CSE3241: Operating System and System Programming

Class-Deadlock

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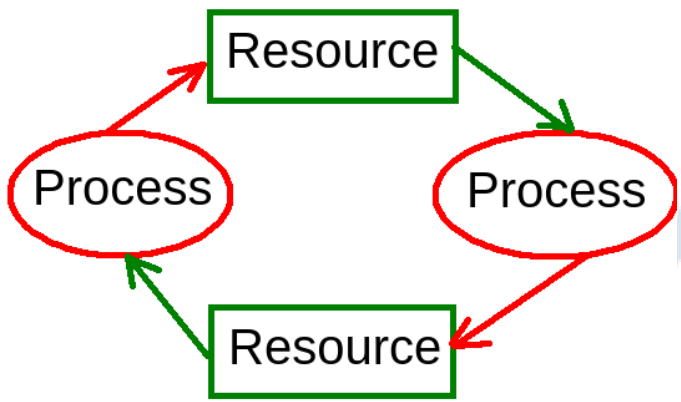
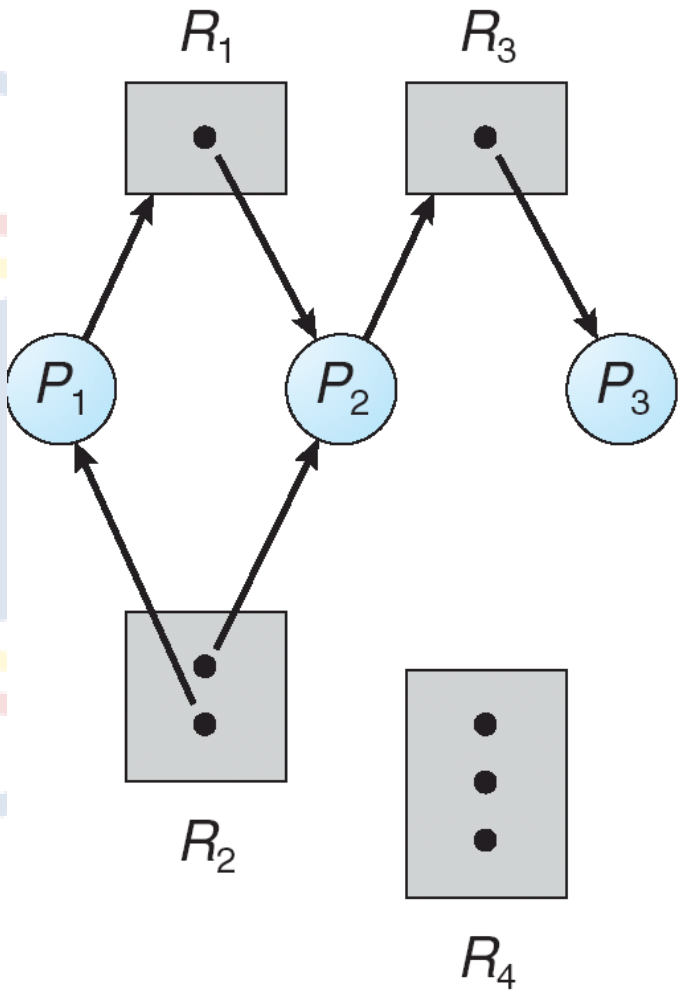
Deadlock

- Deadlock is a situation where two or multiple processes are blocked because each process is holding a resource and waiting for another resource acquired by some other process.



