

Operating System: Deadlock Detection & Recovery

By: Vishvadeep Gothi



VISHVADEEP GOTHI SIR

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in GATE**



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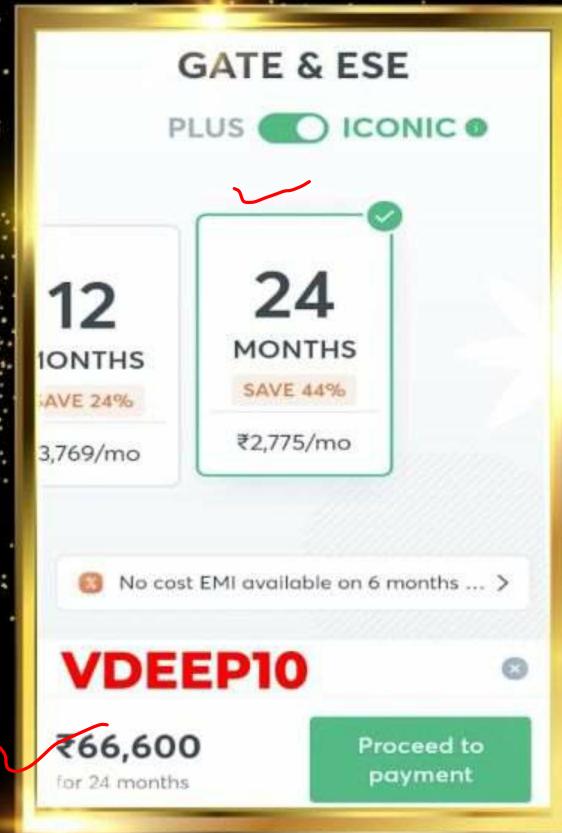
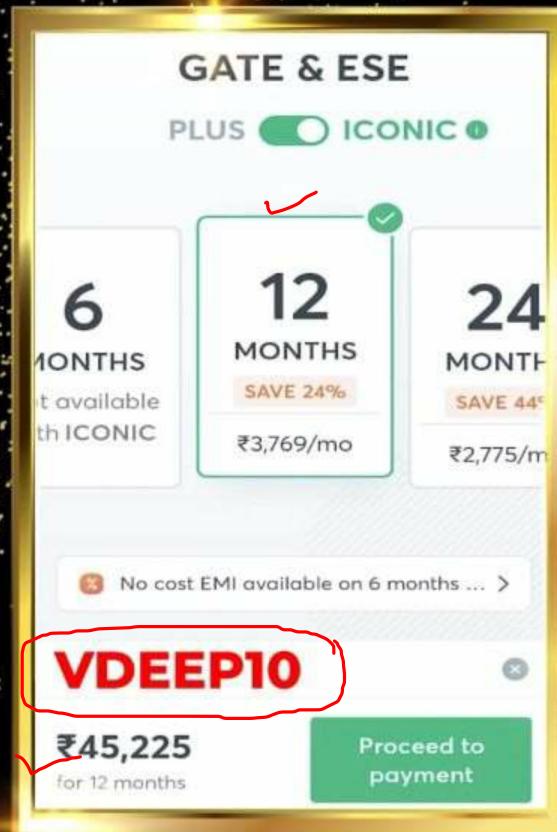
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Recovery From Deadlock

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→ detectⁿ 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

