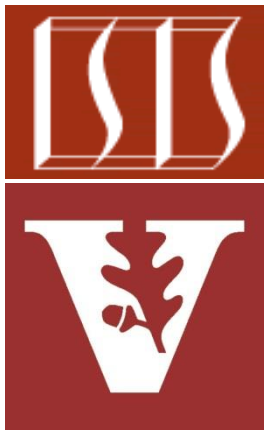
Java Semaphore (Part 1)

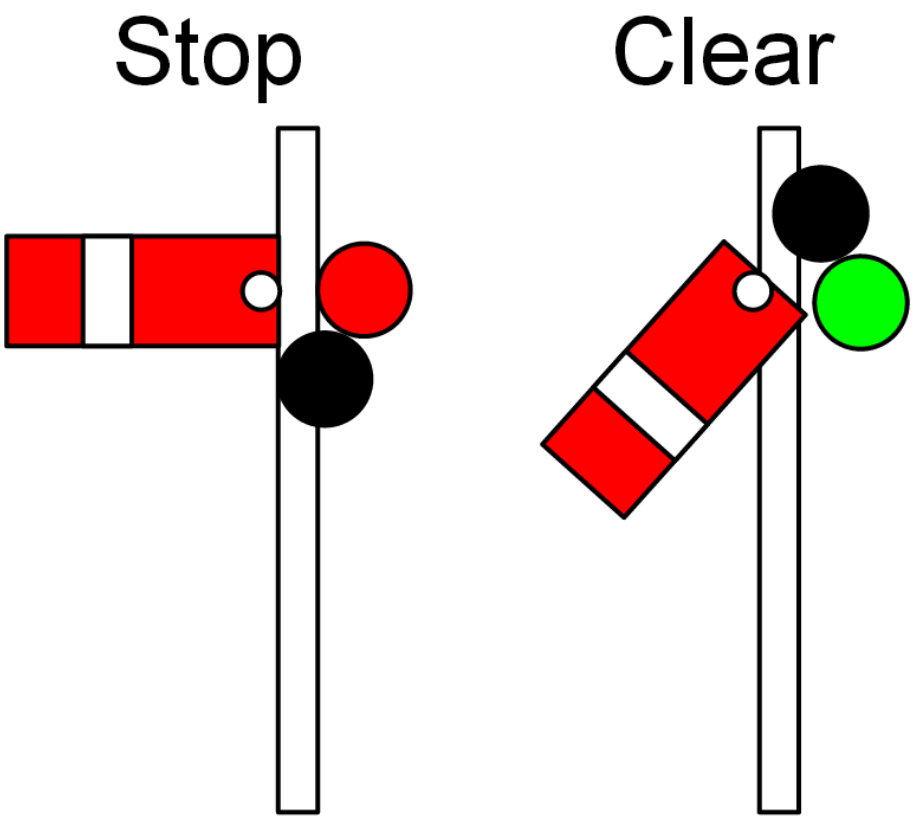


Douglas C. Schmidt
d.schmidt@vanderbilt.edu
www.dre.vanderbilt.edu/~schmidt

Institute for Software
Integrated Systems
Vanderbilt University
Nashville, Tennessee, USA

Learning Objectives in this Part of the Module

- Appreciate the concept of semaphores



Learning Objectives in this Part of the Module

- Appreciate the concept of semaphores
- Recognize the two types of semaphores

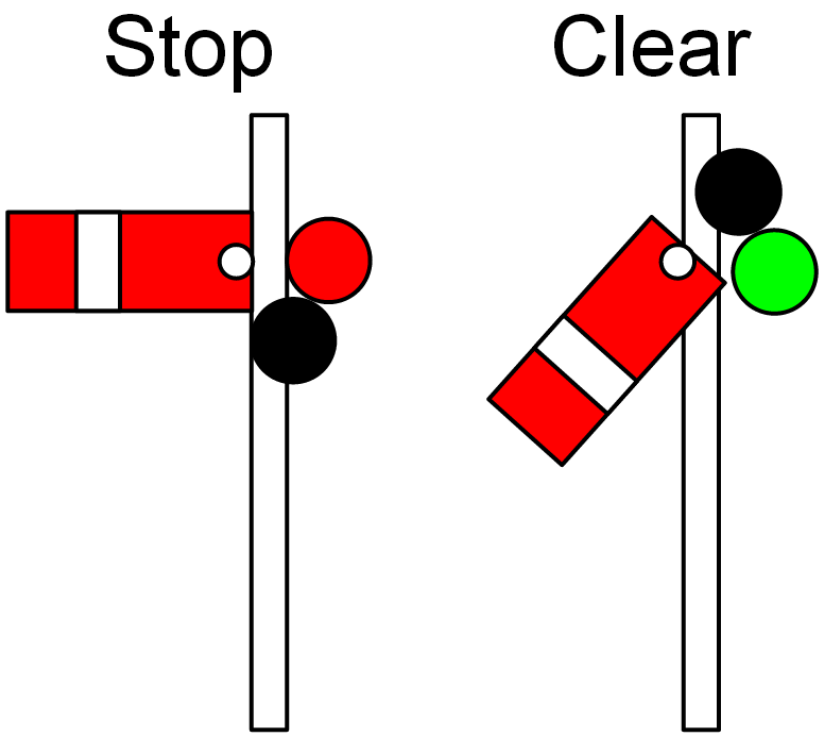
Learning Objectives in this Part of the Module

