Java ReentrantLock: Key Methods

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Learning Objectives in this Part of the Lesson

• Understand the concept of mutual exclusion in concurrent programs
• Note a human-known use of mutual exclusion
• Recognize the structure & functionality of Java ReentrantLocks
• Be aware of reentrant mutex semantics
• Know the key methods defined by the Java ReentrantLock class
Overview of Key ReentrantLock Methods
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- It key methods acquire & release the lock

```java
public class ReentrantLock
    implements Lock,
    java.io.Serializable {

    ...

    public void lock() { sync.lock(); }

    public void lockInterruptibly()
        throws InterruptedException {
        sync.acquireInterruptibly(1);
    }

    public boolean tryLock() {
        return sync.nonfairTryAcquire(1);
    }

    public void unlock() {
        sync.release(1);
    }

    ...

    See src/share/classes/java/util/concurrent/locks/ReentrantLock.java
```
Overview of Key ReentrantLock Methods

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   ...

   See docs.oracle.com/javase/8/docs/api/java/util/concurrent/locks/AbstractQueuedSynchronizer.html
Overview of Key ReentrantLock Methods

- It key methods acquire & release the lock
- lock() acquires the lock if it’s available

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    public void lock() {
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    }
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- If lock isn’t available its implementation depends on the “fairness” policy

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- Non-fair implementations are optimized in hardware

```java
public class ReentrantLock
        implements Lock,
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    ... public void lock() {
        sync.lock();
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```

See en.wikipedia.org/wiki/Spinlock
Overview of Key ReentrantLock Methods

- It key methods acquire & release the lock
- lock() acquires the lock if it’s available
- If lock isn’t available its implementation depends on the “fairness” policy
  - Non-fair implementations are optimized in hardware
  - Fair implementations “park” themselves on a wait queue in FIFO order

```java
public class ReentrantLock implements Lock, java.io.Serializable {
    ...
    public void lock() {
        sync.lock();
    }
    ...
}
```
Overview of Key ReentrantLock Methods

- It key methods acquire & release the lock
  - lock() acquires the lock if it’s available
    - If lock isn’t available its implementation depends on the “fairness” policy
  - lock() is not interruptible

```java
public class ReentrantLock
  implements Lock,
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  ...

  public void lock() {
    sync.lock();
  }

  ...
```

Please DO NOT DISTURB
Overview of Key ReentrantLock Methods

- It key methods acquire & release the lock
- lock() acquires the lock if it’s available
- lockInterruptibly() acquires lock unless interrupted

```java
public class ReentrantLock implements Lock, java.io.Serializable {
    ...
    public void lockInterruptibly() throws InterruptedException {
        sync.acquireInterruptibly(1);
    }
    ...
}
```

See upcoming lesson on “Managing the Java Thread Lifecycle”
Overview of Key ReentrantLock Methods

- It key methods acquire & release the lock
- lock() acquires the lock if it’s available
- lockInterruptibly() acquires lock unless interrupted
- tryLock() acquires lock only if it’s not held by another thread at invocation time

public class ReentrantLock
    implements Lock,
    java.io.Serializable {
    ...
    public boolean tryLock() {
        sync.nonfairTryAcquire(1);
    }
    ...

Untimed tryLock() doesn’t honor fairness setting & can “barge”
Overview of Key ReentrantLock Methods

- It key methods acquire & release the lock
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  - `lock()` acquires the lock if it’s available
  - `lockInterruptibly()` acquires lock unless interrupted
  - `tryLock()` acquires lock only if it’s not held by another thread at invocation time
  - `unlock()` attempts to release the lock
    - `IllegalMonitorStateException` is thrown if calling thread doesn’t hold lock

```java
public class ReentrantLock implements Lock, java.io.Serializable {
    ...
    public void unlock() {
        sync.release(1);
    }
    ...
}
```

i.e., a ReentrantLock is “fully bracketed”!
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- It key methods acquire & release the lock
- lock() acquires the lock if it’s available
- lockInterruptibly() acquires lock unless interrupted
- tryLock() acquires lock only if it’s not held by another thread at invocation time
- unlock() attempts to release the lock
  - IllegalMonitorStateException is thrown if calling thread doesn’t hold lock
  - If hold count > 1 then lock is not released

```java
public class ReentrantLock implements Lock, java.io.Serializable {

  ...

  public void unlock() {
    sync.release(1);
  }

  ...

  unlocked (holdCount = 0)

  lock()

  locked (holdCount = 2)

  Critical Section

  See en.wikipedia.org/wiki/Reentrant_mutex
```
Overview of Other ReentrantLock Methods
Overview of Other ReentrantLock Methods

• There are many other ReentrantLock methods

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<th>Description</th>
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<td>boolean tryLock(long timeout, TimeUnit unit)</td>
<td>Acquires the lock if it is not held by another thread within the given waiting time and the current thread has not been interrupted</td>
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<tr>
<td>boolean isFair()</td>
<td>Returns true if this lock has fairness set true</td>
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<td>boolean isLocked()</td>
<td>Queries if this lock is held by any thread</td>
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<td>Condition newCondition()</td>
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These methods go above & beyond what’s available from Java’s synchronized statements/methods
Overview of Other ReentrantLock Methods

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Timed tryLock() *does* honor fairness setting & can’t “barge”
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Not very useful due to non-determinism of concurrency.
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See upcoming lesson on “Java ConditionObject”
End of Java ReentrantLock: Key Methods