Introduction to Java Semaphore

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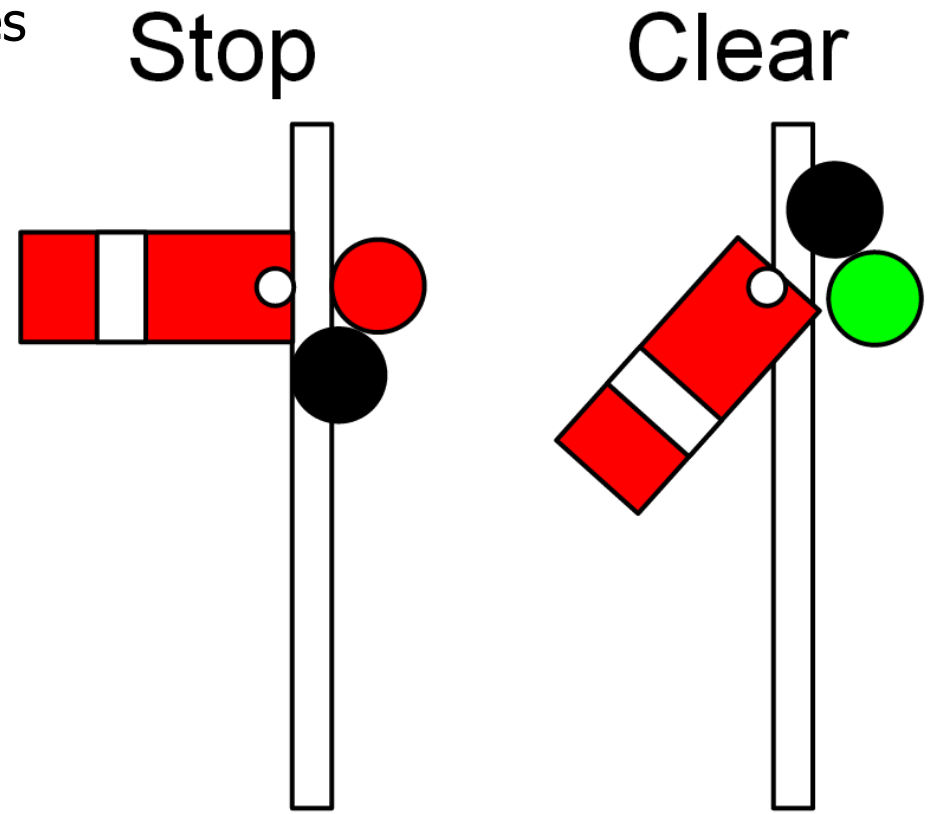
Learning Objectives in this Part of the Lesson

- Understand the concept of semaphores



Learning Objectives in this Part of the Lesson

- Understand the concept of semaphores
- Be aware of the two types of semaphores

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- Understand the concept of semaphores
- Be aware of the two types of semaphores
- Note a human-known use of semaphores

Introduction to Semaphores

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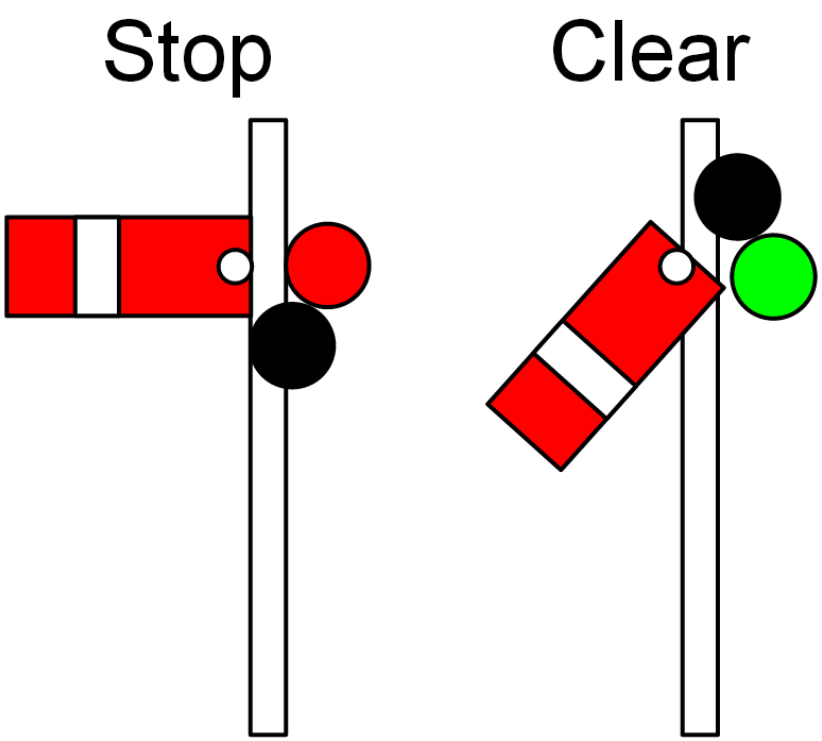
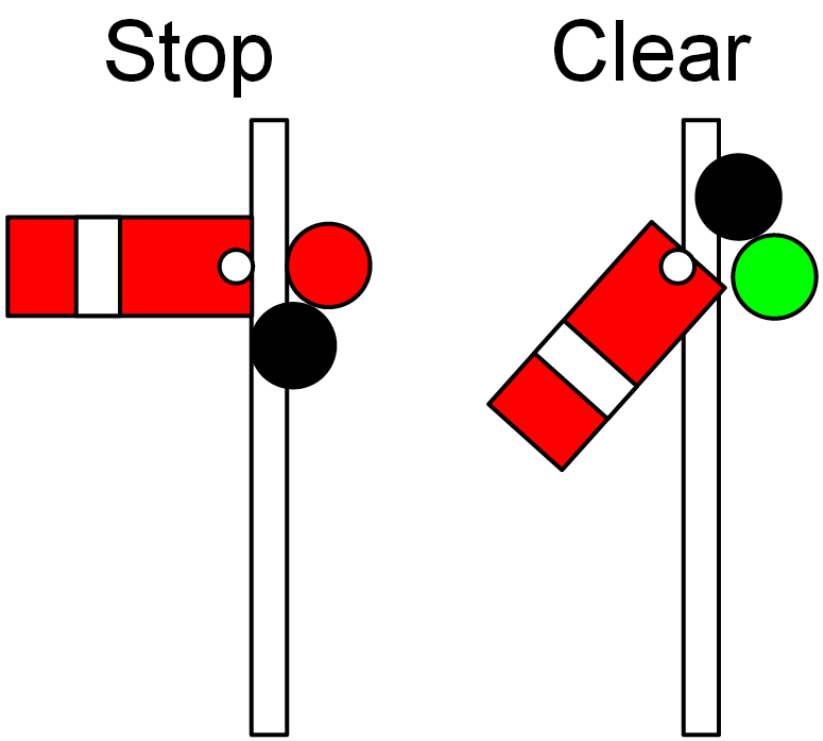
- A semaphore is conceptually an "object" that can be atomically incremented & decremented to control access to a shared resource

