

CSE3241: Operating System and System Programming

Class-Deadlock

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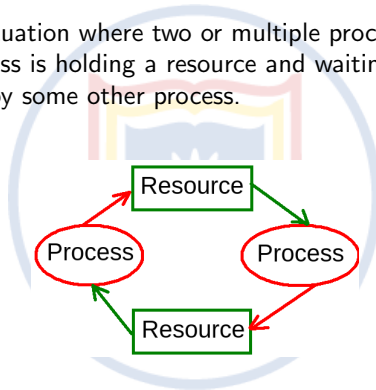
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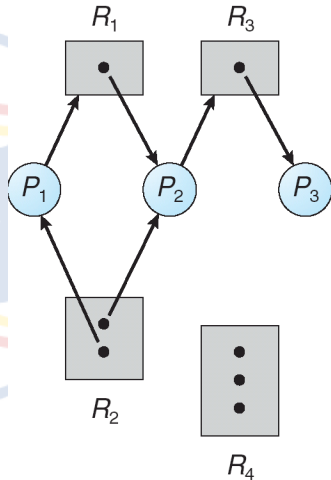
Deadlock

■ 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

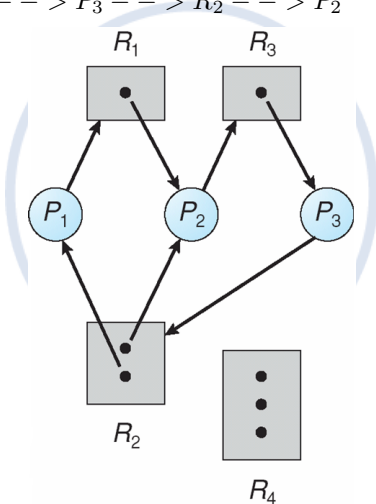
- $P = \{P_1, P_2, \dots, P_n\}$: a set of processes in memory.
- $R = \{R_1, R_2, \dots, R_n\}$: a set of resources (e.g., regular file, pipe).
- $P_i \rightarrow R_j$: P_i has requested for resource R_j .
- $R_j \rightarrow P_i$: resource R_j is hold by process P_i .
- Dot : instance of a resource.



Resource Allocation Graph with Deadlock

■ A cycle must need to be exist in a deadlock graph:

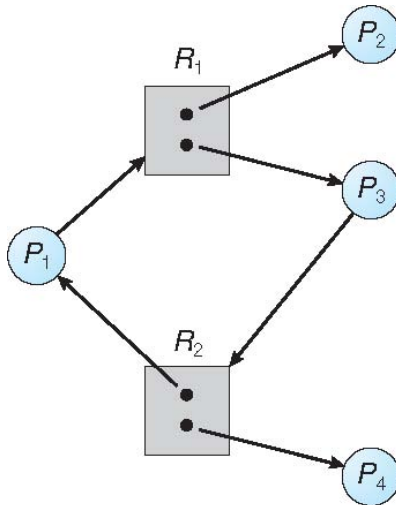
- ▶ $P_1 \rightarrow R_1 \rightarrow P_2 \rightarrow R_3 \rightarrow P_3 \rightarrow R_2 \rightarrow P_1$
- ▶ $P_2 \rightarrow R_3 \rightarrow P_3 \rightarrow R_2 \rightarrow P_2$



Resource Allocation Graph without Deadlock

■ A cycle does not ensure deadlock situation:

► $P_1 \dashrightarrow R_1 \dashrightarrow P_3 \dashrightarrow R_2 \dashrightarrow P_1$



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]

