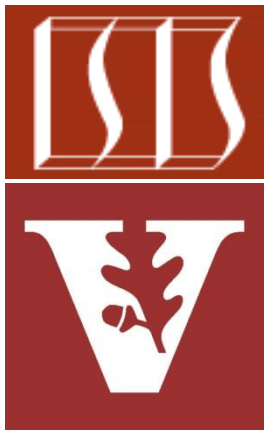
Java StampedLock: Key Methods



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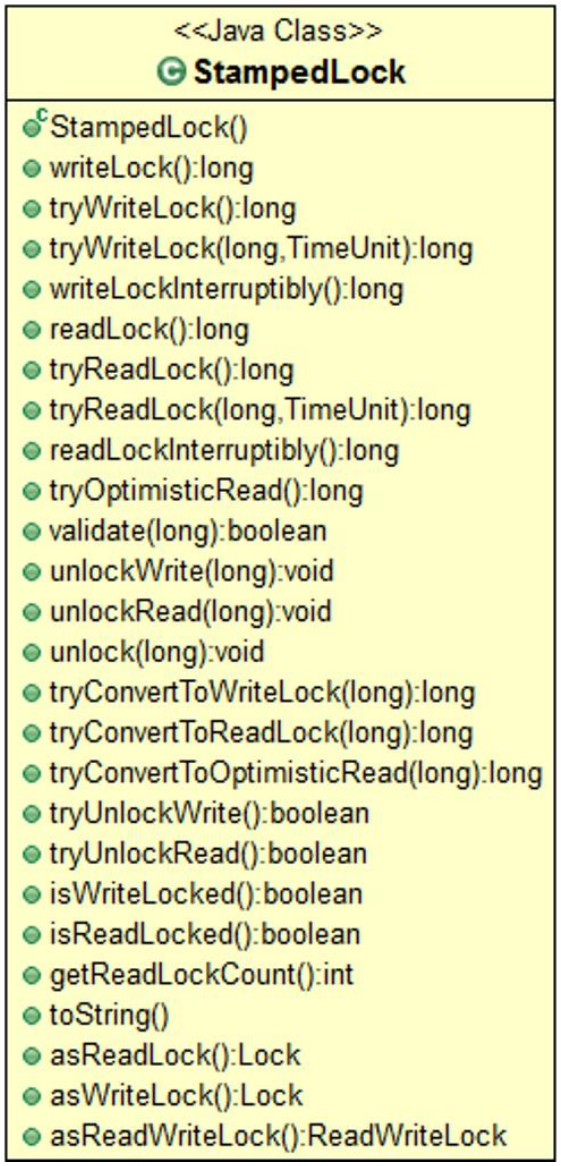
Learning Objectives in this Part of the Lesson

- Understand the structure, functionality of the Java StampedLock class
- Know the key methods in Java StampedLock



Key Methods in Stamped Lock: Writing Mode

Key Methods in StampedLock: Writing Mode

- Writing mode methods, which acquire the lock exclusively

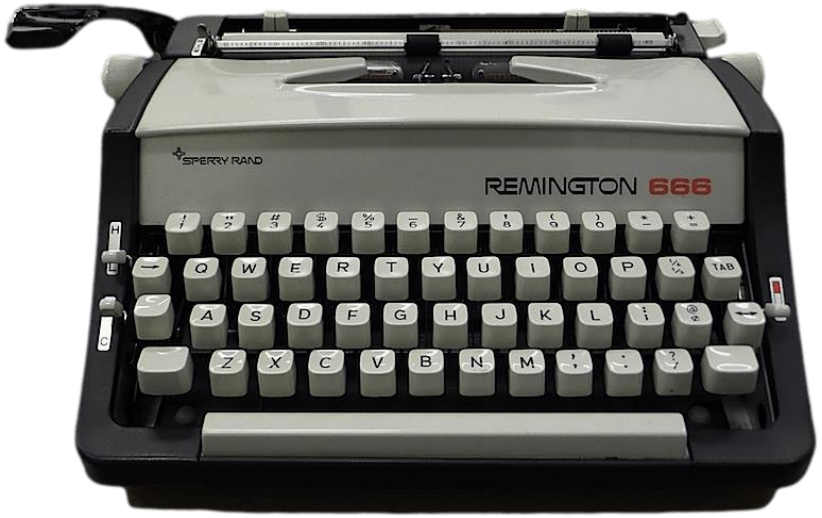
Only one thread at a time can acquire a lock exclusively

```
public class StampedLock
   implements java.io.Serializable {
   ...
   public long writeLock() { ... }

   public long tryWriteLock() { ... }

   public long tryWriteLock
                  (long time,
                   TimeUnit unit) {...}

   ...
```