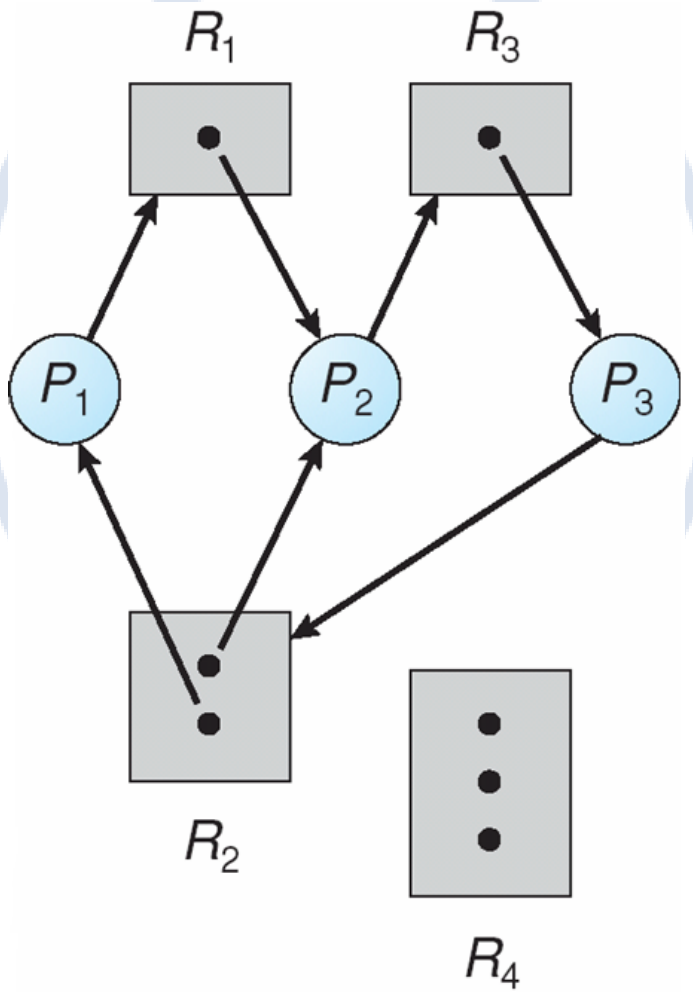
Resource Allocation Graph

- $P = \{P_1, P_2, .., P_n\}$: a set of processes in memory.
- $R = \{R_1, R_2, .., R_n\}$: a set of resources (e.g., regular file, pipe).
- $P_i -> R_j$: P_i has requested for resurce R_j.
- $R_j -> R_i$: resurce R_j is hold by process P_i.
- Dot : instance of a resource.



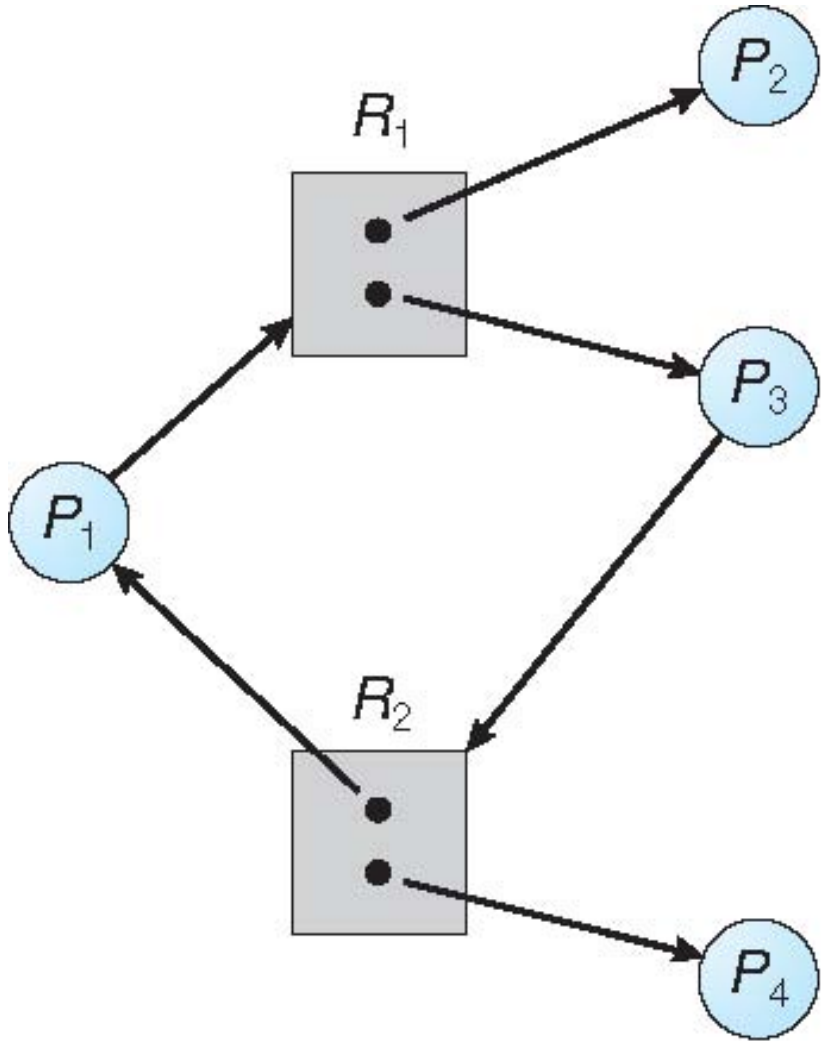
Resource Allocation Graph with Deadlock

- A cycle must need to be exist in a deadlock graph:
  - $P_1 -- > R_1 -- > P_2 -- > R_3 -- > P_3 -- > R_2 -- > P_1$
  - $P_2 -- > R_3 -- > P_3 -- > R_2 -- > P_2$



Resource Allocation Graph without Deadlock

- A cycle does not ensure deadlock situation:
  - $P_1 -- > R_1 -- > P_3 -- > R_2 -- > P_1$



Facts

- If graph contains no cycles
  - no deadlock
- If graph contains a cycle
  - if only one instance per resource type, then deadlock
  - if several instances per resource type, possibility of deadlock

Approaches of Handling Deadlock

- Deadlock can be handled by one of three ways:
  - **Pretend**: Pretend deadlock will never happen.
    - used by most operating systems, including UNIX
  - **Prevent or Avoid**: Ensure that the system will never enter a deadlock state.
  - **Detect and Recover**: Let system to enter a deadlock state and then take a step to recover.

How to Pretend: Ostrich Algorithm

- **Algorithm**: Bury head in the sand and ignore or refuse to think about a problem or something unpleasant.
  - It is upto application developers to handle deadlocks.
  - Mathematicians found it completely unacceptable.
  - Many OS engineers love to embrace this algorithm.
  - Most operating systems implement it including: UNIX, Linux, Microsoft Windows.

Ostrich Bird [Thanks to BBC ScienceFocus Magazine]