- Appreciate the concept of semaphores
- Recognize the two types of semaphores
- Know a human known use of semaphores

Overview of Semaphores

Overview of Semaphores

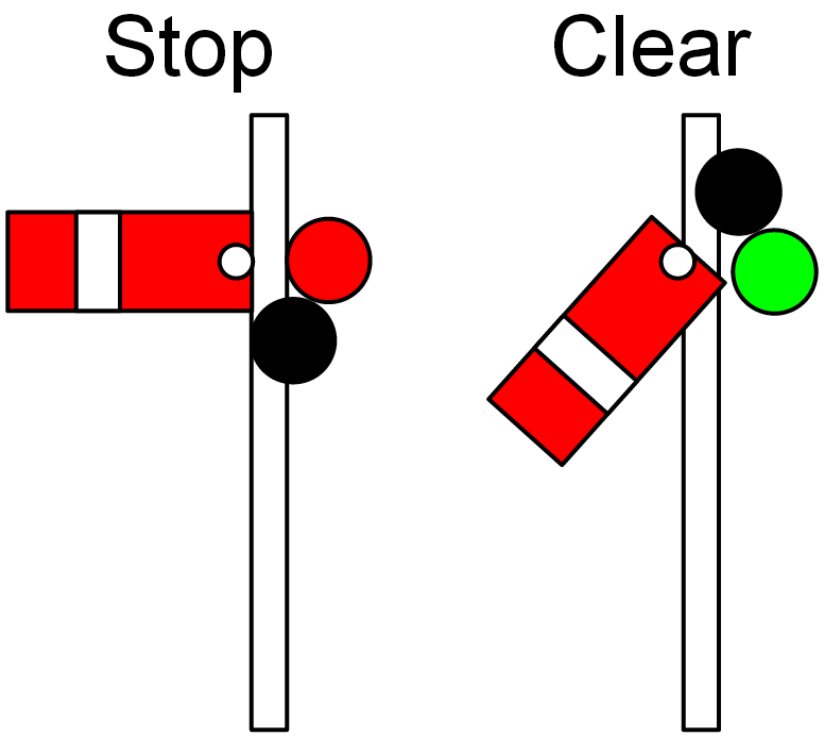
- A semaphore is conceptually an "object" that can be atomically incremented & decremented to control access to a shared resource

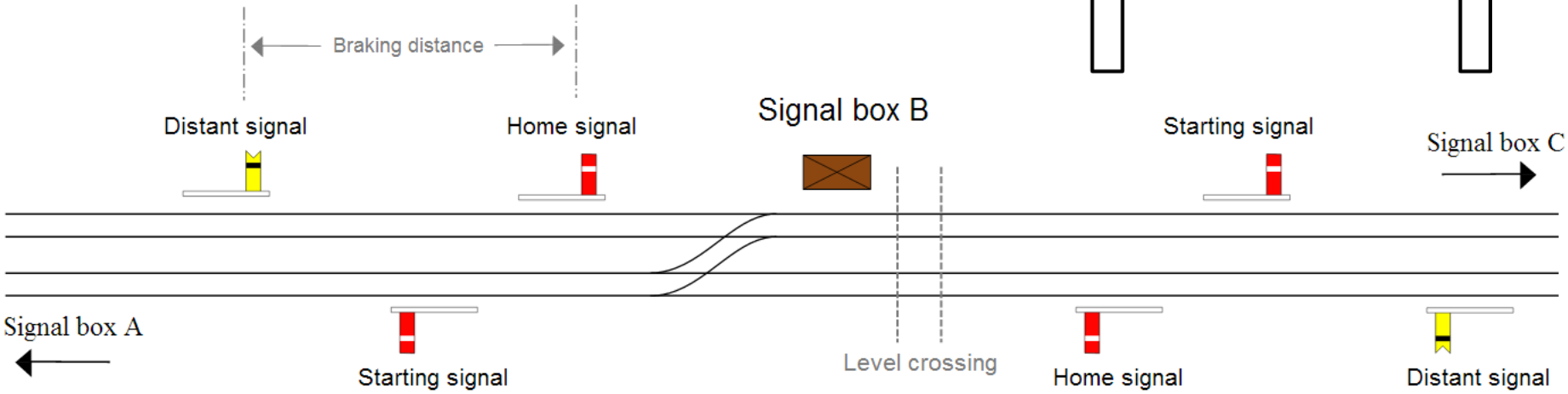


See en.wikipedia.org/wiki/Semaphore_(programming)