Key Methods in StampedLock: Writing Mode

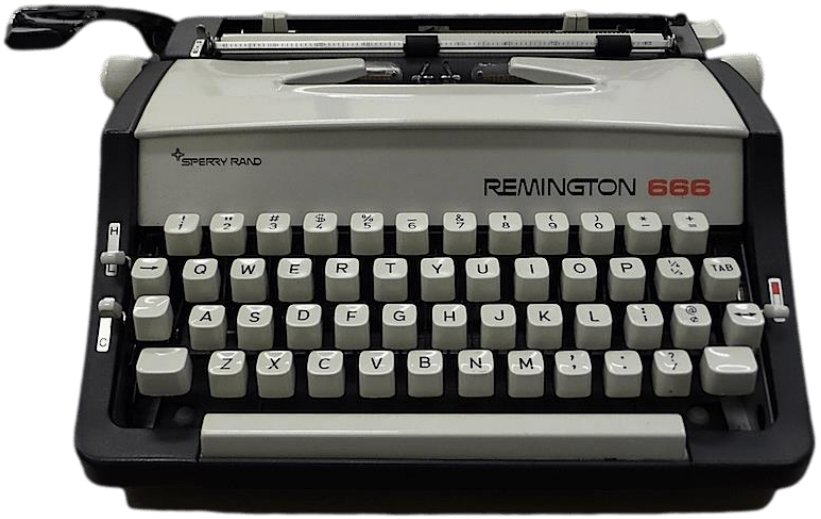
- Writing mode methods, which acquire the lock exclusively


```
public class StampedLock
   implements java.io.Serializable {
   ...
   public long writeLock() { ... }

   public long tryWriteLock() { ... }

   public long tryWriteLock
                  (long time,
                   TimeUnit unit) {...}

   ...
```



These methods are "pessimistic", i.e., they assume contention can occur

Key Methods in StampedLock: Writing Mode

- Writing mode methods, which acquire the lock exclusively

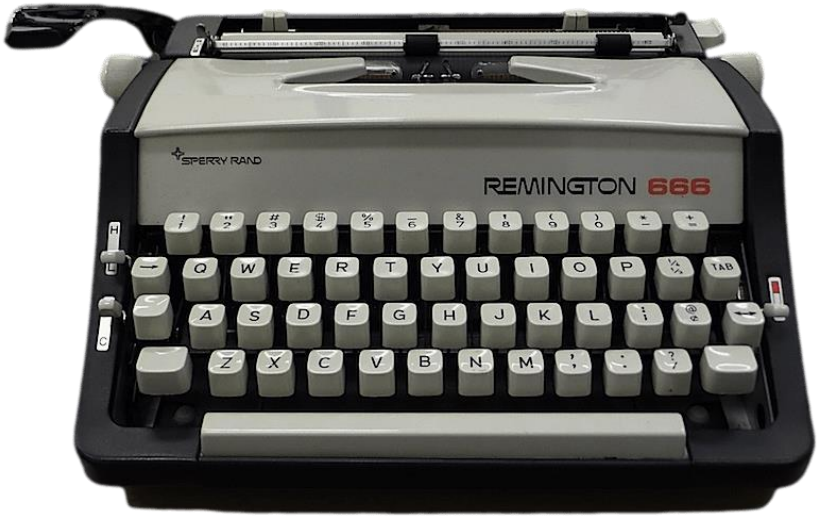
All methods return a "stamp" value, which is a long that contains a version & a mode

```
public class StampedLock
   implements java.io.Serializable {
   ...
   public long writeLock() { ... }

   public long tryWriteLock() { ... }

   public long tryWriteLock
                  (long time,
                   TimeUnit unit) {...}

   ...
```



