Learning Objectives in this Part of the Module

- Appreciate the concept of semaphores
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• Appreciate the concept of semaphores
• Recognize the two types of semaphores
Learning Objectives in this Part of the Module

• Appreciate the concept of semaphores
• Recognize the two types of semaphores
• Know a human known use of semaphores
Overview of Semaphores
Overview of Semaphores

- A semaphore is conceptually an “object” that can be atomically incremented & decremented to control access to a shared resource.

See [en.wikipedia.org/wiki/Semaphore_(programming)](en.wikipedia.org/wiki/Semaphore_(programming))
Overview of Semaphores

- A semaphore is conceptually an “object” that can be atomically incremented & decremented to control access to a shared resource
  - e.g., originally used to control access to a shared railroad track

See en.wikipedia.org/wiki/Railway_semaphore_signal
Overview of Semaphores

- Concurrent programs use semaphores to coordinate interactions between multiple threads

See tutorials.jenkov.com/java-concurrency/semaphores.html
Overview of Semaphores

• Concurrent programs use semaphores to coordinate interactions between multiple threads, e.g.,
  • A semaphore can control the access of threads to a limited # of resources

See [www.youtube.com/watch?v=RAv71VbdkBc](http://www.youtube.com/watch?v=RAv71VbdkBc) for the Semaphore anthem ;-)
Overview of Semaphores

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  - It records a count ("permits") of how many units of a resource are available
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  - It provides operations to adjust the permit count atomically as units are acquired or released
  - Threads can wait (timed or blocking) until a unit of the resource is available
  - When a thread is done with a resource the permit count is incremented atomically & another waiting thread can acquire it
Overview of Semaphores

• There are two types of semaphores
Overview of Semaphores

- There are two types of semaphores
  - Counting semaphores

See javarevisited.blogspot.com/2012/05/counting-semaphore-example-in-java-5.html
Overview of Semaphores

• There are two types of semaphores
  • **Counting semaphores**
  • Have # of permits defined by a counter (N) with precise meaning
Overview of Semaphores

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  • **Counting semaphores**
    • Have # of permits defined by a counter (N) with precise meaning
      • **Negative**
        • exactly -N threads queued waiting to acquire semaphore
Overview of Semaphores

- There are two types of semaphores
  - **Counting semaphores**
    - Have # of permits defined by a counter (N) with precise meaning
      - **Negative**
      - **Zero** == no waiting threads
        - an acquire operation will block the invoking thread until the counter N is positive
Overview of Semaphores

• There are two types of semaphores
  • **Counting semaphores**
    • Have # of permits defined by a counter (N) with precise meaning
      • **Negative**
      • **Zero** = no waiting threads
      • **Positive** = no waiting threads
        • an acquire operation will not block the invoking thread
Overview of Semaphores

• There are two types of semaphores
  • Counting semaphores
  • Binary semaphores
Overview of Semaphores

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  • Counting semaphores
  • **Binary semaphores**
    • Have only 2 states: acquired (0) & not acquired (1)
Overview of Semaphores

- There are two types of semaphores
  - Counting semaphores
  - **Binary semaphores**
    - Have only 2 states: acquired (0) & not acquired (1)
    - Restrict the counter N to the values 0 & 1

In practice, binary semaphores are often implemented via counting semaphores
Overview of Semaphores

- We’ll analyze examples of counting & binary semaphores later
Overview of Semaphores

• We’ll analyze examples of counting & binary semaphores later, e.g.
• The PalantiriSimulator app use a counting semaphore

See github.com/douglascraigschmidt/CS891/tree/master/assignments
Overview of Semaphores

• We’ll analyze examples of counting & binary semaphores later, e.g.
  • The PalantiriSimulator app uses a counting semaphore
  • The Ping/Ping app uses a pair of binary semaphores

See github.com/douglasraigschmidt/LiveLessons/tree/master/PingPongApplication
Human Known Use of Semaphores
Human Known Uses of Semaphores

- A human known use of counting semaphores applies them to schedule access to beach volleyball courts

See en.wikipedia.org/wiki/Corona_del_Mar_State_Beach
Human Known Uses of Semaphores

- A human known use of counting semaphores applies them to schedule access to beach volleyball courts
- A bag full of balls is used to limit the number of teams that can concurrently play volleyball
End of Java Semaphores
(Part 1)