Java Semaphore:
Coordinating Threads

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

- Understand the concept of semaphores
- Be aware of the two types of semaphores
- Note a human known use of semaphores
- Recognize the structure & functionality of Java Semaphore
- Know the key methods defined by the Java Semaphore class
- Learn how Java semaphores enable multiple threads to
  - Mediate access to a limited # of shared resources
- Coordinate the order in which operations occur
Applying Java Semaphores to Coordinate Threads
The Android ping-pong app coordinates thread interactions via various Java synchronizers, including Java semaphores.

- i.e., these two threads alternate printing “ping” & “pong” on the display.

See [github.com/douglascraigschmidt/POSA/tree/master/ex/M3/PingPong](https://github.com/douglascraigschmidt/POSA/tree/master/ex/M3/PingPong)
Applying Java Semaphores to Coordinate Threads

- UML sequence diagram for the ping-pong app

This app can be configured to use a pair of semaphores that coordinate the order in which the “ping” & “pong” threads are called to play ping-pong
The PlayPingPongThread object starts two threads, ping & pong, that alternate printing "Ping" & "Pong", respectively, on the display.
Applying Java Semaphores to Coordinate Threads

- UML sequence diagram for the ping-pong app

The PingPongThread class implements the core ping-pong algorithm, but defers synchronization aspects to subclasses via the Template Method pattern.
Applying Java Semaphores to Coordinate Threads

- UML sequence diagram for the ping-pong app

```
Semaphore pingSem = new Semaphore(1);
Semaphore pongSem = new Semaphore(0);
```

The pingSem & PongSem semaphores coordinate the order in which the “ping” & “pong” threads are called to play ping-pong.
Applying Java Semaphores to Coordinate Threads

- UML sequence diagram for the ping-pong app

This example does not "fully bracket" acquiring & releasing permits, i.e., the thread acquiring a semaphore is different from the thread releasing it!
Applying Java Semaphores to Coordinate Threads

- UML sequence diagram for the ping-pong app

```java
private final Semaphore mMine;
private final Semaphore mOther;

protected void acquire() { mMine.acquire(); }

protected void release() { mOther.release(); }
```

This example does *not* "fully bracket" acquiring & releasing permits, i.e., the thread acquiring a semaphore is different from the thread releasing it!
Applying Java Semaphores to Coordinate Threads

- UML sequence diagram for the ping-pong app

PlayPingPongThread joins with the ping & pong threads once they finish
End of Java Semaphore: Coordinating Threads