Thread Safety with Phaser, StampedLock and VarHandle

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Javaspecialists.eu
java training

Phaser

Phasers

- Allows threads to coordinate by phases
  - Similar to CountDownLatch and CyclicBarrier, but more flexible
- Registration
  - Number of parties *registered* may vary over time
    - Same as *count* in CountDownLatch, *parties* in CyclicBarrier
    - A party can register/deregister itself at any time
- ManagedBlocker
  - Can be used in the ForkJoinPool
- https://github.com/kabutz/modern-synchronizers

Demo of CyclicBarrier vs Phaser

github.com/kabutz/modern-synchronizers

Who's Who

- **Heinz Kabutz @heinzkabutz**
  - **Java Specialists Newsletter**
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  - **https://extreme-java-camp.de/**
    - **11-15 März 2019 in München**

StampedLock

What is StampedLock?

- Java 8 synchronizer
- Allows optimistic reads
  - ReentrantReadWriteLock only has pessimistic reads
- Not reentrant
  - This is not a feature
- Use to enforce invariants across multiple fields
  - For simple classes, synchronized/volatile is easier and faster
- Can split locking and unlocking between threads

Pessimistic Exclusive Lock (write)

```
public class StampedLock {
  long writeLock() // never returns 0, might block

  // returns new write stamp if successful; otherwise 0
  long tryConvertToWriteLock(long stamp)

  void unlockWrite(long stamp) // needs write stamp


// and a bunch of other methods left out for brevity
```

Pessimistic Non-Exclusive Lock (read)

```
public class StampedLock { // continued ...
  long readLock() // never returns 0, might block

  // returns new read stamp if successful; otherwise 0
  long tryConvertToReadLock(long stamp)

  void unlockRead(long stamp) // needs read stamp

  void unlock(long stamp) // unlocks read or write
```

Optimistic Non-Exclusive Read (No Lock)

```
public class StampedLock { // continued ...
  // could return 0 if a write stamp has been issued
  long tryOptimisticRead()

  // return true if stamp was non-zero and no write
  // lock has been requested by another thread since
  // the call to tryOptimisticRead()
  boolean validate(long stamp)
```

Code Idiom for Optimistic Read

```
public double optimisticRead() {
  long stamp = sl.tryOptimisticRead();
  double currentState1 = state1,
         currentState2 = state2, ... etc.;
  if (!sl.validate(stamp)) {
    stamp = sl.readLock();
    try {
      currentState1 = state1;
      currentState2 = state2, ... etc.;
    } finally {
      sl.unlockRead(stamp);
    }
  }
  return calculateSomething(currentState1, currentState2);
}
```

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```

We get a stamp to use for the optimistic read

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```

We read field values into local fields

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}
```

Next we validate that no write locks have been issued in the meanwhile

Code Idiom for Optimistic Read

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    try {
      currentState1 = state1;
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      sl.unlockRead(stamp);
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  }
  return calculateSomething(currentState1, cur
}
```

If they have, then we don't know if our state is clean

Thus we acquire a pessimistic read lock and read the state into local fields

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    stamp = sl.readLock();
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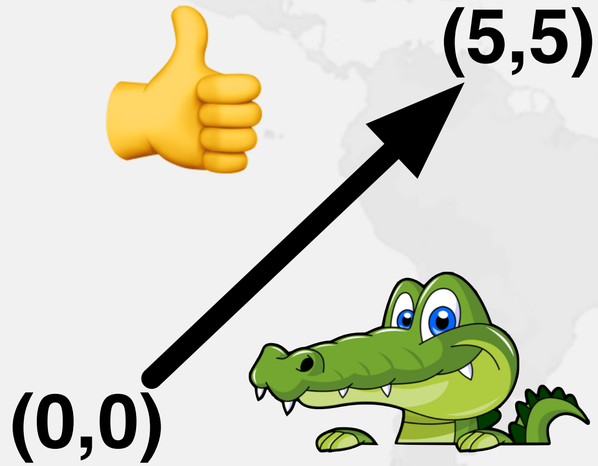
}
```

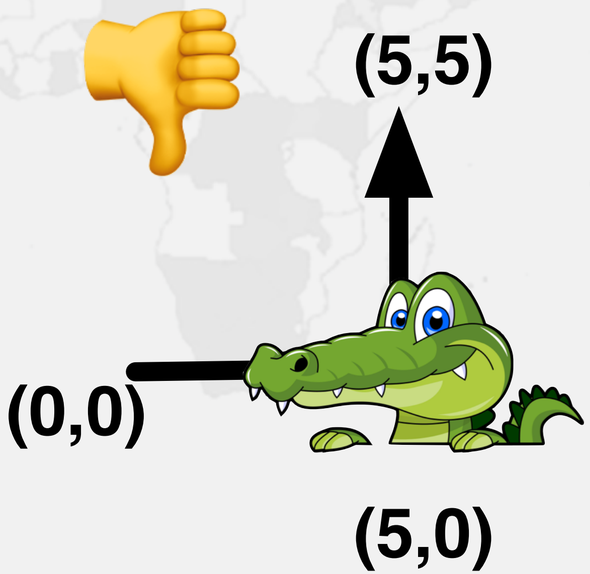
Sifis the Cretan Crocodile (RIP)

- Poor critter was roaming around Crete
  - The pet became too big
  - Or hungry
- Eventually died in our cold winter months

Introducing the Position Class

- When moving from (0,0) to (5,5), we want to travel in a diagonal line
  - We don't want to ever see our position at (0,5) or especially (5,0)





Refactoring Position and IntList

github.com/kabutz/modern-synchronizers

VarHandle

Java 9 VarHandles Instead of Unsafe

- VarHandles remove biggest temptation to use Unsafe
  - As fast as Unsafe
- Can read and write fields of class
  - getVolatile() / setVolatile()
  - getAcquire() / setRelease()
  - getOpaque() / setOpaque()
  - get() / set() - plain
  - compareAndSet(), returning boolean
  - compareAndExchangeVolatile(), returning found value always

Refactoring Position from StampedLock to VarHandle

github.com/kabutz/modern-synchronizers

Questions?

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