Java StampedLock: Example Application

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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
- Recognize how to apply Java StampedLock in practice

```
class Point { ...
  void moveIfAtOrigin(double newX, double newY) {
    long stamp = sl.readLock();
    try
      while (x == 0.0 && y == 0.0) {
        long ws = sl.tryConvertToWriteLock(stamp);
        if (ws != 0L) {
          stamp = ws;
          x = newX; y = newY;
          break;
        } else {
          sl.unlockRead(stamp);
          stamp = sl.writeLock();
        } ...
```

Applying Java Stamped Lock in Practice

Applying Java StampedLock in Practice

- The Point class shows how to program with StampedLock

```
class Point {

  private double x;
  private double y;

  private final StampedLock sl =
    new StampedLock();
  ...
```

See docs.oracle.com/javase/8/docs/api/java/util/concurrent/locks/StampedLock.html

Applying Java StampedLock in Practice

- The Point class shows how to program with StampedLock

```
class Point {
```

Maintains two-dimensional points

```
  private double x;
  private double y;

  private final StampedLock sl =
    new StampedLock();
  ...
```

Applying Java StampedLock in Practice

- The Point class shows how to program with StampedLock

State that must be protected

```
class Point {

  private double x;
  private double y;

  private final StampedLock sl =
    new StampedLock();
  ...
```

Applying Java StampedLock in Practice

- The Point class shows how to program with StampedLock

```
class Point {

  private double x;
  private double y;

  private final StampedLock sl =
    new StampedLock();
  ...
```

StampedLock that does the protecting

Applying Java StampedLock: Writing Mode

Applying Java StampedLock: Writing Mode

- Performing an exclusive write with a StampedLock

```
class Point {
  ...

  void move(double deltaX,
            double deltaY) {
    long stamp = sl.writeLock();
      try {
        x += deltaX;
        y += deltaY;
      } finally {
        sl.unlockWrite(stamp);
      }
    }
  ...
```

This method atomically moves a point to a new location

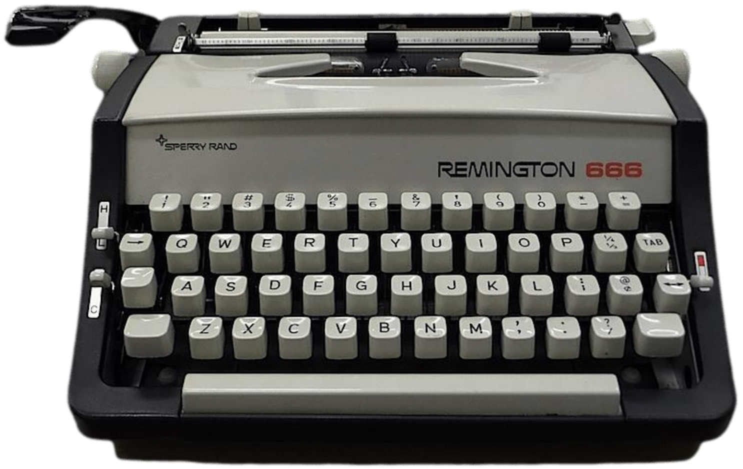
Applying Java StampedLock: Writing Mode

- Performing an exclusive write with a StampedLock

```
class Point {
  ...

  void move(double deltaX,
            double deltaY) {
    long stamp = sl.writeLock();
      try {
        x += deltaX;
        y += deltaY;
      } finally {
        sl.unlockWrite(stamp);
      }
  }
  ...
```

Acquire a write lock



Applying Java StampedLock: Writing Mode

- Performing an exclusive write with a StampedLock

```
class Point {
  ...

  void move(double deltaX,
            double deltaY) {
    long stamp = sl.writeLock();
      try {
        x += deltaX;
        y += deltaY;
      } finally {
        sl.unlockWrite(stamp);
      }
    }
  ...
```

Modify the state atomically

Applying Java StampedLock: Writing Mode

- Performing an exclusive write with a StampedLock

```
class Point {
  ...

  void move(double deltaX,
            double deltaY) {
    long stamp = sl.writeLock();
      try {
        x += deltaX;
        y += deltaY;
      } finally {
        sl.unlockWrite(stamp);
      }
    }
  ...
```