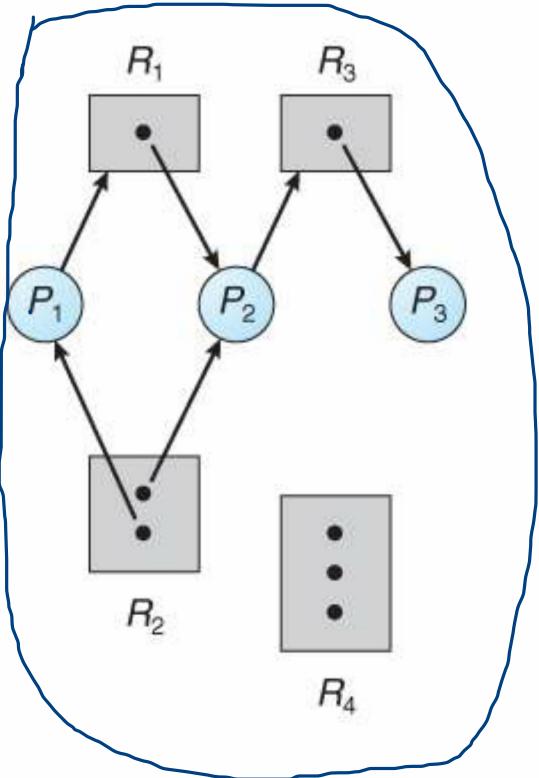


Req. edge : process to resource



Allocat'n edge : instance to process

Wait For Graph



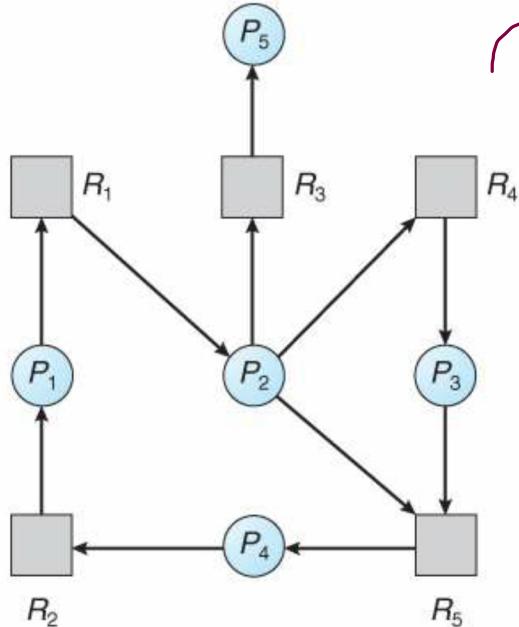
Wait For Graph

Vertices \Rightarrow only process

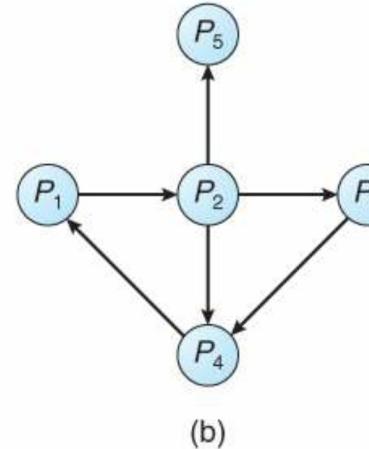
edge:- from p_i to p_j

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.

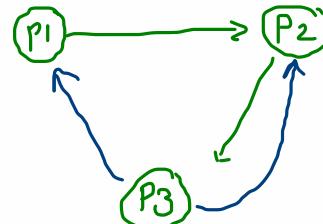
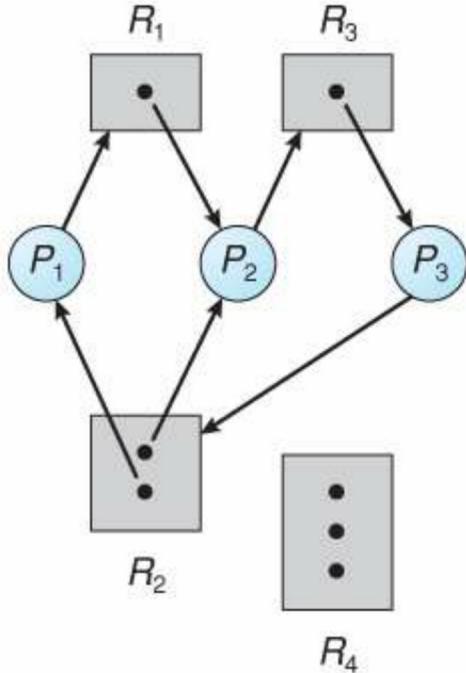
p_5 can completely execute.