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

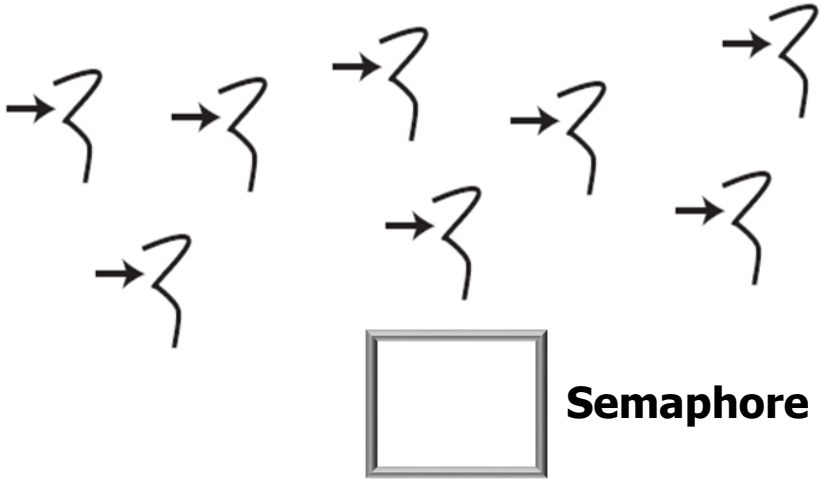




See en.wikipedia.org/wiki/Railway_semaphore_signal

Overview of Semaphores

- Concurrent programs use semaphores to coordinate interactions between multiple threads

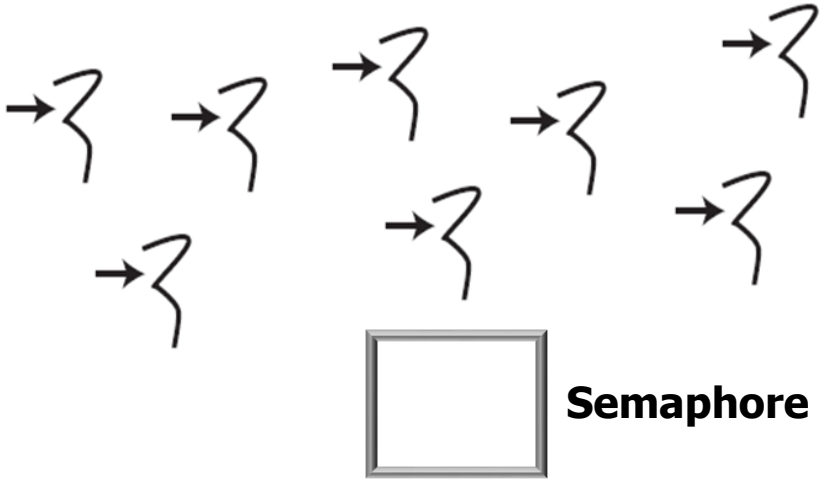


Semaphore

See tutorials.jenkov.com/java-concurrency/semaphores.html

Overview of Semaphores

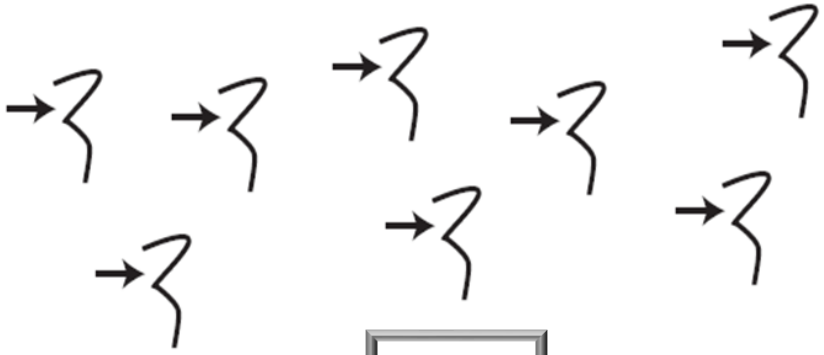
- Concurrent programs use semaphores to coordinate interactions between multiple threads, e.g.,
  - A semaphore can control the access of threads to a limited # of resources