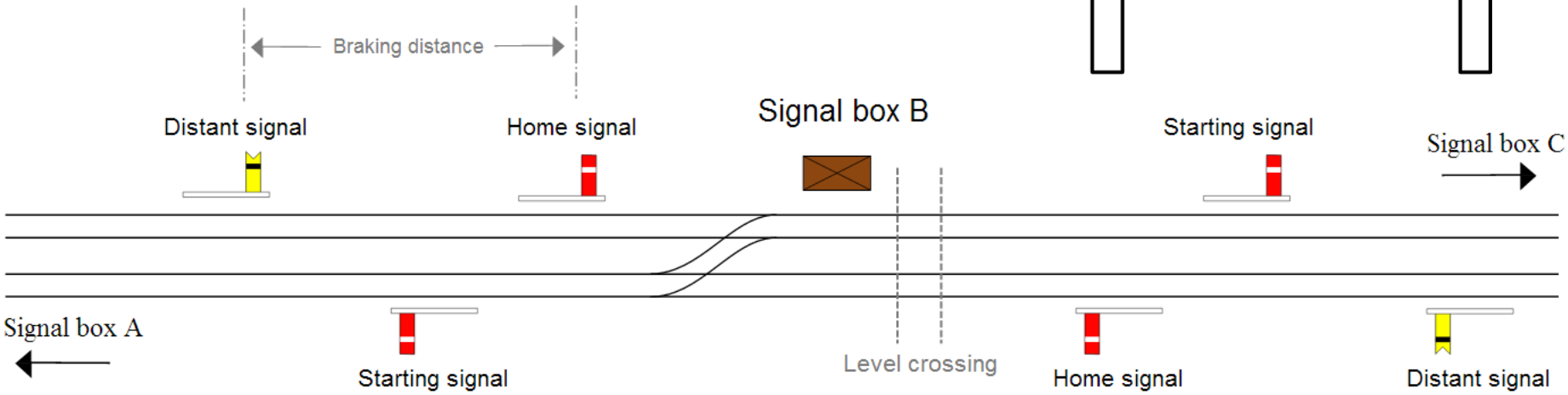


See en.wikipedia.org/wiki/Semaphore_(programming)

Introduction to 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

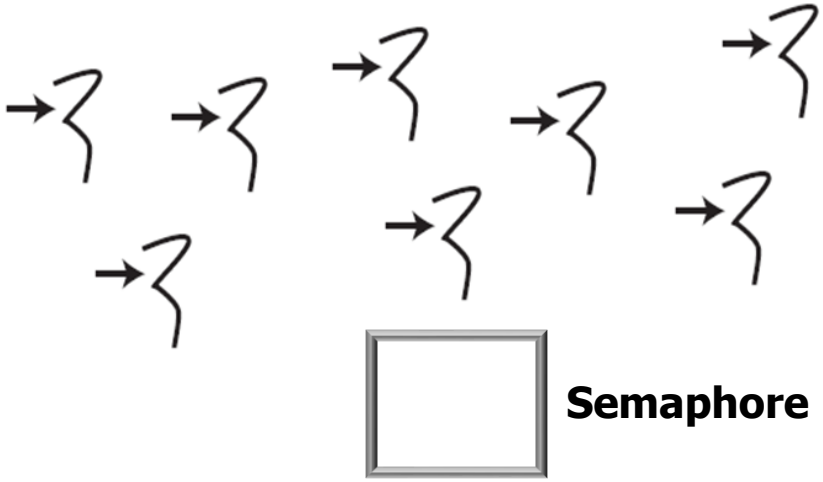




See en.wikipedia.org/wiki/Railway_semaphore_signal

Introduction to Semaphores

- Concurrent programs use semaphores to coordinate interactions between multiple threads



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

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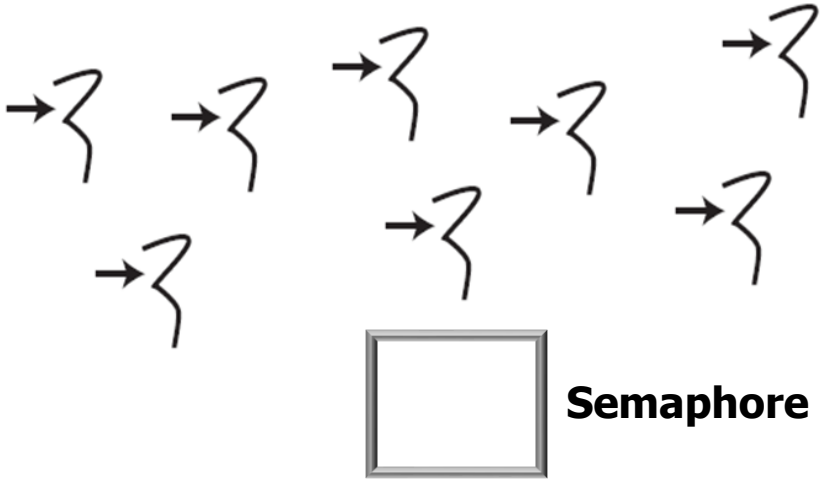
  - A semaphore can control the access of threads to a limited # of resources



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

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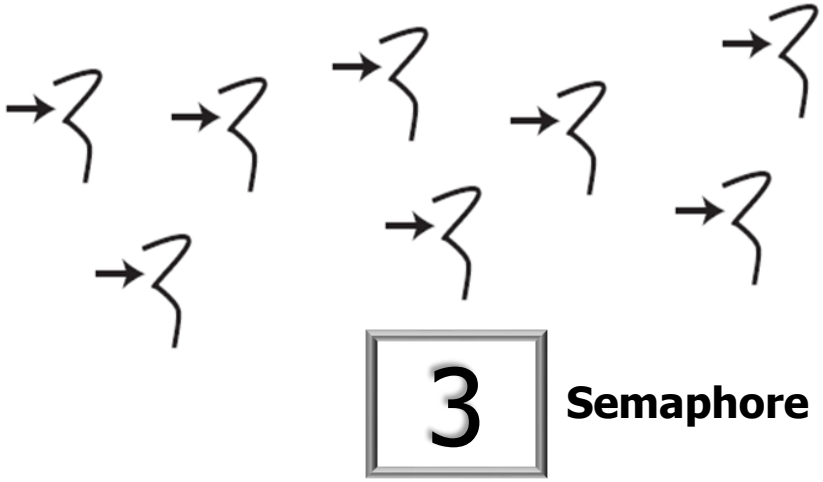