See dzone.com/articles/a-look-at-stampedlock

Key Methods in StampedLock: Writing Mode

- Writing mode methods, which acquire the lock exclusively
  - Acquires lock exclusively, blocking until available
    - This method can't be interrupted


```
public class StampedLock
   implements java.io.Serializable {
   ...
   public long writeLock() { ... }

   public long tryWriteLock() { ... }

   public long tryWriteLock
                  (long time,
                   TimeUnit unit) {...}

   ...
```

There's also a writeLockInterruptibly() method that can be interrupted

Key Methods in StampedLock: Writing Mode

- Writing mode methods, which acquire the lock exclusively
  - Acquires lock exclusively, blocking until available
  - Acquires lock exclusively if it's immediately available
    - Otherwise, it returns 0

```
public class StampedLock
  implements java.io.Serializable {
  ...
  public long writeLock() { ... }

  public long tryWriteLock() { ... }

  public long tryWriteLock
                (long time,
                 TimeUnit unit) {...}
  ...
```

Key Methods in StampedLock: Writing Mode

- Writing mode methods, which acquire the lock exclusively
  - Acquires lock exclusively, blocking until available
  - Acquires lock exclusively if it's immediately available
  - Acquires lock exclusively if available within given time
    - Otherwise, it returns 0

```
public class StampedLock
  implements java.io.Serializable {
  ...
  public long writeLock() { ... }

  public long tryWriteLock() { ... }

  public long tryWriteLock
                (long time,
                 TimeUnit unit) {...}
  ...
```

Key Methods in StampedLock: Writing Mode

- Writing mode methods, which acquire the lock exclusively
  - Acquires lock exclusively, blocking until available
  - Acquires lock exclusively if it's immediately available
  - Acquires lock exclusively if available within given time
    - Otherwise, it returns 0
    - This method throws Interrupted Exception if it's interrupted

```
public class StampedLock
   implements java.io.Serializable {
   ...
   public long writeLock() { ... }

   public long tryWriteLock() { ... }

   public long tryWriteLock
                (long time,
                 TimeUnit unit) {...}
   ...
```

Key Methods in Stamped Lock: Reading Mode

Key Methods in StampedLock: Reading Mode

- Reading mode methods, which acquire the lock non-exclusively

```
public class StampedLock
   implements java.io.Serializable {
   ...
   public long readLock() { ... }

   public long tryReadLock() { ... }

   public long tryReadLock
                  (long time,
                   TimeUnit unit) {...}
   ...
```

Many threads at a time can acquire a lock non-exclusively

Key Methods in StampedLock: Reading Mode

- Reading mode methods, which acquire the lock non-exclusively


```
public class StampedLock
   implements java.io.Serializable {
   ...
   public long readLock() { ... }

   public long tryReadLock() { ... }

   public long tryReadLock
                  (long time,
                   TimeUnit unit) {...}
   ...
```

These methods are "pessimistic", i.e., they assume contention can occur

Key Methods in StampedLock: Reading Mode

- Reading mode methods, which acquire the lock non-exclusively

Again, all methods return a "stamp", which is a long that contains a version & a mode

```
public class StampedLock
   implements java.io.Serializable {
   ...
   public long readLock() { ... }

   public long tryReadLock() { ... }

   public long tryReadLock
                  (long time,
                   TimeUnit unit) {...}
   ...
```

Key Methods in StampedLock: Reading Mode

- Reading mode methods, which acquire the lock non-exclusively
  - Acquires lock non-exclusively, blocking until available
    - This method can't be interrupted


```
public class StampedLock
   implements java.io.Serializable {
   ...
   public long readLock() { ... }

   public long tryReadLock() { ... }

   public long tryReadLock
                  (long time,
                   TimeUnit unit) {...}
   ...
```