See www.youtube.com/watch?v=RAv71VbdkBc for the Semaphore anthem ;-)

Overview of Semaphores

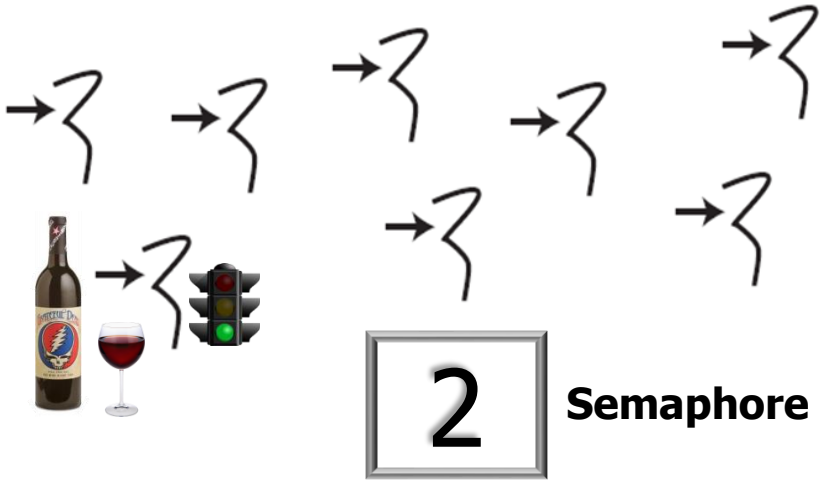
- Concurrent programs use semaphores to coordinate interactions between multiple threads, e.g.,
  - A semaphore can control the access of threads to a limited # of resources
  - It records a count ("permits") of how many units of a resource are available



Semaphore

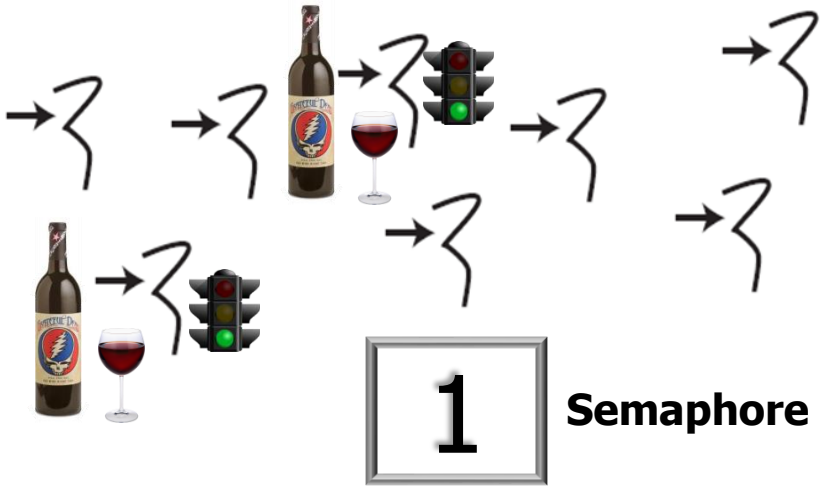
Overview of Semaphores

- 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
  - It records a count ("permits") of how many units of a resource are available
  - It provides operations to adjust the permit count atomically as units are acquired or released



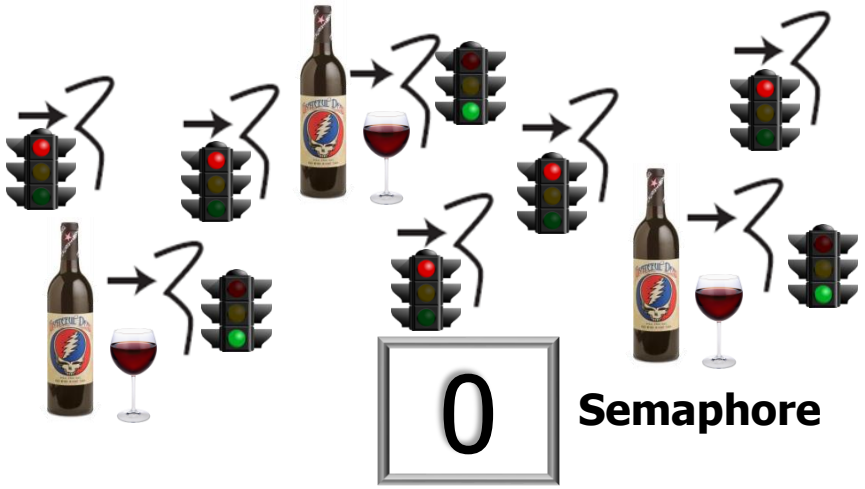
Overview of Semaphores

- 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
  - It records a count ("permits") of how many units of a resource are available
  - It provides operations to adjust the permit count atomically as units are acquired or released