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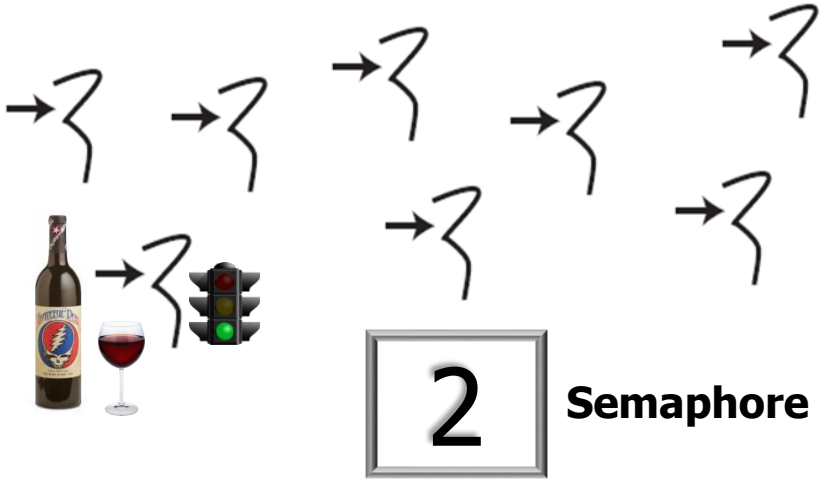

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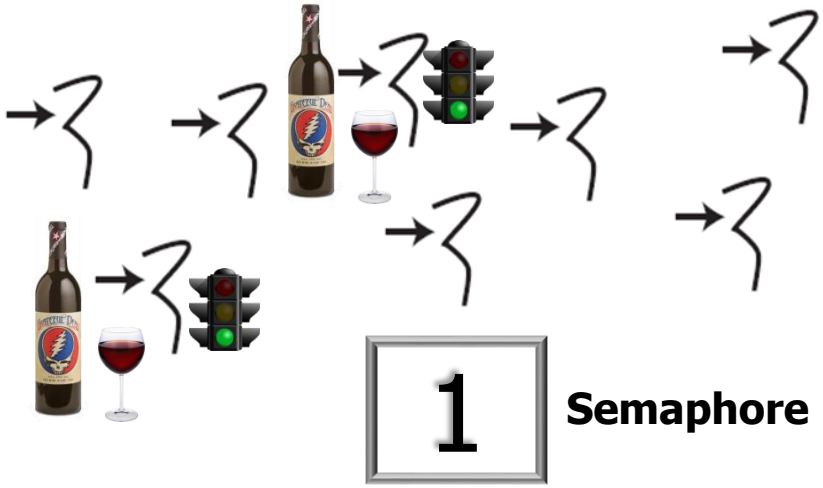

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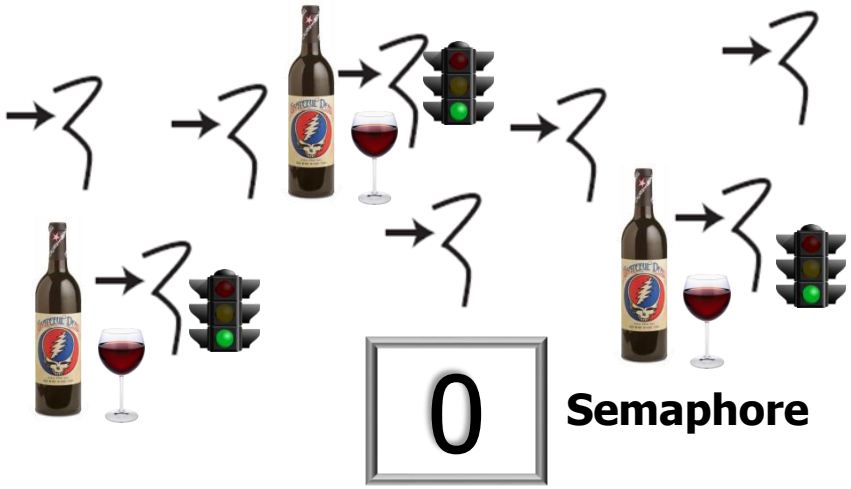

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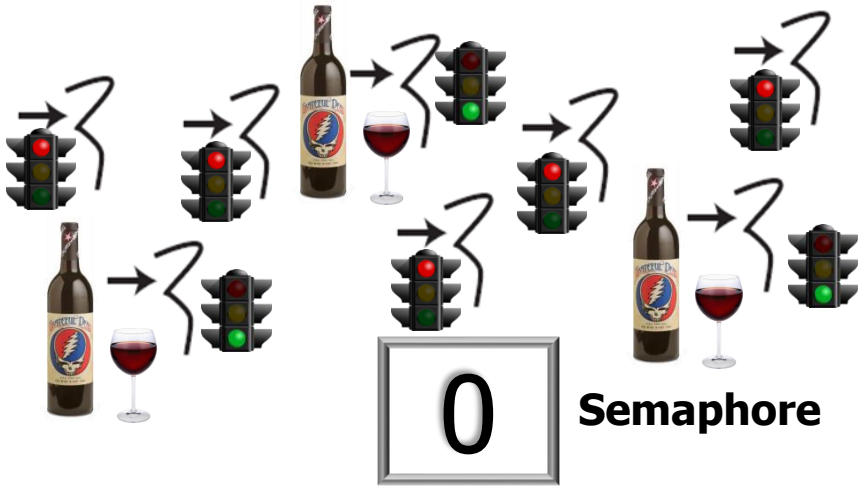

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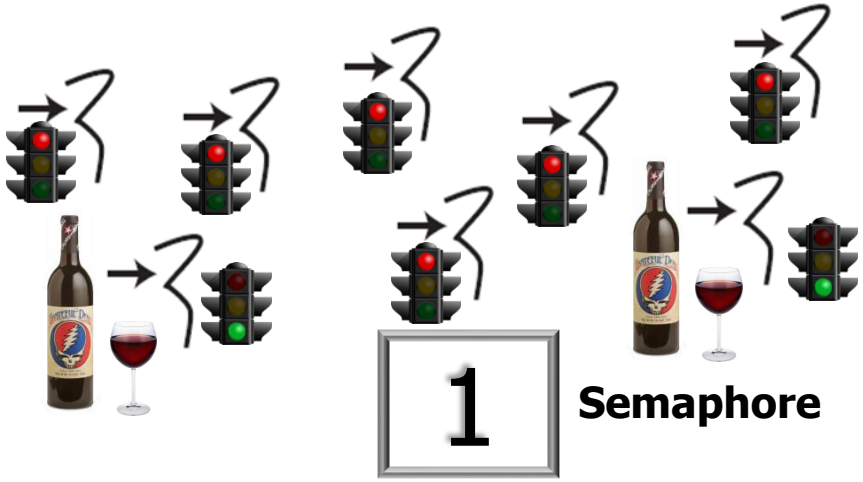
  - When a thread is done with a resource the permit count is incremented atomically & another waiting thread can acquire it



