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DEADLOCK

Deadlock Concept^{1/2}

- *Deadlock* scenario: A set of processes each holding a resource and waiting to acquire a resource held by another process in the set.

Example 1

System has 2 disk drives D1 and D2, each process (P1 and P2) hold one disk drive and each needs another one.

Example 2

Semaphores A and B, initialized to 1

P1

wait (A);

wait (B);

P2

wait(B)

wait(A)

System has 2 disk drives D1 and D2 each process (P1 and P2) hold one disk drive and each needs another one.

Deadlock Concept_{2/2}

- Resource types R_1, R_2, \dots, R_m
 - *CPU cycles, memory space, I/O devices*
- Each resource type R_i has W_i instances.
 - *Any instance of a resource of type R_i will satisfy a request for that resource type.*
- Each process utilizes a resource as follows:
 - Request
 - Use
 - Release

Deadlock Characterization

- Deadlock can arise if following four conditions hold *simultaneously*:

- Mutual exclusion

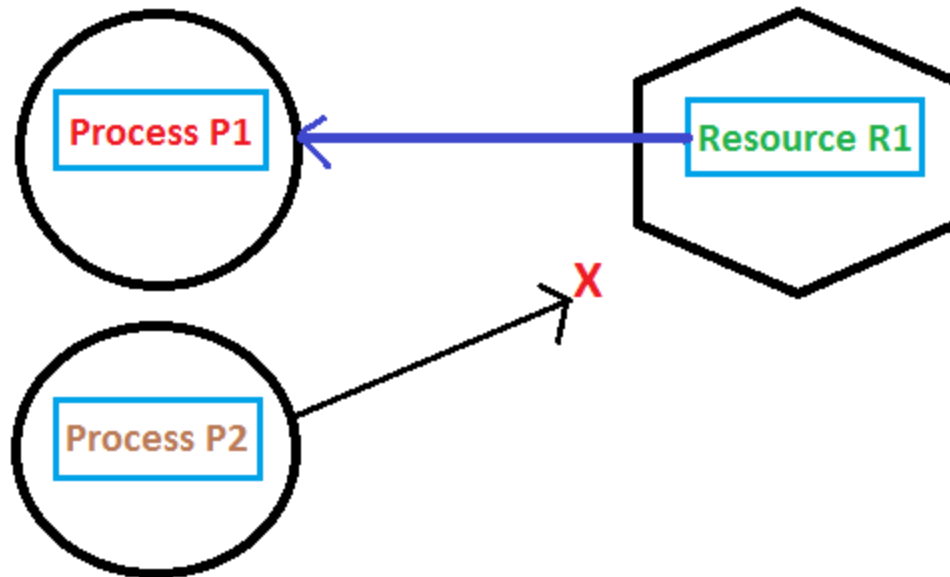
- Hold and wait

- No preemption

- Circular wait

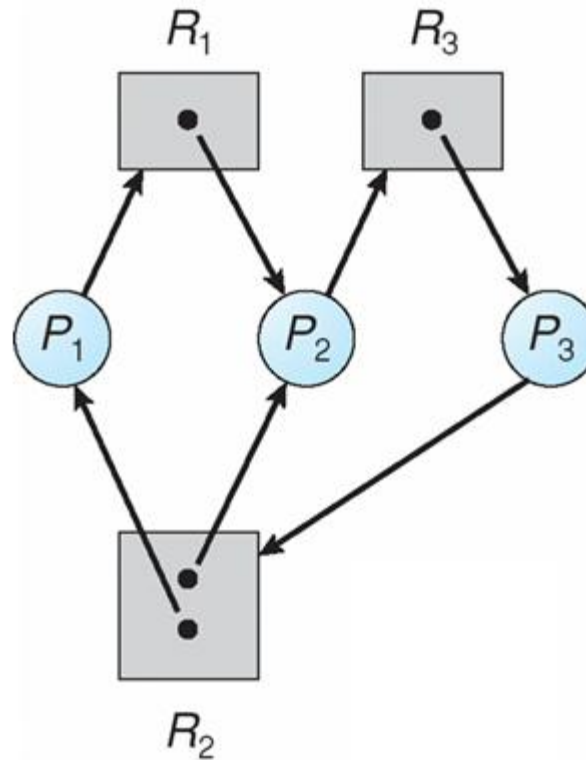
Mutual exclusion

- Only one process at a time can use a resource.