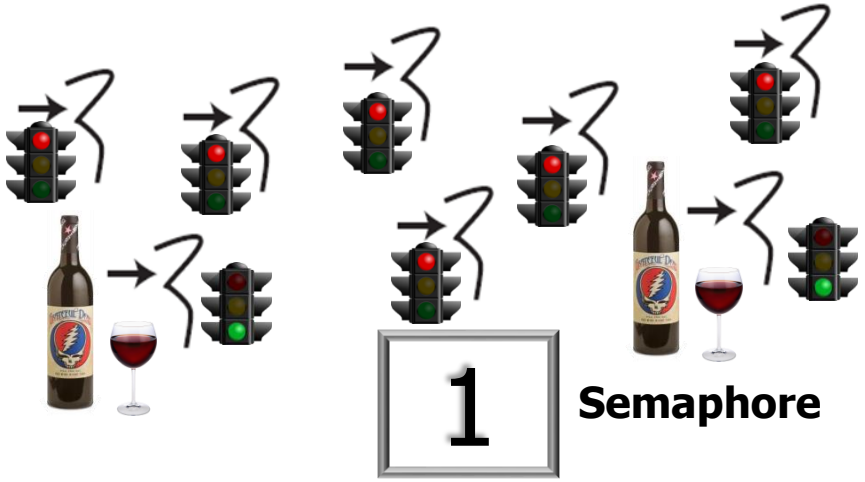
Overview of Semaphores

- 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
  - It records a count ("permits") of how many units of a resource are available
  - 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



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
  - It records a count ("permits") of how many units of a resource are available
  - 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