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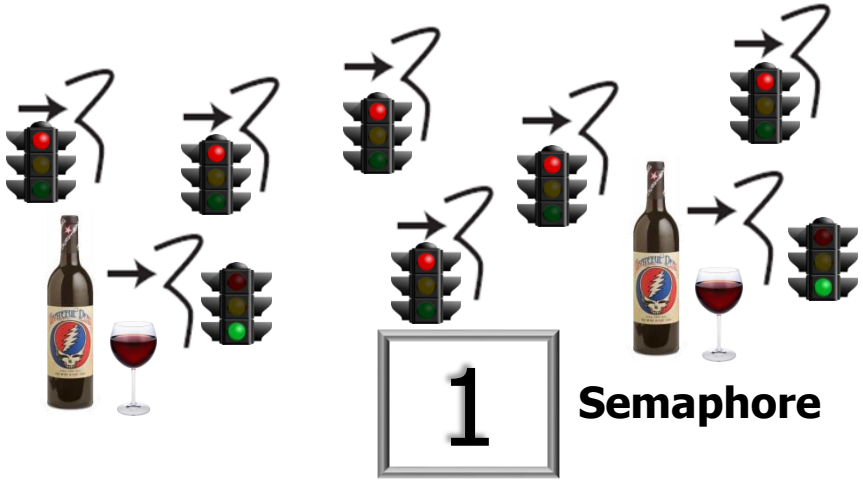

This example "fully brackets" the acquiring & releasing of permits, i.e., the thread that acquires a semaphore is the *same* as the one that releases it

Introduction to Semaphores

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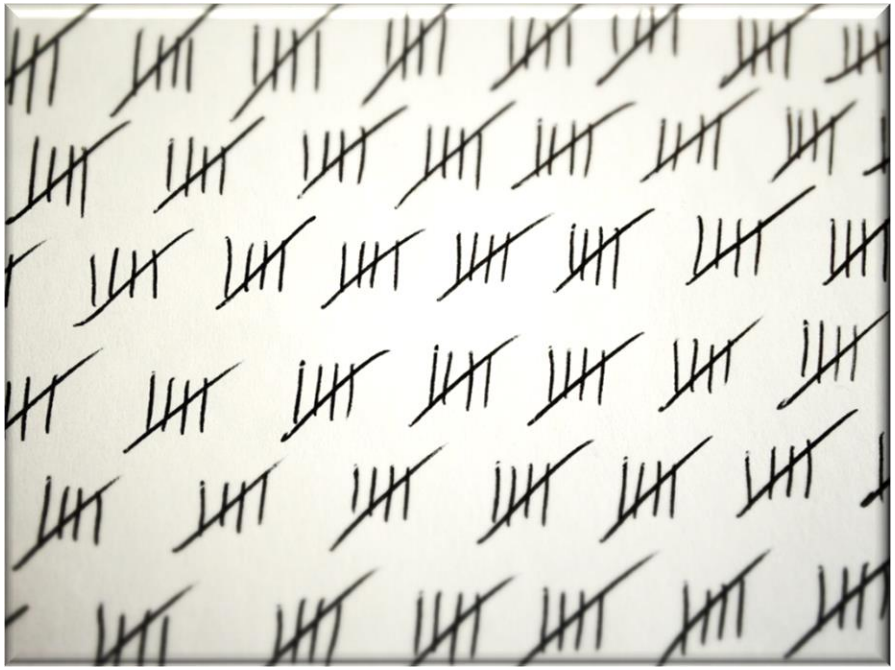
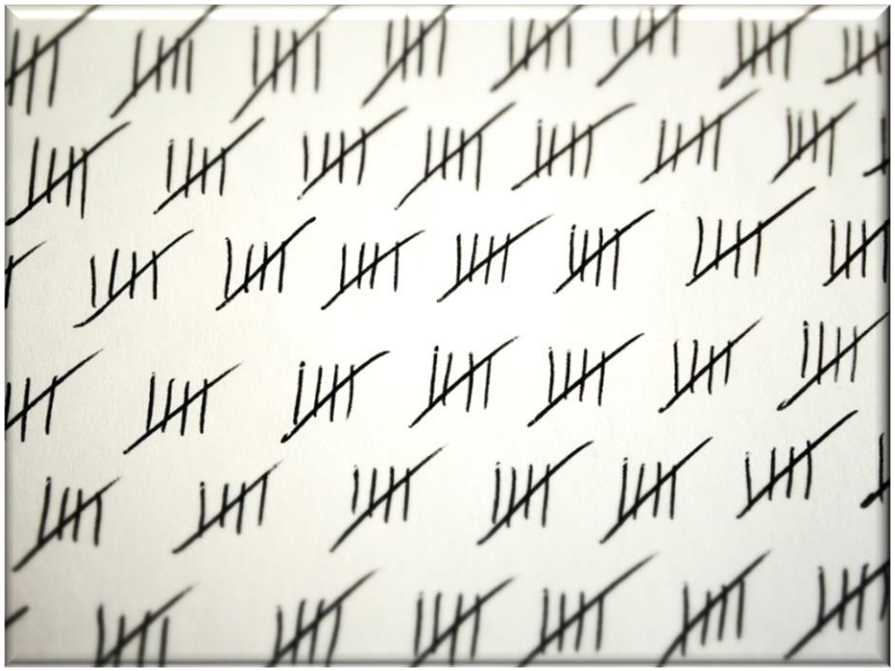
  - **Counting semaphores**