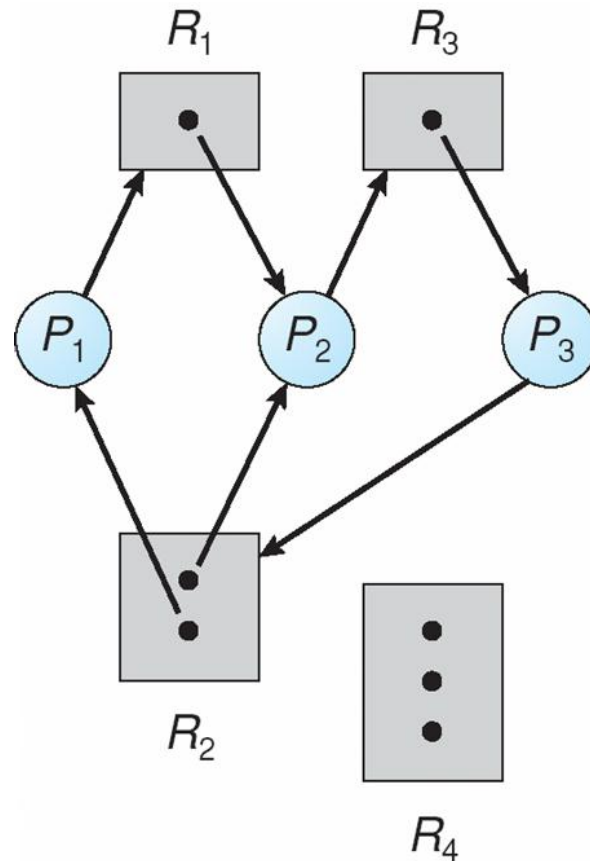
Hold and wait

- A process holding at least one resource, is waiting to acquire additional resources held by other processes.



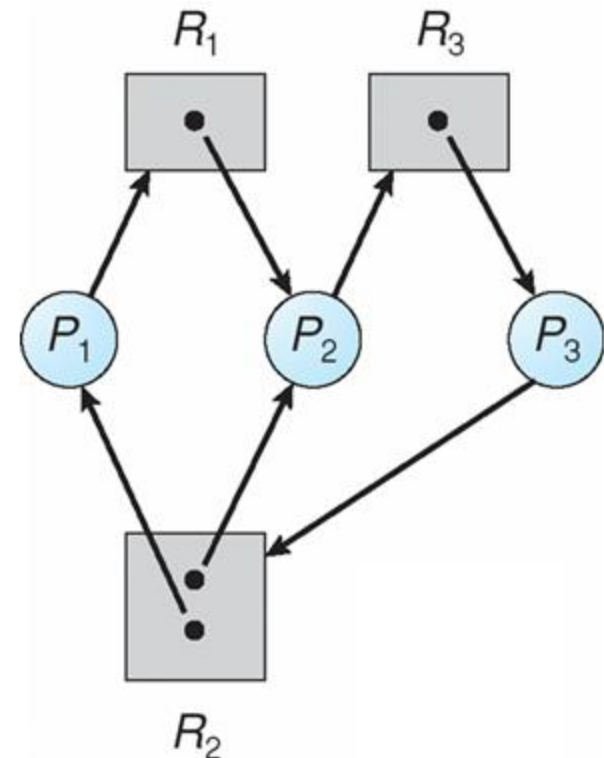
No preemption

- A resource can be released only voluntarily by the process holding it, after that process has completed its task.



Circular wait

- There exists a set $\{P_1, P_2, \dots, P_n\}$ of waiting processes such that:
 - P_1 is waiting for a resource that is held by P_2 ,
 - P_2 is waiting for a resource that is held by P_3, \dots ,
 - P_{n-1} is waiting for a resource that is held by P_n ,
 - P_n is waiting for a resource that is held by P_1 .



References

1. Silberschatz, Galvin and Gagne, “Operating Systems Concepts”, Wiley.
2. William Stallings, “Operating Systems: Internals and Design Principles”, 6th Edition, Pearson Education.
3. D M Dhamdhere, “Operating Systems: A Concept based Approach”, 2nd Edition, TMH.

Thank You.