There's also a readLockInterruptibly() method that *can* be interrupted

Key Methods in StampedLock: Reading Mode

- Reading mode methods, which acquire the lock non-exclusively
  - Acquires lock non-exclusively, blocking until available
  - Acquires lock non-exclusively if immediately available
    - Otherwise, it returns 0

```
public class StampedLock
  implements java.io.Serializable {
  ...
  public long readLock() { ... }

  public long tryReadLock() { ... }

  public long tryReadLock
                (long time,
                 TimeUnit unit) {...}
  ...
```

Key Methods in StampedLock: Reading Mode

- Reading mode methods, which acquire the lock non-exclusively
  - Acquires lock non-exclusively, blocking until available
  - Acquires lock non-exclusively if immediately available
  - Acquires lock non-exclusively if it is available within given time
    - Otherwise, it returns 0

```
public class StampedLock
  implements java.io.Serializable {
  ...
  public long readLock() { ... }

  public long tryReadLock() { ... }

  public long tryReadLock
                (long time,
                 TimeUnit unit) {...}
  ...
```

Key Methods in StampedLock: Reading Mode

- Reading mode methods, which acquire the lock non-exclusively
  - Acquires lock non-exclusively, blocking until available
  - Acquires lock non-exclusively if immediately available
  - Acquires lock non-exclusively if it is available within given time
    - Otherwise, it returns 0
    - This method throws Interrupted Exception if it's interrupted

```
public class StampedLock
  implements java.io.Serializable {
  ...
  public long readLock() { ... }

  public long tryReadLock() { ... }

  public long tryReadLock
                (long time,
                 TimeUnit unit) {...}
  ...
```

Key Methods in Stamped Lock: Optimistic Mode

Key Methods in StampedLock: Optimistic Mode

- Optimistic reading mode methods, which acquire the lock non-exclusively

```
public class StampedLock
   implements java.io.Serializable {
   ...
   public long tryOptimisticRead()
      { ... }

   public boolean validate
               (long stamp) { ... }
   ...
```

Many threads at a time can acquire a lock non-exclusively

Key Methods in StampedLock: Optimistic Mode

- Optimistic reading mode methods, which acquire the lock non-exclusively


```
public class StampedLock
   implements java.io.Serializable {
   ...
   public long tryOptimisticRead()
      { ... }

   public boolean validate
                (long stamp) { ... }
   ...
```

These methods are "optimistic", i.e., they assume contention may not occur

Key Methods in StampedLock: Optimistic Mode

- Optimistic reading mode methods, which acquire the lock non-exclusively
  - Returns an "observation stamp" for later validation or 0 if the lock is currently held exclusively

```
public class StampedLock
  implements java.io.Serializable {
  ...
  public long tryOptimisticRead()
    { ... }

  public boolean validate
              (long stamp) { ... }
  ...
```

Key Methods in StampedLock: Optimistic Mode

- Optimistic reading mode methods, which acquire the lock non-exclusively
  - Returns an "observation stamp" for later validation or 0 if the lock is currently held exclusively
    - Code using this mode reads the value of fields & holds them in local variables for use after they are "validated"

```
public class StampedLock
  implements java.io.Serializable {
  ...
  public long tryOptimisticRead()
    { ... }

  public boolean validate
              (long stamp) { ... }
  ...
```

See upcoming part of this lesson on "*Java StampedLock: Example Application*"

Key Methods in StampedLock: Optimistic Mode

- Optimistic reading mode methods, which acquire the lock non-exclusively
  - Returns an "observation stamp" for later validation or 0 if the lock is currently held exclusively
    - Code using this mode reads the value of fields & holds them in local variables for use after they are "validated"
  - tryOptimisticRead() internally does a volatile read on a field inside of StampedLock to ensure "fresh" values of fields are observed

```
public class StampedLock
   implements java.io.Serializable {
   ...
   public long tryOptimisticRead()
      { ... }

   public boolean validate
                (long stamp) { ... }
   ...
```