Release the write lock

Applying Java StampedLock: Optimisitic & Reading Mode

Applying Java StampedLock: Optimisitic & Reading Mode

- Performing a optimistic read with a StampedLock

A read-only method

```
class Point {
  ...
  double distanceFromOrigin() {
    long stamp = sl.tryOptimisticRead();
    double currX = x, currY = y;
    if (!sl.validate(stamp)) {
        stamp = sl.readLock();
        try {
          currX = x; currY = y;
        } finally
        { sl.unlockRead(stamp); }
     }
     return Math.sqrt (currX * currX + currY * currY);
   }
  ...
```

Applying Java StampedLock: Optimisitic & Reading Mode

- Performing a optimistic read with a StampedLock

```
class Point {
  ...
  double distanceFromOrigin() {
    long stamp = sl.tryOptimisticRead();
    double currX = x, currY = y;
    if (!sl.validate(stamp)) {
        stamp = sl.readLock();
        try {
          currX = x; currY = y;
        } finally
        { sl.unlockRead(stamp); }
     }
     return Math.sqrt (currX * currX + currY * currY);
   }
  ...
```

Attempt to get an "observation" stamp

Applying Java StampedLock: Optimisitic & Reading Mode

- Performing a optimistic read with a StampedLock

```
class Point {
  ...
  double distanceFromOrigin() {
    long stamp = sl.tryOptimisticRead();
    double currX = x, currY = y;
    if (!sl.validate(stamp)) {
        stamp = sl.readLock();
        try {
          currX = x; currY = y;
        } finally
        { sl.unlockRead(stamp); }
     }
     return Math.sqrt (currX * currX + currY * currY);
   }
  ...
```

"Optimistically" read state into local variables

Code using optimistic reading mode typically copies the values of fields & holds them in local variables for use after they are validated

Applying Java StampedLock: Optimisitic & Reading Mode

- Performing a optimistic read with a StampedLock

```
class Point {
  ...
  double distanceFromOrigin() {
    long stamp = sl.tryOptimisticRead();
    double currX = x, currY = y;
    if (!sl.validate(stamp)) {
        stamp = sl.readLock();
        try {
          currX = x; currY = y;
        } finally
        { sl.unlockRead(stamp); }
     }
     return Math.sqrt (currX * currX + currY * currY);
   }
  ...
```

Check if another thread acquired the lock for writing after earlier call to tryOptimisticRead()

Applying Java StampedLock: Optimisitic & Reading Mode

- Performing a optimistic read with a StampedLock

```
class Point {
  ...
  double distanceFromOrigin() {
    long stamp = sl.tryOptimisticRead();
    double currX = x, currY = y;
    if (!sl.validate(stamp)) {
        stamp = sl.readLock();
        try {
          currX = x; currY = y;
        } finally
        { sl.unlockRead(stamp); }
     }
     return Math.sqrt (currX * currX + currY * currY);
   }
  ...
```

If write lock occurred then acquire a read lock (blocking as long as the write lock is held by another thread)

Applying Java StampedLock: Optimisitic & Reading Mode

- Performing a optimistic read with a StampedLock

```
class Point {
  ...
  double distanceFromOrigin() {
    long stamp = sl.tryOptimisticRead();
    double currX = x, currY = y;
    if (!sl.validate(stamp)) {
        stamp = sl.readLock();
        try {
          currX = x; currY = y;
        } finally
        { sl.unlockRead(stamp); }
     }
     return Math.sqrt (currX * currX + currY * currY);
   }
  ...
```

Make copies of x & y via "pessimistic" reads

Applying Java StampedLock: Optimisitic & Reading Mode

- Performing a optimistic read with a StampedLock

```
class Point {
  ...
  double distanceFromOrigin() {
    long stamp = sl.tryOptimisticRead();
    double currX = x, currY = y;
    if (!sl.validate(stamp)) {
        stamp = sl.readLock();
        try {
          currX = x; currY = y;
        } finally
        { sl.unlockRead(stamp); }
     }
     return Math.sqrt (currX * currX + currY * currY);
   }
  ...
```

Release read lock

Applying Java StampedLock: Optimisitic & Reading Mode

- Performing a optimistic read with a StampedLock

```
class Point {
  ...
  double distanceFromOrigin() {
    long stamp = sl.tryOptimisticRead();
    double currX = x, currY = y;
    if (!sl.validate(stamp)) {
        stamp = sl.readLock();
        try {
          currX = x; currY = y;
        } finally
        { sl.unlockRead(stamp); }
    }
    return Math.sqrt (currX * currX + currY * currY);
  }
  ...
```

