CSCE 313-201
Introduction to Computer Systems
Fall 2020

Practice
Dmitri Loguinov
Texas A&M University

September 24, 2020
Semaphore Problems

• Concurrency is a difficult concept
  – Hard to fully understand without practice
• Threads are replaced with arbitrary actors
  – E.g., “no more than 15 animals can enter the room”
• Rules for semaphore/mutex solutions
• 1) All wait() functions are blocking
  – No timeouts to break out of deadlocks
• 2) No looping while waiting for events
  – Example on the right is not acceptable →
• 3) Bulk semaphore release(N) is available
• 4) Semaphore release beyond max throws an error

```cpp
mutex.Lock();
while (Q.size() == 0)
    mutex.Unlock()
    Sleep
mutex.Lock()
```
Semaphore Problems

• In programs, you can obviously violate these rules
  – However, tests will require less-straightforward approaches that demonstrate your grasp of synchronization theory

• Exam preparation guide:
  – Little Book of Semaphores
  – http://greenteapress.com/semaphores/

• Make sure to actively attempt solving problems
  – Tests will have similar levels of difficulty

• Problem #1
  – Bears and goats come to a party; however, the barn can hold only 15 animals max

```c
void EnterBarn (void) {
  // called when animal wants to enter
}

void Party (void) {
  // called when partying
}
```
### Semaphore Problems

- **Problem #2**
  - Barn holds no more than 8 bears and no more than 12 goats at any time

- **Problem #3**
  - No more than 8 bears, no more than 12 goats, and no more than 15 combined

- **Problem #4**
  - First animal to enter turns on the lights
  - Last animal to exit turns off lights
  - Nobody can enter or leave while lights are being manipulated

- **Problem #5**
  - If Pig (assumed to be unique) shows up to party, no other animal can enter until Pig voluntarily leaves
Semaphore Problems

• Problem #6
  - Pig wants to crash the party, but with style
  - If Pig arrives and fewer than 50 animals are in barn, it waits
  - While Pig is waiting, new animals may enter or depart; once critical mass of 50 is reached, the pig crashes party
  - While Pig is inside, all arriving animals must wait outside until Pig departs

• Problem #7
  - Same as #6, but Pig locks the door, nobody can leave

• Problem #8
  - If room is empty, any animal may enter
  - If room has someone inside, new animals must wait outside until they are allowed to enter by whoever is departing
  - Departing animal prefers to let animals of the same type in
Semaphore Problems

• Work on these at home
  - Were on the test last year

• Problem #9
  - Bears and goats come to party at the barn; main caveat is bears may get drunk and start eating goats
  - If barn is empty, either type of animal may enter
  - If bears are inside, arriving bears should enter without delay
  - If goats are inside, arriving goats should enter without delay

• Problem #10
  - Same as #9, but barn occupancy is 50 animals max

• Problem #11
  - Same as #9, but no starvation