See www.javaspecialists.eu/archive/Issue242.html

Key Methods in StampedLock: Optimistic Mode

- Optimistic reading mode methods, which acquire the lock non-exclusively
  - Returns an "observation stamp" for later validation or 0 if the lock is currently held exclusively
  - Returns true if lock hasn't been acquired exclusively since stamp was issued, else false

```
public class StampedLock
  implements java.io.Serializable {
  ...
  public long tryOptimisticRead()
    { ... }

  public boolean validate
              (long stamp) { ... }
  ...
```

Key Methods in StampedLock: Optimistic Mode

- Optimistic reading mode methods, which acquire the lock non-exclusively
  - Returns an "observation stamp" for later validation or 0 if the lock is currently held exclusively
- Returns true if lock hasn't been acquired exclusively since stamp was issued, else false
  - If validate() succeeds (i.e., returns true) synchronization overhead is *very* low & there's no need to unlock the "lock"

```
public class StampedLock
   implements java.io.Serializable {
   ...
   public long tryOptimisticRead()
      { ... }

   public boolean validate
                (long stamp) { ... }
   ...
```

Key Methods in Stamped Lock: Conversions

Key Methods in StampedLock: Conversions

- Conditionally convert a stamp across lock modes


```
public class StampedLock
   implements java.io.Serializable {
   ...
   public long
            tryToConvertToWriteLock
              (long stamp) { ... }

   public long
            tryToConvertToReadLock
              (long stamp) { ... }

   public long
         tryToConvertToOptimisticRead
              (long stamp) { ... }
   ...
```

These calls perform work *atomically* (despite lack of documentation ;-))

Key Methods in StampedLock: Conversions

- Conditionally convert a stamp to a write lock

```
public class StampedLock
  implements java.io.Serializable {
  ...
  public long
           tryToConvertToWriteLock
             (long stamp) { ... }

  public long
           tryToConvertToReadLock
             (long stamp) { ... }

  public long
        tryToConvertToOptimisticRead
             (long stamp) { ... }
  ...
```

Key Methods in StampedLock: Conversions

- Conditionally convert a stamp to a write lock
  - If lock state matches stamp, performs one following action

```
public class StampedLock
  implements java.io.Serializable {
  ...
  public long
           tryToConvertToWriteLock
             (long stamp) { ... }

  public long
           tryToConvertToReadLock
             (long stamp) { ... }

  public long
       tryToConvertToOptimisticRead
             (long stamp) { ... }
  ...
```

Key Methods in StampedLock: Conversions

- Conditionally convert a stamp to a write lock
  - If lock state matches stamp, performs one following action
    - If stamp represents holding a write lock, return it

```
public class StampedLock
  implements java.io.Serializable {
  ...
  public long
           tryToConvertToWriteLock
             (long stamp) { ... }

  public long
           tryToConvertToReadLock
             (long stamp) { ... }

  public long
       tryToConvertToOptimisticRead
             (long stamp) { ... }
  ...
```

Key Methods in StampedLock: Conversions

- Conditionally convert a stamp to a write lock
  - If lock state matches stamp, performs one following action
    - If stamp represents holding a write lock, return it
    - If stamp represents holding a read lock—& a write lock is available—atomically release read lock & return write stamp


```
public class StampedLock
  implements java.io.Serializable {
  ...
  public long
            tryToConvertToWriteLock
              (long stamp) { ... }

  public long
            tryToConvertToReadLock
              (long stamp) { ... }

  public long
       tryToConvertToOptimisticRead
              (long stamp) { ... }
  ...
```

This represents a "lock upgrade"

Key Methods in StampedLock: Conversions

- Conditionally convert a stamp to a write lock
  - If lock state matches stamp, performs one following action
    - If stamp represents holding a write lock, return it
    - If stamp represents holding a read lock—& a write lock is available—atomically release read lock & return write stamp
    - If stamp represents a read that's optimistic, return a write stamp if immediately available

```
public class StampedLock
  implements java.io.Serializable {
...
public long
          tryToConvertToWriteLock
            (long stamp) { ... }

public long
          tryToConvertToReadLock
            (long stamp) { ... }

public long
     tryToConvertToOptimisticRead
            (long stamp) { ... }
...
```