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

Introduction to Semaphores

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



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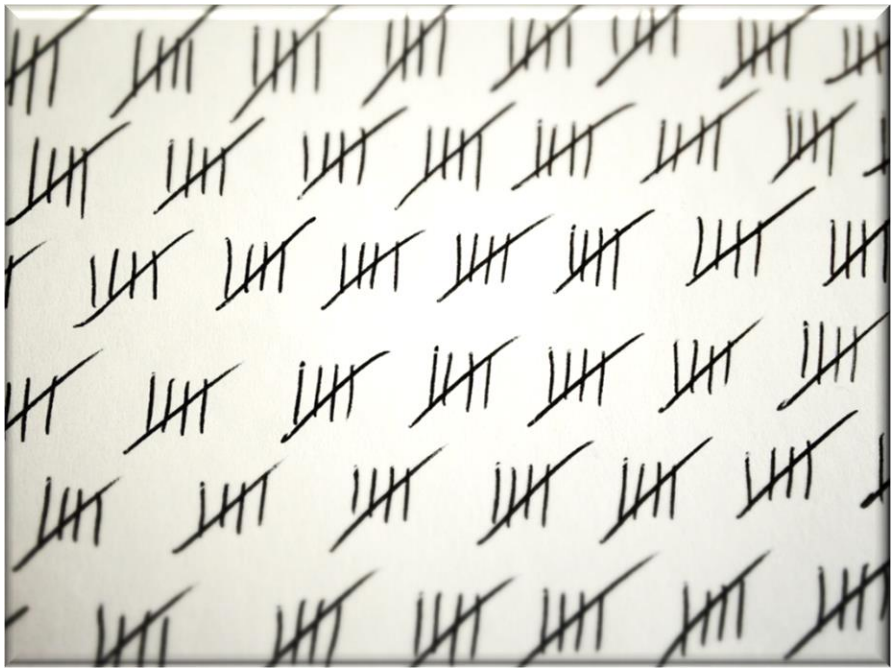
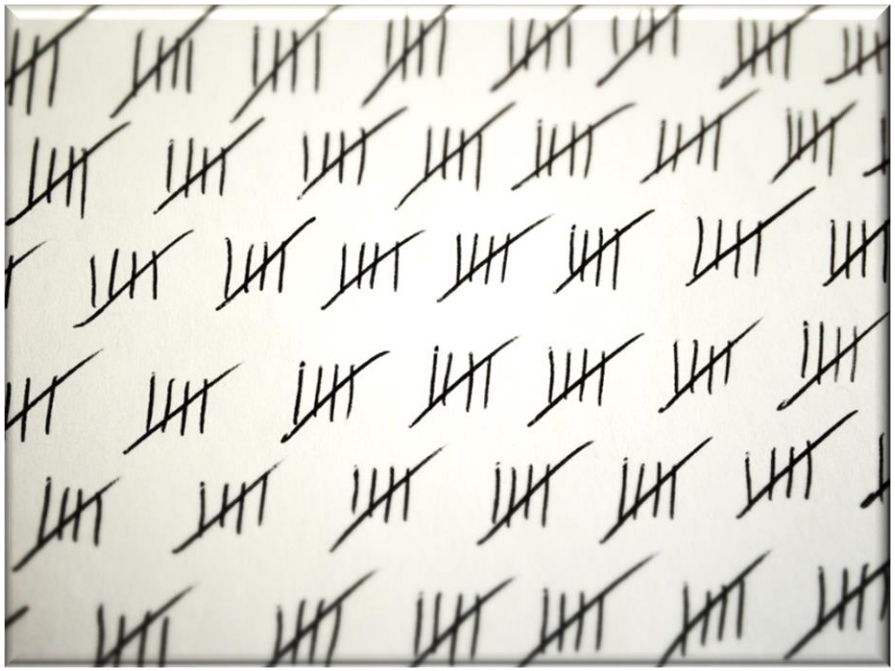
- There are two types of semaphores
  - **Counting semaphores**
    - Have # of permits defined by a counter (N) with precise meaning
      - **Negative**
        - exactly -N threads queued waiting to acquire semaphore



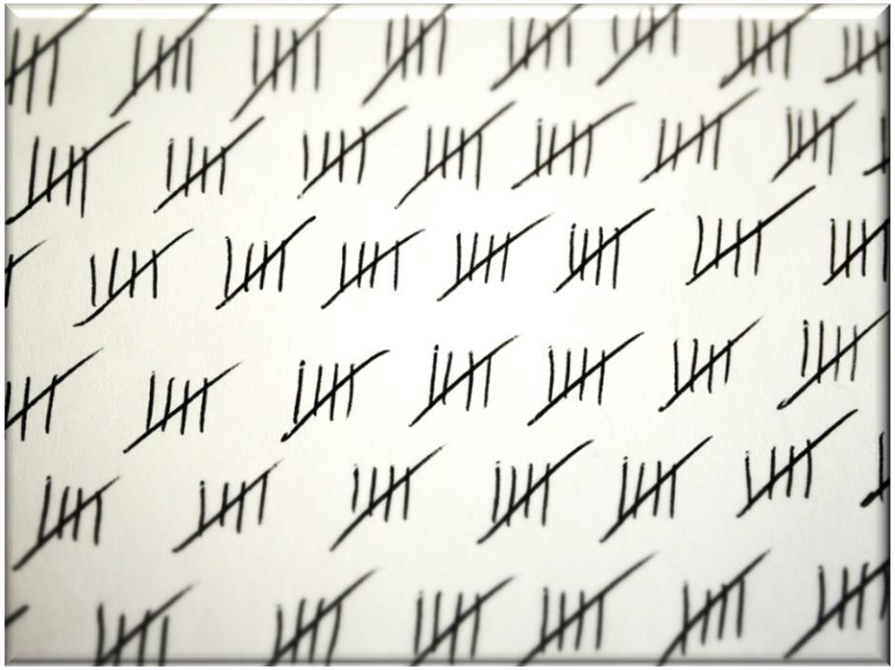
Introduction to Semaphores

- 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



Introduction to 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



A valid semaphore implementation needn't be precisely aligned with these states

Introduction to Semaphores

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

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

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- There are two types of semaphores
  - Counting semaphores
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    - Have only 2 states: acquired (0) & not acquired (1)

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- 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

