# CSC 112: Computer Operating Systems
# Lecture 4

## Deadlocks Exercises

Department of Computer Science,
Hofstra University

Acknowledgement: Lecture slides based on UC Berkeley CS 162: Operating Systems and System Programming

# Quiz: Dining Lawyers I

- If each lawyer has 2 arms, and there is a pile of knives and forks at center of the table. Assume there are at least 1 knife and 1 fork, so at least one lawyer can eat. (There is no other constraint on the numbers of knives, forks, or lawyers.) Each lawyer follows the following steps:
- (1) Pick up a knife
- (2) Pick up a fork
- (3) Eat
- (4) Return the knife and fork to the pile
- Q: Can the system be deadlocked?

# Quiz: Dining Lawyers II

- If each lawyer has 4 arms, and there is a pile of knives and forks at center of the table. Assume there are at least 2 knives and 2 forks, so at least one lawyer can eat. Each lawyer follows the following steps:
- (1) Pick up 2 knives atomically
- (2) Pick up 2 forks atomically
- (3) Eat
- (4) Return the knives and forks to the pile
- Q: Can the system be deadlocked?

# Quiz: Dining Lawyers III

- If each lawyer has 4 arms, and there is a pile of knives and forks at center of the table. Assume there are at least 2 knives and 2 forks, so at least one lawyer can eat. Each lawyer follows the following steps:
- (1) Pick up a knife
- (2) Pick up another knife
- (3) Pick up a fork
- (4) Pick up another fork
- (5) Eat
- (6) Return the knife and fork to the pile
- Q1: Can the system be deadlocked?
- Q2: What if each lawyer may have a different number of arms, and may request a different ratio of knives vs. forks?

# Quiz: Banker's algorithm

- 4 threads P0 through P4; 4 resource types with 10, 5, 6, 5 instances each.
- Current system state encoded in matrices *R, C* and vector *E.*

Total Request matrix

$$R = \begin{bmatrix} 7 & 5 & 3 \\ 3 & 2 & 2 \\ 9 & 0 & 2 \\ 2 & 2 & 2 \\ 4 & 3 & 3 \end{bmatrix}$$

Current allocation matrix

$$C = \begin{bmatrix} 0 & 1 & 0 \\ 2 & 0 & 0 \\ 3 & 0 & 2 \\ 2 & 1 & 1 \\ 0 & 0 & 2 \end{bmatrix}$$

Resources in existence

$$E = [10 \quad 5 \quad 7]$$

Resources available

$$A = [3 \quad 3 \quad 2]$$

# Quiz: Deadlocks II

- Is there a possible deadlock?

```
 1   Semaphore L1=1, L2=1, L3=1;
 2
 3   // Thread 1:
 4   L1.wait();
 5   L2.wait();
 6   // critical section requiring L1 and L2 locked.
 7   L2.post();
 8   L1.post();
 9
10   // Thread 2:
11   L3.wait();
12   L1.wait();
13   // critical section requiring L3 and L1 locked.
14   L1.post();
15   L3.post();
16
17   // Thread 3:
18   L2.wait();
19   L3.wait();
20   // critical section requiring L2 and L3 locked.
21   L3.post();
22   L2.post();
```