Key Methods in StampedLock: Conversions

- Conditionally convert a stamp to a write lock
  - If lock state matches stamp, performs one following action
    - If stamp represents holding a write lock, return it
    - If stamp represents holding a read lock—& a write lock is available—atomically release read lock & return write stamp
    - If stamp represents a read that's optimistic, return a write stamp if immediately available
  - Else return zero

```
public class StampedLock
  implements java.io.Serializable {
...
public long
          tryToConvertToWriteLock
            (long stamp) { ... }

public long
          tryToConvertToReadLock
            (long stamp) { ... }

public long
     tryToConvertToOptimisticRead
            (long stamp) { ... }
...
```

Key Methods in StampedLock: Conversions

- Conditionally convert a stamp to a read lock

```
public class StampedLock
  implements java.io.Serializable {
  ...
  public long
           tryToConvertToWriteLock
             (long stamp) { ... }

  public long
           tryToConvertToReadLock
             (long stamp) { ... }

  public long
        tryToConvertToOptimisticRead
             (long stamp) { ... }
  ...
```

Key Methods in StampedLock: Conversions

- Conditionally convert a stamp to a read lock
  - If lock state matches stamp, performs one following action

```
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  implements java.io.Serializable {
  ...
  public long
           tryToConvertToWriteLock
             (long stamp) { ... }

  public long
           tryToConvertToReadLock
             (long stamp) { ... }

  public long
       tryToConvertToOptimisticRead
             (long stamp) { ... }
  ...
```

Key Methods in StampedLock: Conversions

- Conditionally convert a stamp to a read lock
  - If lock state matches stamp, performs one following action
    - If stamp represents holding a write lock atomically release it & obtain read lock


```
public class StampedLock
  implements java.io.Serializable {
  ...
  public long
            tryToConvertToWriteLock
              (long stamp) { ... }

  public long
            tryToConvertToReadLock
              (long stamp) { ... }

  public long
       tryToConvertToOptimisticRead
              (long stamp) { ... }
  ...
```

This represents a "lock downgrade"

Key Methods in StampedLock: Conversions

- Conditionally convert a stamp to a read lock
  - If lock state matches stamp, performs one following action
    - If stamp represents holding a write lock atomically release it & obtain read lock
    - If stamp represents holding a read lock, return it

```
public class StampedLock
  implements java.io.Serializable {
...
public long
          tryToConvertToWriteLock
            (long stamp) { ... }

public long
          tryToConvertToReadLock
            (long stamp) { ... }

public long
     tryToConvertToOptimisticRead
            (long stamp) { ... }
...
```

Key Methods in StampedLock: Conversions

- Conditionally convert a stamp to a read lock
  - If lock state matches stamp, performs one following action
    - If stamp represents holding a write lock atomically release it & obtain read lock
    - If stamp represents holding a read lock, return it
    - If stamp represents holding an optimistic read, return read stamp only if available

```
public class StampedLock
  implements java.io.Serializable {
...
public long
          tryToConvertToWriteLock
            (long stamp) { ... }

public long
          tryToConvertToReadLock
            (long stamp) { ... }

public long
     tryToConvertToOptimisticRead
            (long stamp) { ... }
...
```

Key Methods in StampedLock: Conversions

- Conditionally convert a stamp to a read lock
  - If lock state matches stamp, performs one following action
    - If stamp represents holding a write lock atomically release it & obtain read lock
    - If stamp represents holding a read lock, return it
    - If stamp represents holding an optimistic read, return read stamp only if available
  - Else return zero

```
public class StampedLock
  implements java.io.Serializable {
...
public long
          tryToConvertToWriteLock
            (long stamp) { ... }

public long
          tryToConvertToReadLock
            (long stamp) { ... }

public long
     tryToConvertToOptimisticRead
            (long stamp) { ... }
...
```

Key Methods in StampedLock: Conversions

- Conditionally convert a stamp to an optimistic read lock

```
public class StampedLock
  implements java.io.Serializable {
  ...
  public long
           tryToConvertToWriteLock
             (long stamp) { ... }

  public long
           tryToConvertToReadLock
             (long stamp) { ... }

  public long
       tryToConvertToOptimisticRead
             (long stamp) { ... }
  ...
```