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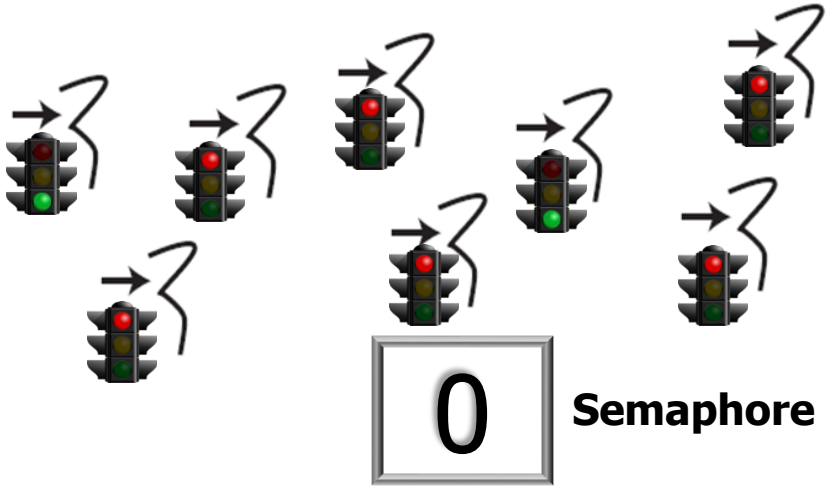
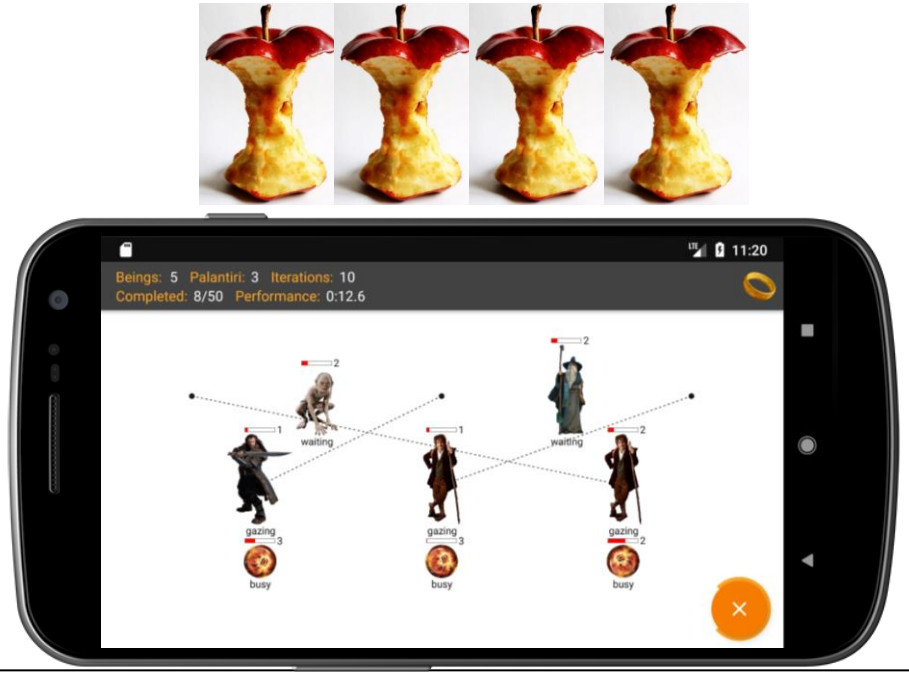
  - The PalantiriSimulator app use a counting semaphore

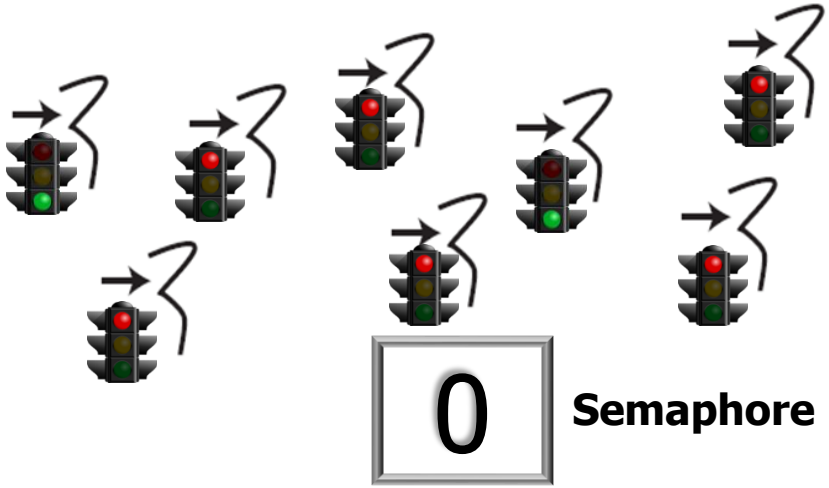


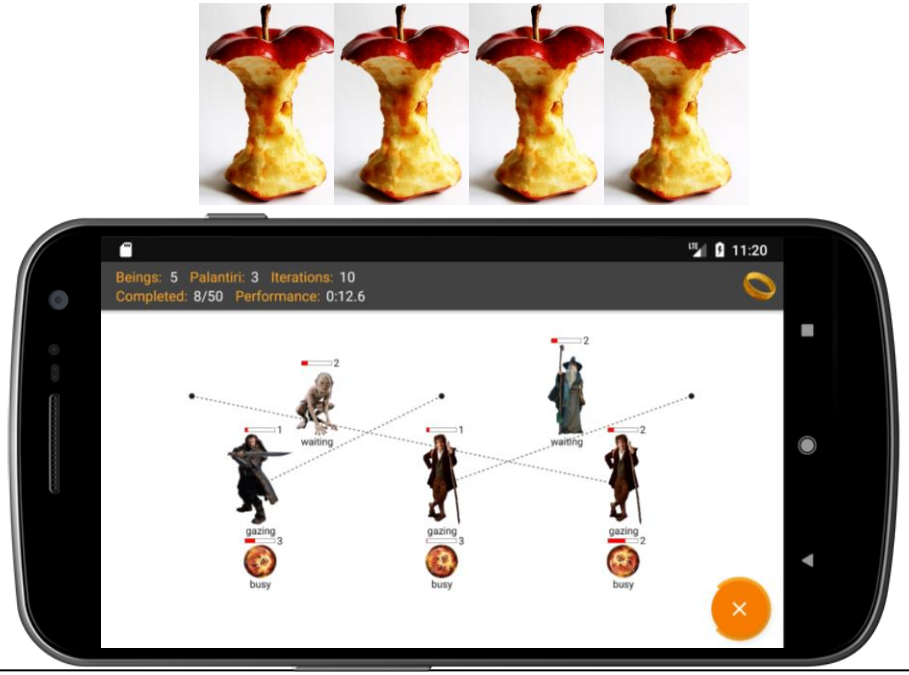


See github.com/douglascraigschmidt/LiveLessons/tree/master/PalantiriManagerApplication

Introduction to Semaphores

- We'll analyze examples of counting & binary semaphores later, e.g.
  - The PalantiriSimulator app use a counting semaphore
    - This use case demonstrates fully-bracketed semaphores