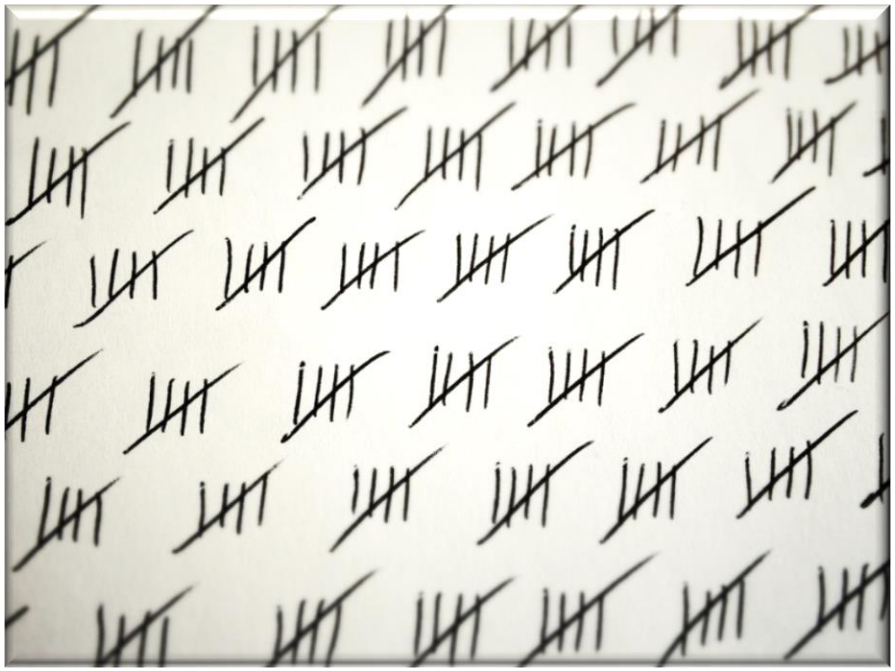


Overview of Semaphores

- There are two types of semaphores

Overview of Semaphores

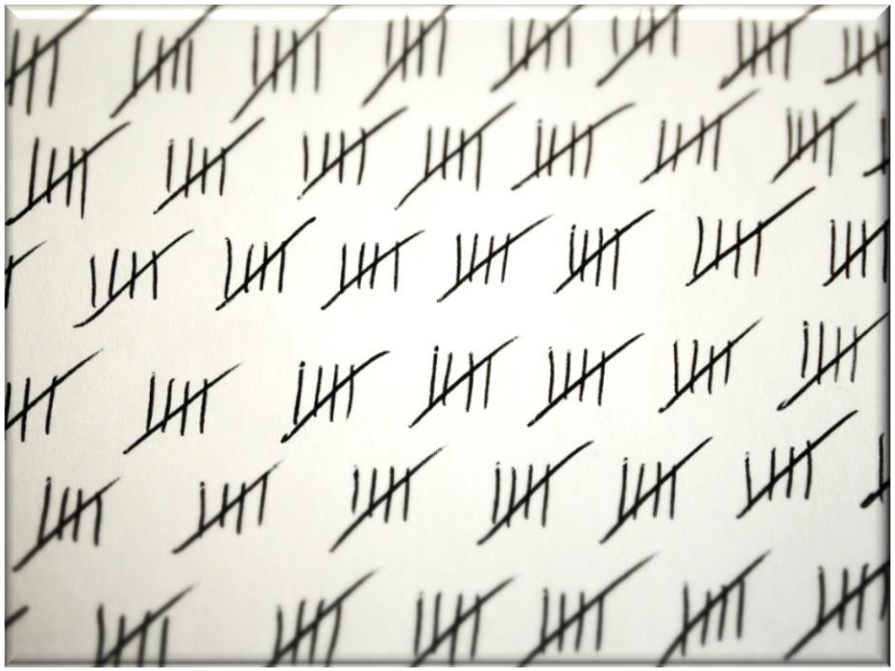
- There are two types of semaphores
  - **Counting semaphores**