No lock to release if validate() succeeded

Applying Java StampedLock: Optimisitic & Reading Mode

- Performing a optimistic read with a StampedLock

```
class Point {
  ...
  double distanceFromOrigin() {
    long stamp = sl.tryOptimisticRead();
    double currX = x, currY = y;
    if (!sl.validate(stamp)) {
        stamp = sl.readLock();
        try {
          currX = x; currY = y;
        } finally
        { sl.unlockRead(stamp); }
     }
     return Math.sqrt (currX * currX + currY * currY);
   }
  ...
```

Do computation with the copied values

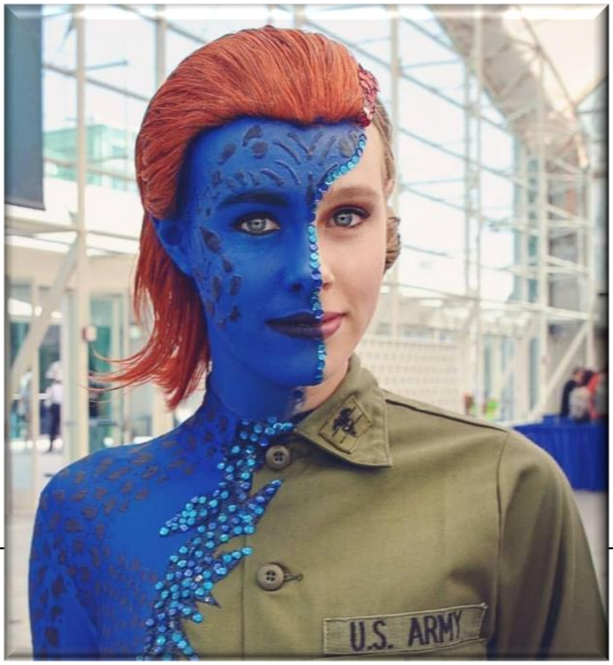
Applying Java Stamped Lock: Conditional Write

Applying Java StampedLock: Conditional Write

- Performing a conditional write with a StampedLock

Move a point only if it's current at the origin

```
class Point {
  ...
  void moveIfAtOrigin(double newX, double newY) {
    long stamp = sl.readLock();
    try {
      while (x == 0.0 && y == 0.0) {
        long ws = sl.tryConvertToWriteLock(stamp);
        if (ws != 0L) {
          stamp = ws;
          x = newX; y = newY;
          break;
        } else {
          sl.unlockRead(stamp);
          stamp = sl.writeLock();
        }
      ...
```



Applying Java StampedLock: Conditional Write

- Performing a conditional write with a StampedLock

```
class Point {
  ...
  void moveIfAtOrigin(double newX, double newY) {
    long stamp = sl.readLock();
    try
      while (x == 0.0 && y == 0.0) {
        long ws = sl.tryConvertToWriteLock(stamp);
        if (ws != 0L) {
          stamp = ws;
          x = newX; y = newY;
          break;
        } else {
          sl.unlockRead(stamp);
          stamp = sl.writeLock();
        }
      ...
```

Acquire a read lock

Applying Java StampedLock: Conditional Write

- Performing a conditional write with a StampedLock

```
class Point {
  ...
  void moveIfAtOrigin(double newX, double newY) {
    long stamp = sl.readLock();
    try
      while (x == 0.0 && y == 0.0) {
        long ws = sl.tryConvertToWriteLock(stamp);
        if (ws != 0L) {
          stamp = ws;
          x = newX; y = newY;
          break;
        } else {
          sl.unlockRead(stamp);
          stamp = sl.writeLock();
        }
      ...
```

Check whether x & y are at the origin

This loop only executes at most twice!