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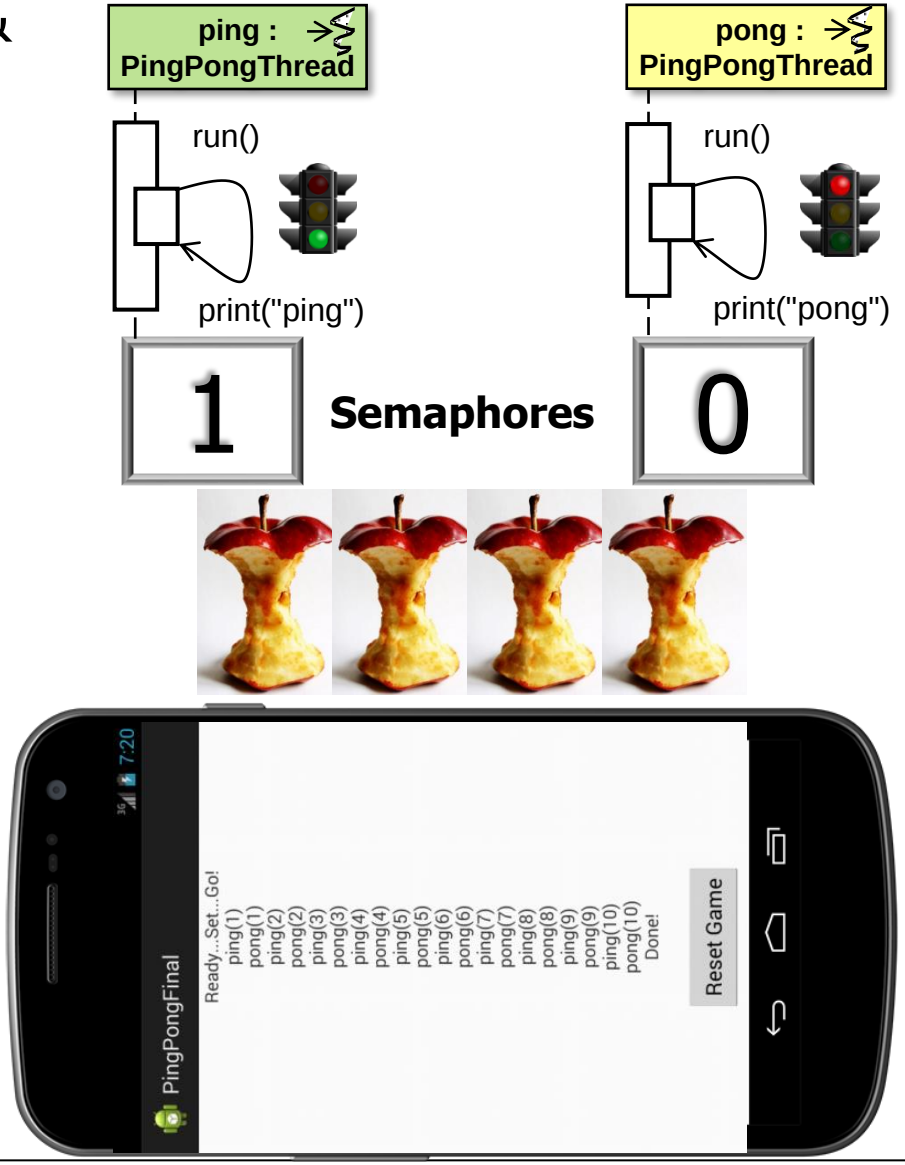
- We'll analyze examples of counting & binary semaphores later, e.g.
  - The PalantiriSimulator app use a counting semaphore
  - The Ping/Ping app uses a pair of binary semaphores