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

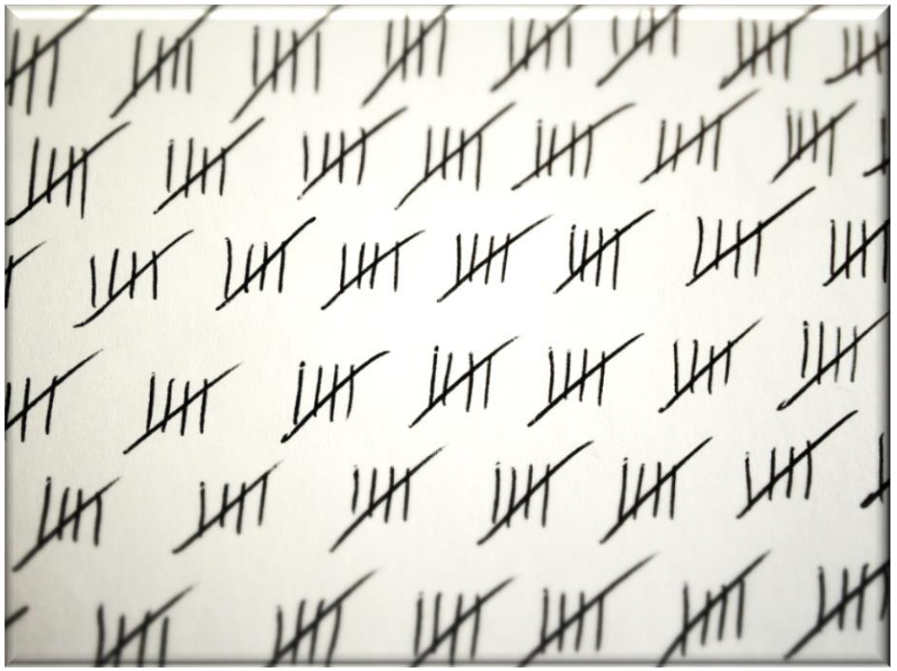
Overview of Semaphores

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



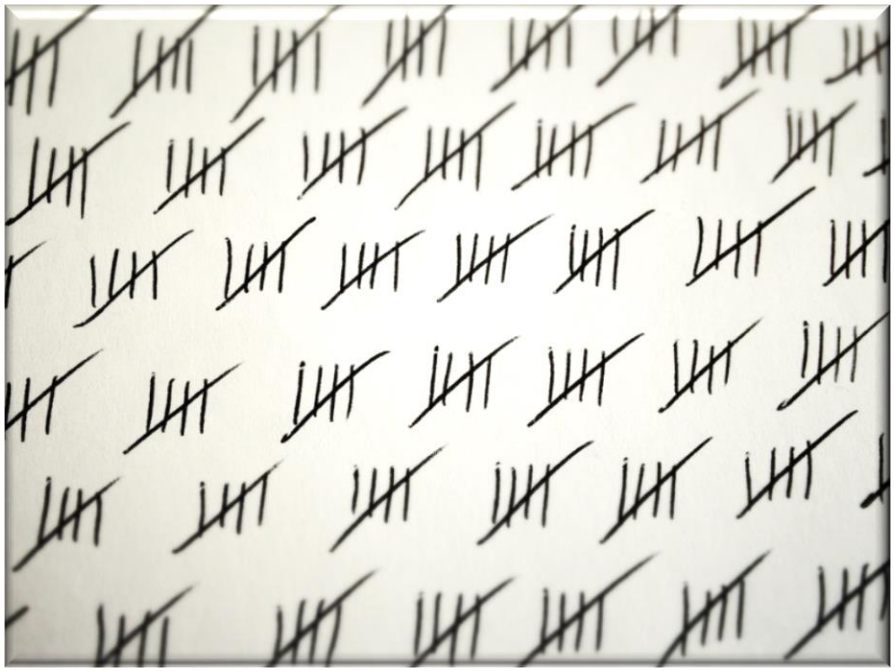
Overview of Semaphores

- There are two types of semaphores
  - **Counting semaphores**
    - Have # of permits defined by a counter (N) with precise meaning
      - **Negative**
        - exactly -N threads queued waiting to acquire semaphore



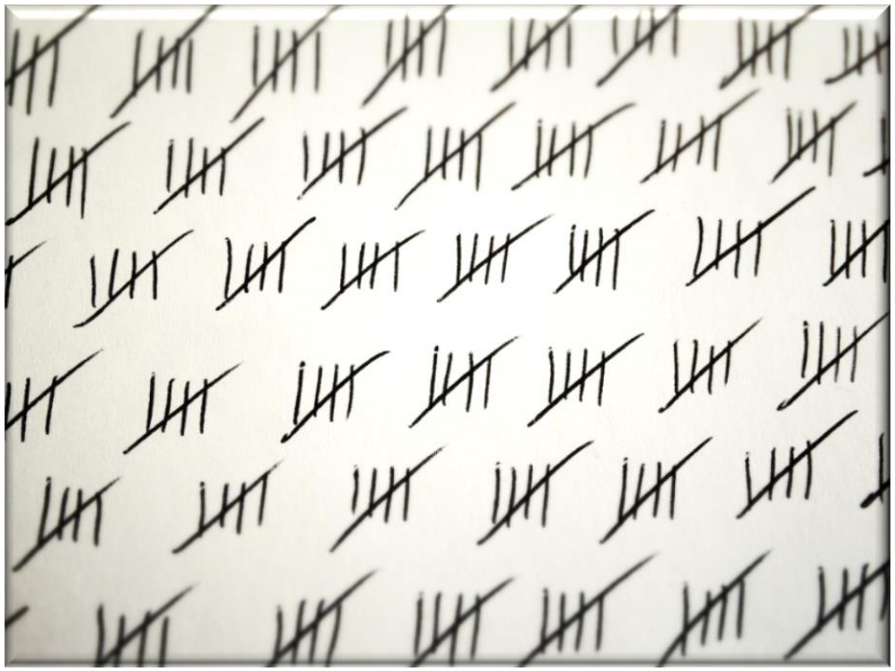
Overview of Semaphores

- 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**

See howtodoinjava.com/core-java/multi-threading/binary-semaphore-tutorial-and-example

Overview of Semaphores

- There are two types of semaphores
  - 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

