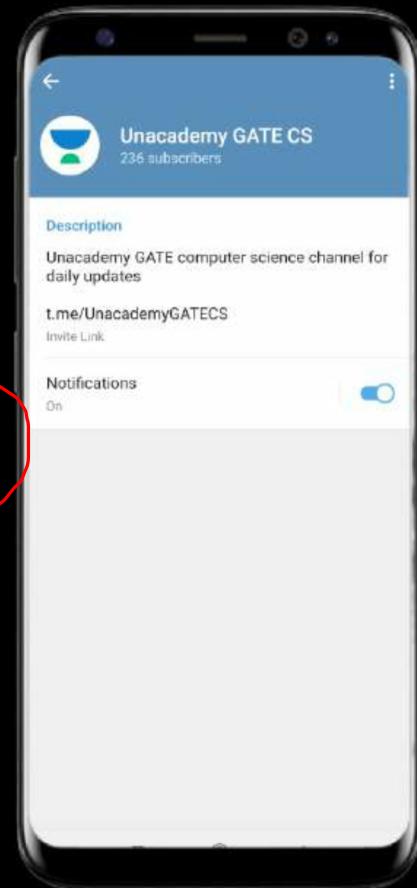
System Call

Fork()





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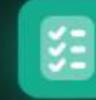


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