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CS-501

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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	**P2**
wait (A);	wait(B)
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 R1, R2, . . ., Rm
  - *CPU cycles, memory space, I/O devices*
- Each resource type Ri has Wi instances.
  - *Any instance of a resource of type Ri will satisfy a request for that resource type.*
- Each process utilizes a resource as follows:
  - Request
  - Use
  - Release

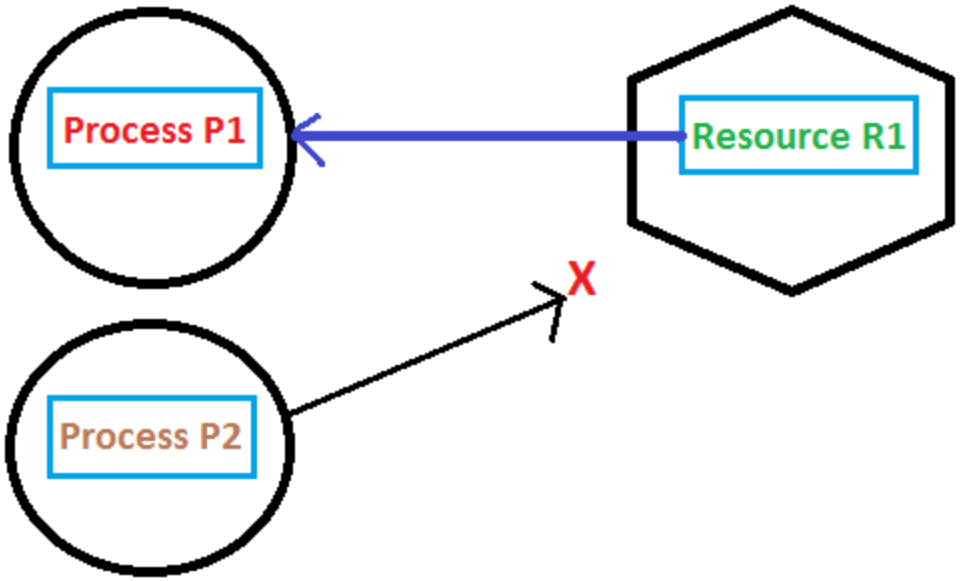
Deadlock Characterization

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

  - Mutual exclusion
  - Hold and wait
  - No preemption
  - Circular wait

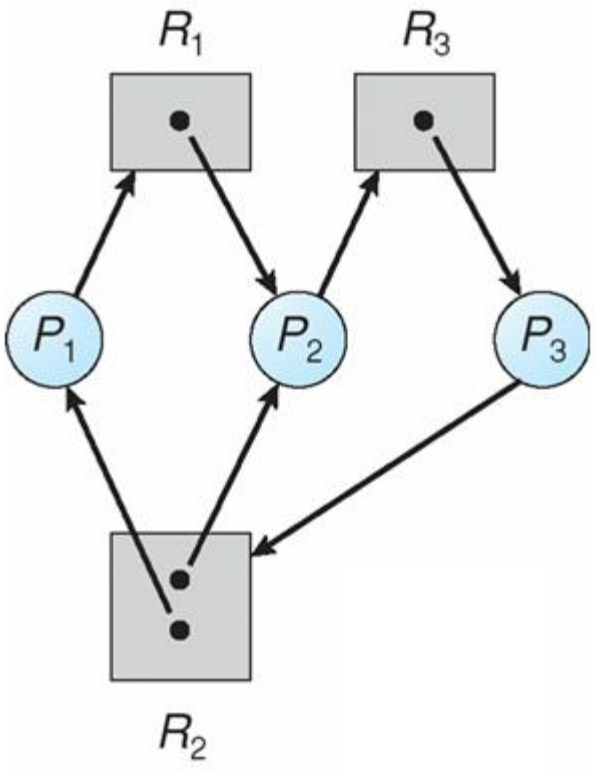
Mutual exclusion

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



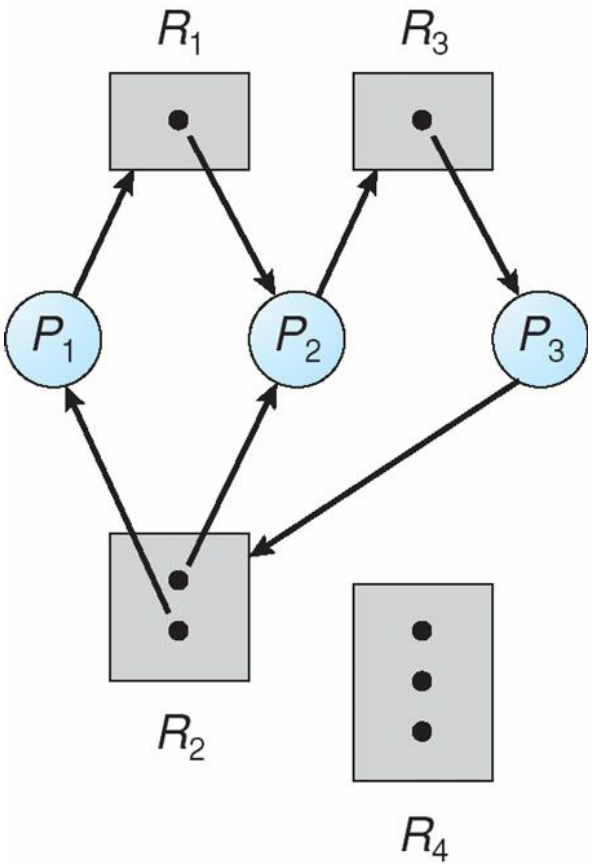
Hold and wait

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



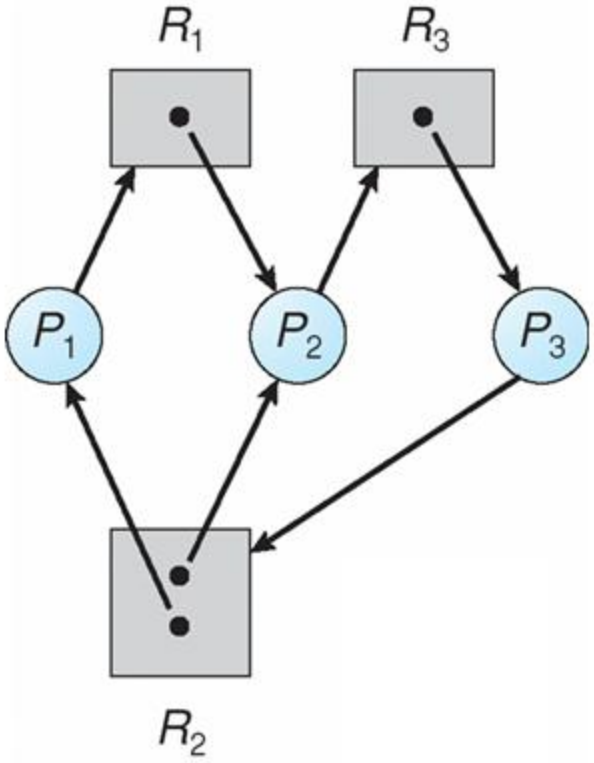
No preemption

- 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 {P1, P2, …, Pn} of waiting processes such that:
  - P1 is waiting for a resource that is held by P2,
  - P2 is waiting for a resource that is held by P3, …,
  - Pn–1 is waiting for a resource that is held by Pn,
  - Pn is waiting for a resource that is held by P1.



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.