Mediating Access to Shared Resources via Java Semaphore

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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 number of shared resources
Applying a Java Semaphore to Mediate Access
Applying a Java Semaphore to Mediate Access

- This Android app shows how an Java semaphore can be used to limit the # of Middle-Earth beings who can gaze into Palantiri concurrently.

Each being is implemented to run in a separate thread.

See [en.wikipedia.org/wiki/Palantir](en.wikipedia.org/wiki/Palantir)
Applying a Java Semaphore to Mediate Access

- This Android app shows how a Java semaphore can be used to limit the number of Middle-Earth beings who can gaze into Palantiri concurrently.
- The app can be configured to restrict the number of being threads that concurrently gaze into palantiri.

E.g., limit to two palantiri on a quad-core device to ensure system responsiveness.
Applying a Java Semaphore to Mediate Access

• This Android app shows how an Java semaphore can be used to limit the # of Middle-Earth beings who can gaze into Palantiri concurrently

• The app can be configured to restrict the # of being threads that concurrently gaze into palantiri

• A permit must be acquired from a semaphore before a being can gaze

Acquiring a permit atomically decrements the permit count
Applying a Java Semaphore to Mediate Access

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- The app can be configured to restrict the # of being threads that concurrently gaze into palantiri.

- A permit must be acquired from a semaphore before a being can gaze.

All available permits are now in use.
Applying a Java Semaphore to Mediate Access

- This Android app shows how an Java semaphore can be used to limit the # of Middle-Earth beings who can gaze into Palantiri concurrently
  - The app can be configured to restrict the # of being threads that concurrently gaze into palantiri
  - A permit must be acquired from a semaphore before a being can gaze
  - Other being threads must block until a permit is available
Applying a Java Semaphore to Mediate Access

- This Android app shows how a Java semaphore can be used to limit the number of Middle-Earth beings who can gaze into Palantiri concurrently.
  - The app can be configured to restrict the number of being threads that concurrently gaze into Palantiri.
  - A permit must be acquired from a semaphore before a being can gaze.
  - Other being threads must block until a permit is available.
  - When a being thread is done gazing it releases the semaphore.
Applying a Java Semaphore to Mediate Access

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• The app can be configured to restrict the number of being threads that concurrently gaze into palantiri.

• A permit must be acquired from a semaphore before a being can gaze.

• Other being threads must block until a permit is available.
  • When a being thread is done gazing it releases the semaphore.
  • Another being thread can then acquire it & proceed to gaze.
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- Other being threads must block until a permit is available.
  - When a being thread is done gazing it releases the semaphore.
  - Another being thread can then acquire it & proceed to gaze.

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.
Applying a Java Semaphore to Mediate Access

- UML sequence diagram for this app

```java
start()
run()
start()
start()
run()
r = acquire()
r.gaze()
release(r)
run()
r = acquire()
r.gaze()
release(r)
run()
r = acquire()
r.gaze()
release(r)
run()
r = acquire()
r.gaze()
release(r)
```

: Palantiri Presenter
: BeingRunnables
: Palantir
mPalantiriManager : PalantiriManager

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Applying a Java Semaphore to Mediate Access

• UML sequence diagram for this app

start()

: Palantiri

Presenter →
Applying a Java Semaphore to Mediate Access

• UML sequence diagram for this app

![UML sequence diagram](image_url)
Applying a Java Semaphore to Mediate Access

- UML sequence diagram for this app

```
start()
run()
start()
run()
start()
run()
```

: Palantiri

: BeingRunnables

Presenter

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Applying a Java Semaphore to Mediate Access

- UML sequence diagram for this app

```
start()
start()
start()

run()
p = acquire()
p = acquire()
p = acquire()

PalantiriManager : PalantiriManager
BeingRunnables
mPalantiriManager

: PalantiriPresenter
```
Applying a Java Semaphore to Mediate Access

- UML sequence diagram for this app

```
start()
start()
start()

run()
p = acquire()
```

```
start()
start()
start()

run()
p = acquire()
```

```
run()
p = acquire()
```

```
run()
p = acquire()
```

```
mPalantiriManager : PalantiriManager
: BeingRunnables
: PalantiriPresenter
```
Applying a Java Semaphore to Mediate Access

- UML sequence diagram for this app

```java
start()
run()
start()
start()
p.presentation()
p = acquire()
p = acquire()
p = acquire()
p.presentation()
p.presentation()
p.presentation()
p.presentation()
```
Applying a Java Semaphore to Mediate Access

- UML sequence diagram for this app

```
start()  
      |    
      v    
start()  
      |    
start()  
      |    
run()   
      |    
p.gaze()  
      |    
release(p)  
      |    
p = acquire()  
      |    
d= acquire()  
      |    
run()   
      |    
p.gaze()  
      |    
release(p)  
```
Applying a Java Semaphore to Mediate Access

- UML sequence diagram for this app

```
Applying a Java Semaphore to Mediate Access

start()

: Palantiri Presenter
: BeingRunnables

p : Palantir

mPalantiriManager : PalantiriManager
```

```java
start()
start()
start()
run()
p.gaze()
p = acquire()
release(p)
run()
p = acquire()
p.gaze()
p = acquire()
run()
p.gaze()
p = acquire()
release(p)
```
Applying a Java Semaphore to Mediate Access

- UML sequence diagram for this app

```
: Palantiri
  Presenter

: BeingRunnables

p : Palantir

mPalantiriManager : PalantiriManager

start()
run()
start()
start()
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p = acquire()
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release(p)
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Applying a Java Semaphore to Mediate Access

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start() 
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run() 
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p.gaze() 
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p = acquire() 
p.gaze() 
run() 
p = acquire() 
p.gaze() 
run() 
release(p) 
release(p) 
release(p) 
```

Applying a Java Semaphore to Mediate Access

: Palantiri : Presenter

: BeingRunnables

p : Palantir

mPalantiriManager : PalantiriManager

BeingRunnables

Palantiri

Presenter

Palantiri

PalantiriPresenter

PalantiriManager

PalantiriManager

Palantiri

Palantiri

Presenter
Applying a Java Semaphore to Mediate Access

- UML sequence diagram for this app

```
: Palantiri Presenter ➝
: BeingRunnables ➝
: Palantir ➝
: mPalantiriManager ➝

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run()
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p.gaze()
release(p)

run()
p = acquire()
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run()
p = acquire()
p.gaze()
release(p)
```

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End of Mediating Access to Shared Resources via Java Semaphore