Applying Java StampedLock: Conditional Write

- Performing a conditional write with a StampedLock

```
class Point {
  ...
  void moveIfAtOrigin(double newX, double newY) {
    long stamp = sl.readLock();
    try
      while (x == 0.0 && y == 0.0) {
        long ws = sl.tryConvertToWriteLock(stamp);
        if (ws != 0L) {
          stamp = ws;
          x = newX; y = newY;
          break;
        } else {
          sl.unlockRead(stamp);
          stamp = sl.writeLock();
        }
      ...
```

Try to upgrade to a write lock w/out blocking

tryConvertToWriteLock() atomically releases the read lock & acquires the write lock if there are no other readers

Applying Java StampedLock: Conditional Write

- Performing a conditional write with a StampedLock

```
class Point {
  ...
  void moveIfAtOrigin(double newX, double newY) {
    long stamp = sl.readLock();
    try
      while (x == 0.0 && y == 0.0) {
        long ws = sl.tryConvertToWriteLock(stamp);
        if (ws != 0L) {
          stamp = ws;
          x = newX; y = newY;
          break;
        } else {
          sl.unlockRead(stamp);
          stamp = sl.writeLock();
        }
      ...
```

Upgrade succeeded w/out blocking!

Applying Java StampedLock: Conditional Write

- Performing a conditional write with a StampedLock

```
class Point {
  ...
  void moveIfAtOrigin(double newX, double newY) {
    long stamp = sl.readLock();
    try
      while (x == 0.0 && y == 0.0) {
        long ws = sl.tryConvertToWriteLock(stamp);
        if (ws != 0L) {
          stamp = ws;
          x = newX; y = newY;
          break;
        } else {
          sl.unlockRead(stamp);
          stamp = sl.writeLock();
        }
    ...
```

Update stamp & modify Point's state

Applying Java StampedLock: Conditional Write

- Performing a conditional write with a StampedLock

```
class Point {
  ...
  void moveIfAtOrigin(double newX, double newY) {
    long stamp = sl.readLock();
    try
      while (x == 0.0 && y == 0.0) {
        long ws = sl.tryConvertToWriteLock(stamp);
        if (ws != 0L) {
          stamp = ws;
          x = newX; y = newY;
          break;  ⇦ Exit the loop
        } else {
          sl.unlockRead(stamp);
          stamp = sl.writeLock();
        }
      ...
```

Applying Java StampedLock: Conditional Write

- Performing a conditional write with a StampedLock

```
class Point {
  ...
  void moveIfAtOrigin(double newX, double newY) {
    long stamp = sl.readLock();
    try
      while (x == 0.0 && y == 0.0) {
        long ws = sl.tryConvertToWriteLock(stamp);
        if (ws != 0L) {
          stamp = ws;
          x = newX; y = newY;
          break;
        } else {
          sl.unlockRead(stamp);
          stamp = sl.writeLock();
        }
      ...
```

Upgrade failed, so release the read lock & block until the write lock acquired exclusively

The **x** & **y** field values may change between unlockRead() & writeLock()!

Applying Java StampedLock: Conditional Write

- Performing a conditional write with a StampedLock

```
class Point {
  ...
  void moveIfAtOrigin(double newX, double newY) {
    long stamp = sl.readLock();
    try
      while (x == 0.0 && y == 0.0) {
        long ws = sl.tryConvertToWriteLock(stamp);
        if (ws != 0L) {
          stamp = ws;
          x = newX; y = newY;
          break;
        } else {
          sl.unlockRead(stamp);
          stamp = sl.writeLock();
        }
      ...
```

Must retest loop condition since x & y field values may change between unlockRead() & writeLock()!

Applying Java StampedLock: Conditional Write

- Performing a conditional write with a StampedLock

```
class Point {
  ...
  void moveIfAtOrigin(double newX, double newY) {
    long stamp = sl.readLock();
    try
      while (x == 0.0 && y == 0.0) {
        long ws = sl.tryConvertToWriteLock(stamp);
        if (ws != 0L) {
          stamp = ws;
          x = newX; y = newY;
          break;
        } else {
          sl.unlockRead(stamp);
          stamp = sl.writeLock();
        }
      ...
```

This conversion will always succeed since stamp is now a write lock

Applying Java StampedLock: Conditional Write

- Performing a conditional write with a StampedLock

```
class Point {
  ...
  void moveIfAtOrigin(double newX, double newY) {
    long stamp = sl.readLock();
    try {
      while (x == 0.0 && y == 0.0) {
        ...
          stamp = ws;
        ...
          stamp = sl.writeLock();
        }
      }
    } finally { sl.unlock(stamp); }
  }
  ...
```

Release the appropriate lock

End of Java Stamped Lock: Example Application