Key Methods in StampedLock: Conversions

- Conditionally convert a stamp to an optimistic read lock
  - If lock state matches stamp, performs one following action

```
public class StampedLock
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  ...
  public long
           tryToConvertToWriteLock
             (long stamp) { ... }

  public long
           tryToConvertToReadLock
             (long stamp) { ... }

  public long
       tryToConvertToOptimisticRead
             (long stamp) { ... }
  ...
```

Key Methods in StampedLock: Conversions

- Conditionally convert a stamp to an optimistic read lock
  - If lock state matches stamp, performs one following action
    - If stamp represents holding a lock release it & return an observation stamp


```
public class StampedLock
  implements java.io.Serializable {
  ...
  public long
           tryToConvertToWriteLock
             (long stamp) { ... }

  public long
           tryToConvertToReadLock
             (long stamp) { ... }

  public long
       tryToConvertToOptimisticRead
             (long stamp) { ... }
  ...
```

This represents a "lock downgrade"

Key Methods in StampedLock: Conversions

- Conditionally convert a stamp to an optimistic read lock
  - If lock state matches stamp, performs one following action
    - If stamp represents holding a lock release it & return an observation stamp
    - If stamp represents holding an optimistic read, return it if it's validated

```
public class StampedLock
  implements java.io.Serializable {
  ...
  public long
           tryToConvertToWriteLock
             (long stamp) { ... }

  public long
           tryToConvertToReadLock
             (long stamp) { ... }

  public long
       tryToConvertToOptimisticRead
             (long stamp) { ... }
  ...
```

Key Methods in StampedLock: Conversions

- Conditionally convert a stamp to an optimistic read lock
  - If lock state matches stamp, performs one following action
    - If stamp represents holding a lock release it & return an observation stamp
    - If stamp represents holding an optimistic read, return it if it's validated
    - Else return zero

```
public class StampedLock
   implements java.io.Serializable {
   ...
   public long
            tryToConvertToWriteLock
              (long stamp) { ... }

   public long
            tryToConvertToReadLock
              (long stamp) { ... }

   public long
        tryToConvertToOptimisticRead
              (long stamp) { ... }
   ...
```

Key Methods in Stamped Lock: Unlocking

Key Methods in StampedLock: Unlocking

- There are several ways to unlock a StampedLock

```
public class StampedLock
   implements java.io.Serializable {
   ...
   public void unlockWrite
      (long stamp) { ... }

   public void unlockRead
      (long stamp) { ... }

   public void unlock
      (long stamp) { ... }

   ...
```

Key Methods in StampedLock: Unlocking

- There are several ways to unlock a StampedLock
  - Releases exclusive lock if the state matches given stamp

```
public class StampedLock
  implements java.io.Serializable {
  ...
  public void unlockWrite
     (long stamp) { ... }

  public void unlockRead
     (long stamp) { ... }

  public void unlock
     (long stamp) { ... }

  ...
```

Key Methods in StampedLock: Unlocking

- There are several ways to unlock a StampedLock
  - Releases exclusive lock if the state matches given stamp
  - Releases non-exclusive lock if the state matches given stamp

```
public class StampedLock
  implements java.io.Serializable {
  ...
  public void unlockWrite
     (long stamp) { ... }

  public void unlockRead
     (long stamp) { ... }

  public void unlock
     (long stamp) { ... }

  ...
```

Key Methods in StampedLock: Unlocking

- There are several ways to unlock a StampedLock
  - Releases exclusive lock if the state matches given stamp
  - Releases non-exclusive lock if the state matches given stamp
  - Releases lock if the lock state matches given stamp

```
public class StampedLock
  implements java.io.Serializable {
  ...
  public void unlockWrite
     (long stamp) { ... }

  public void unlockRead
     (long stamp) { ... }

  public void unlock
     (long stamp) { ... }

  ...
```

unlock() is slightly less efficient than unlockWrite() & unlockRead()

End of Java StampedLock: Key Methods