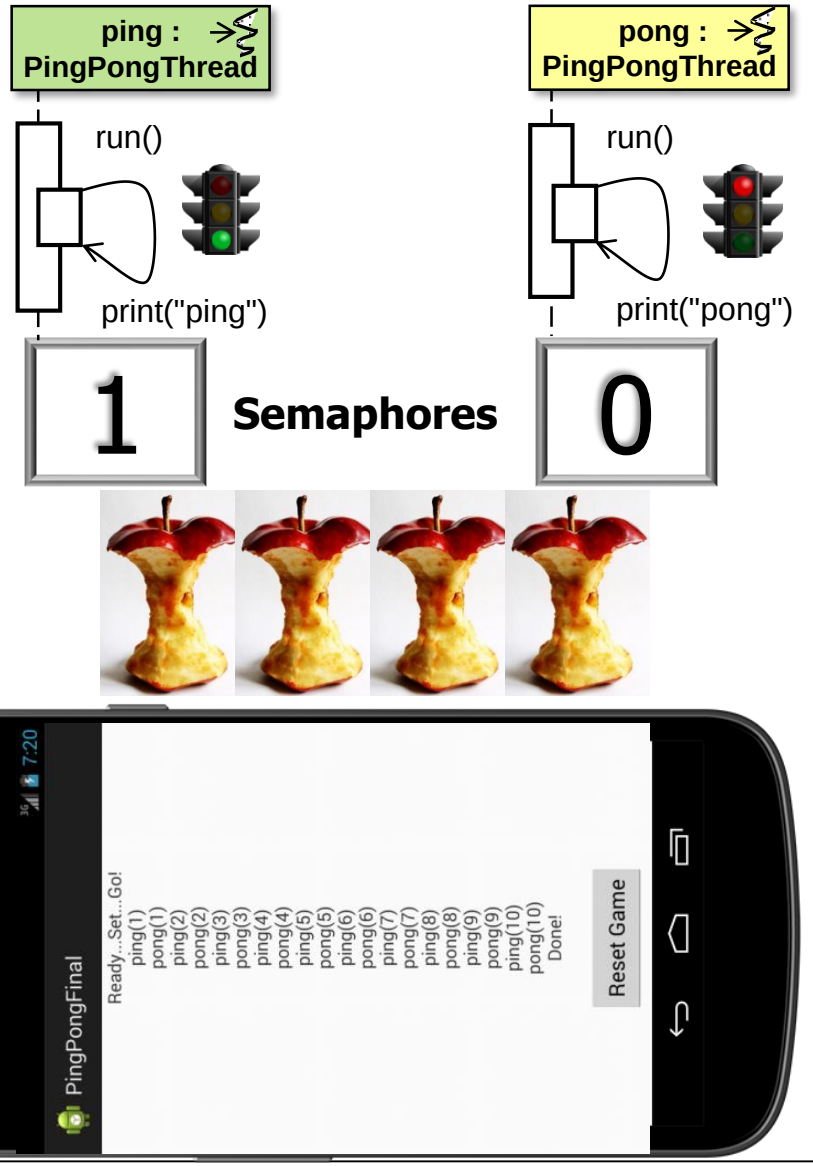
Overview of Semaphores

- 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 use a counting semaphore
  - The Ping/Ping app uses a pair of binary semaphores



See github.com/douglascraigschmidt/LiveLessons/tree/master/PingPongApplication

Human Known Use of Semaphores

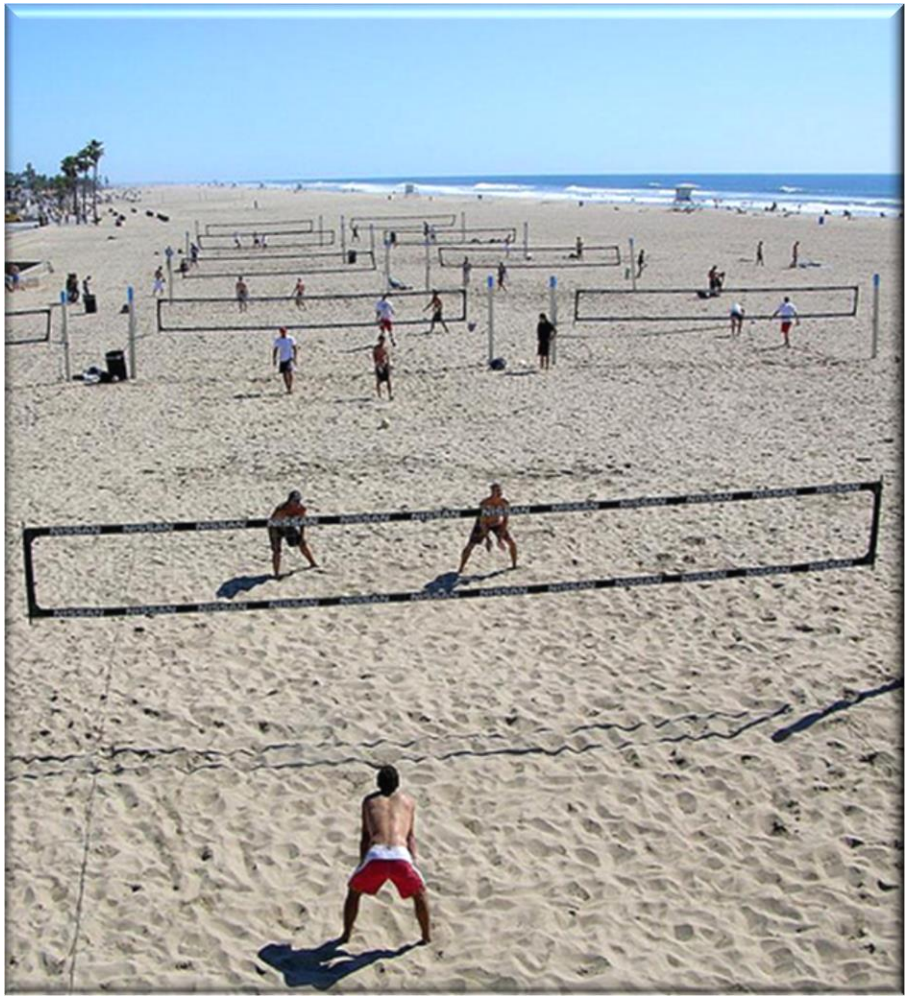
Human Known Uses of Semaphores

- 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)