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

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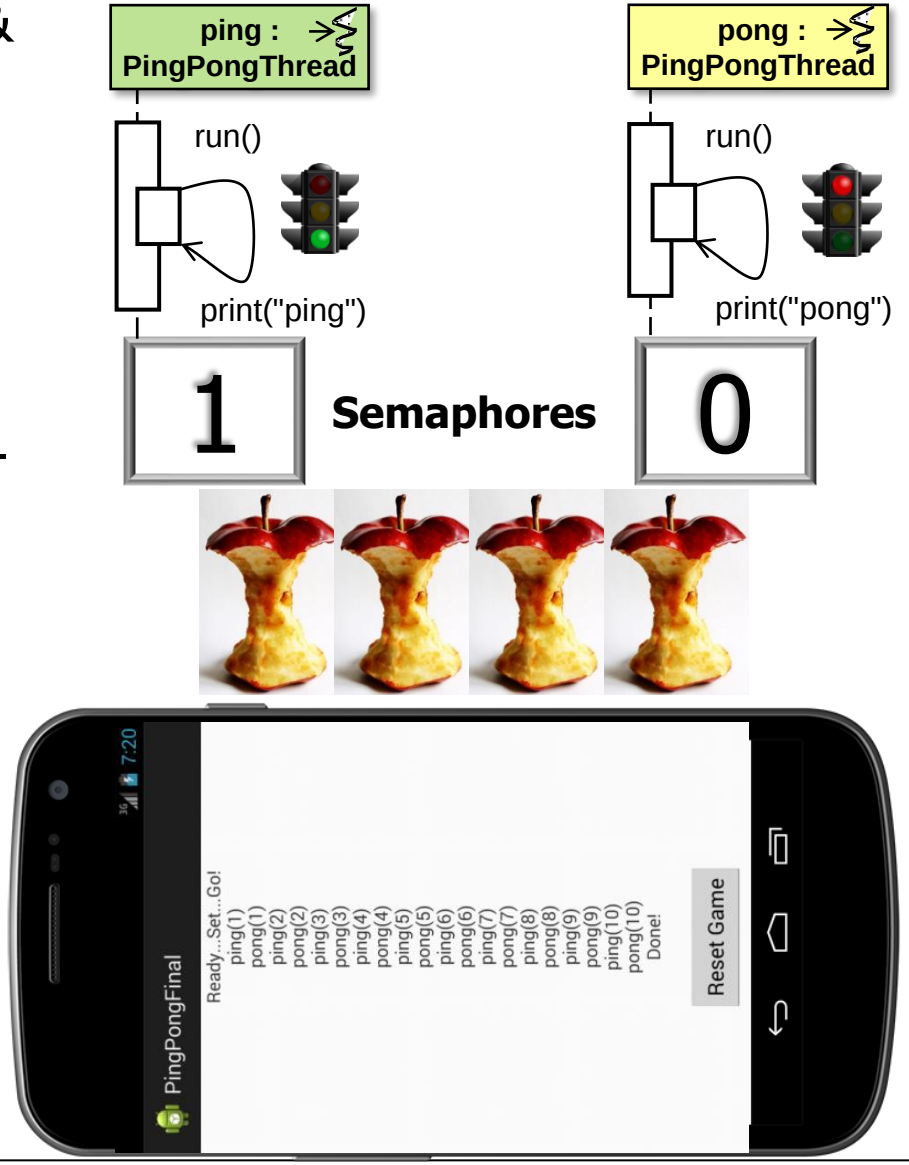
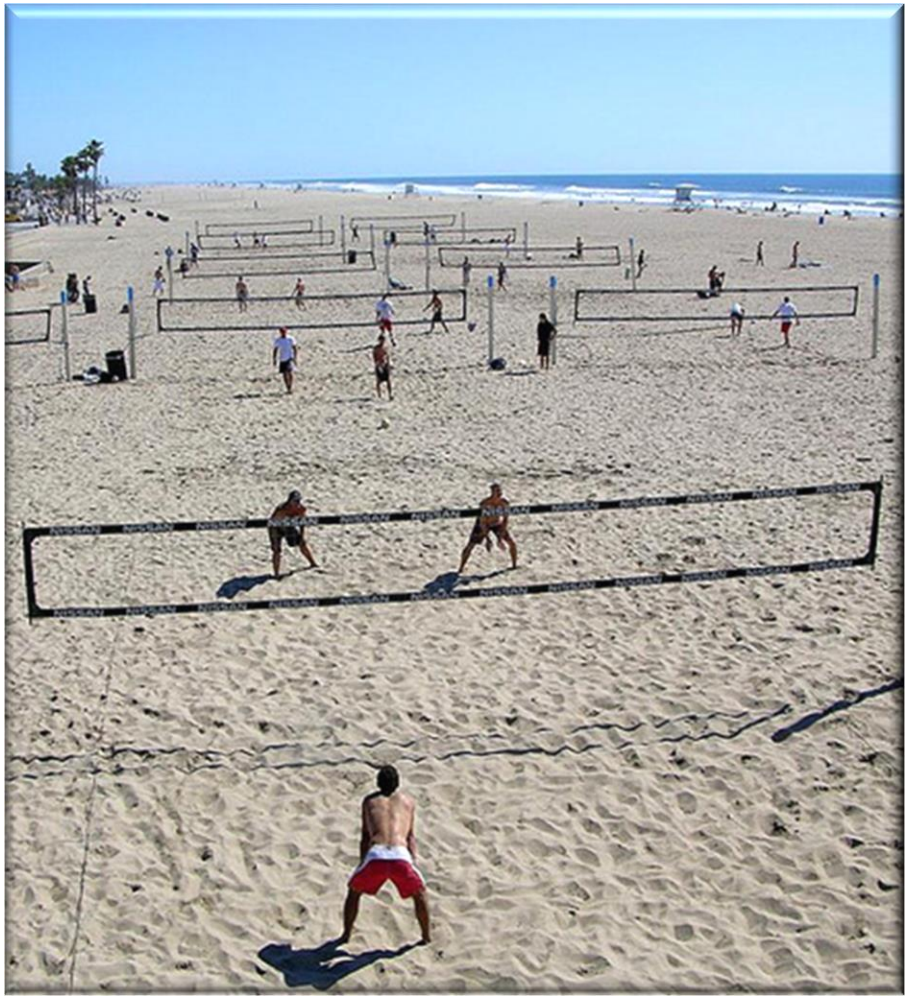
  - The PalantiriSimulator app use a counting semaphore
  - The Ping/Ping app uses a pair of binary semaphores
    - This use case demonstrates non-bracketed semaphores



Human Known Use of Semaphores

Human Known Uses of Semaphores

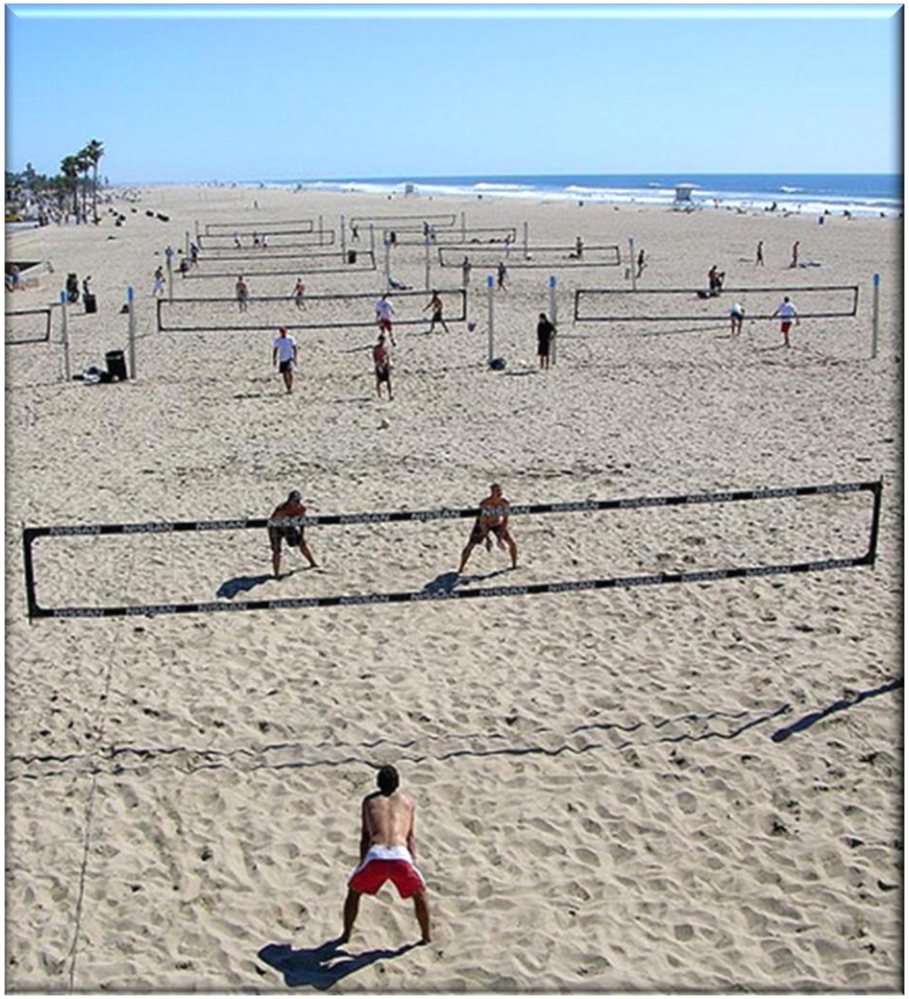
- A human known use of counting semaphores applies them to schedule access to beach volleyball courts



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 Introduction to Java Semaphores