CSCE 313-200
Introduction to Computer Systems
Spring 2018

Practice

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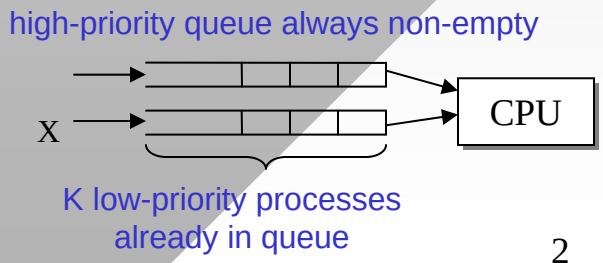
Midterm #1

```
for (int count = 0; count < 50; count++)
    tally ++;
  // converted by compiler to
  // __asm {
  //       mov       eax, tally
  //       inc       eax
  //       mov       tally, eax
  // }
```

- Problem 6
  - Part in bold is important to solving this question
  - Upper bound is sequential execution, we get 100
  - Lower bound?
- Problem 2: WRR queuing
  - If N jobs are pushed on the CPU, (1-w)N are from low-priority Q
  - Equating K = (1-w)N, we obtain N = K / (1-w) time slices
  - Total delay = N*Δ seconds where Δ is one slice delay

```
mov       eax, 0
// → switch




inc       eax (= 1)
mov       tally, 1
// switch →
...
mov       tally, 50
```

```
mov       eax, 0
inc       eax (=1)
mov       tally, eax
mov       eax, 1
...
mov       tally, 49
// ← switch

mov       eax, 1
// ← switch



inc       eax, (=2)
mov       tally, 2
```



Semaphore Problems

- Concurrency is a difficult concept
  - Cannot be understood 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

```
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

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

```
void Party (void) {
  // called when partying
}
```

Semaphore Problems

```
void LeaveBarn (int type) {
  // 0 = goat, 1 = bear
}
```

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

```
void EnterBarn (int type) {
  // 0 = goat, 1 = bear
}
```

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

```
void TurnOnLights(void) {
  // gets called if room is dark
}
```

- 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 ensures lack of starvation