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.

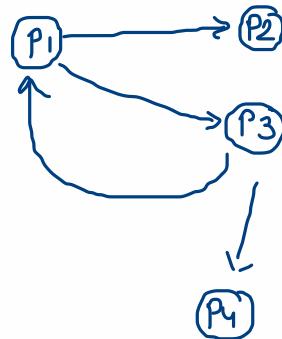
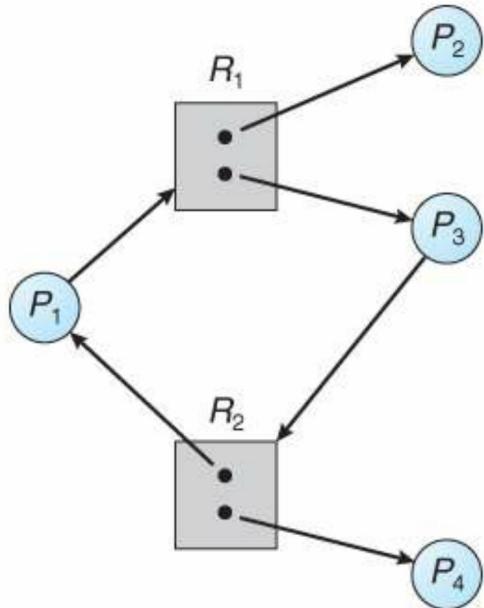


Wait For Graph: Example



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



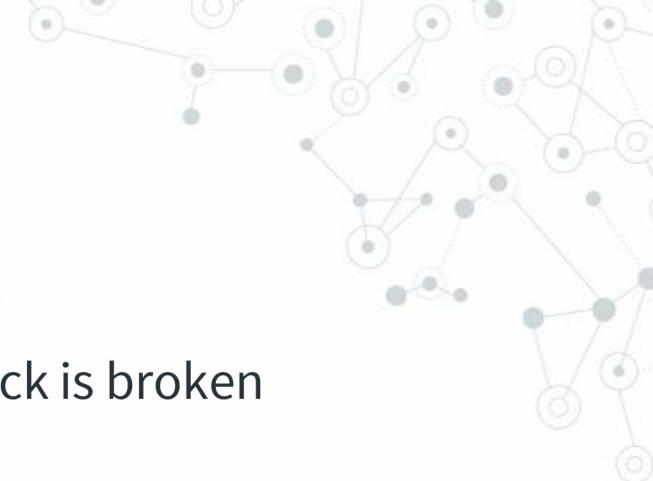
Recovery From Deadlock

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

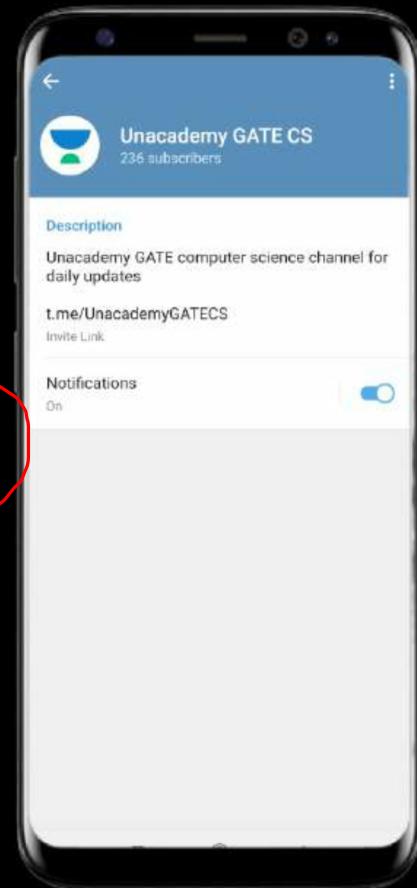
System Call

Fork()





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