Java ReentrantReadWriteLock: Example Application

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Learning Objectives in this Part of the Lesson

- Understand the structure & functionality of the Java ReentrantReadWriteLock class
- Know the key methods in Java ReentrantReadWriteLock
- Recognize how to apply Java ReentrantReadWriteLock in practice

```java
class SimpleAtomicLong {
    private long mValue;

    private ReentrantReadWriteLock mRWLock = new ReentrantReadWriteLock();

    // ...
```
Applying the Java ReentrantReadWriteLock
The SimpleAtomicLong class shows how to program with ReentrantReadWriteLock

class SimpleAtomicLong {
    private long mValue;

    private ReentrantReadWriteLock mRWLock
        mRWLock = new
            ReentrantReadWriteLock();

    ...

Applying the Java ReentrantReadWriteLock

- The SimpleAtomicLong class shows how to program with ReentrantReadWriteLock

```java
class SimpleAtomicLong {
    private long mValue;

    private ReentrantReadWriteLock mRWLock = new ReentrantReadWriteLock();

    // ...

    See src/share/classes/java/util/concurrent/atomic/AtomicLong.java
}
```

Java AtomicLong actually uses “compare-and-swap”
The SimpleAtomicLong class shows how to program with ReentrantReadWriteLock

```java
class SimpleAtomicLong {
    private long mValue;
    private ReentrantReadWriteLock mRWLock = new ReentrantReadWriteLock();
    ...
}
```

The value written to & read from (which is not atomic by default)

See [dzone.com/articles/longdouble-are-not-atomic-in-java](dzone.com/articles/longdouble-are-not-atomic-in-java)
Applying the Java ReentrantReadWriteLock

- The SimpleAtomicLong class shows how to program with ReentrantReadWriteLock

```java
class SimpleAtomicLong {
    private long mValue;
    private ReentrantReadWriteLock mRWLock = new ReentrantReadWriteLock();
    ...
}
```

*The ReentrantReadWriteLock that serializes access to mValue*

There’s no need to use “fair” lock semantics here
Applying the Java ReentrantReadWriteLock

- The SimpleAtomicLong class shows how to program with ReentrantReadWriteLock

```java
class SimpleAtomicLong {
    private long mValue;
    
    public SimpleAtomicLong(long init) {
        mValue = init;
    }
    
    // Constructor initializes the mValue field
}
```

This constructor needs no lock since it’s only called once in a single thread!
The SimpleAtomicLong class shows how to program with ReentrantReadWriteLock.

```java
class SimpleAtomicLong {
    private long mValue;
    ...

    public long incrementAndGet() {
        mRWLock.writeLock().lock();
        try {
            return ++mValue;
        } finally {
            mRWLock.writeLock().unlock();
        }
    }
    ...
```

*This method writes mValue atomically*
The SimpleAtomicLong class shows how to program with ReentrantReadWriteLock

```java
class SimpleAtomicLong {
    private long mValue;
    ...

    public long incrementAndGet() {
        mRWLock.writeLock().lock();
        try {
            return ++mValue;
        } finally {
            mRWLock.writeLock().unlock();
        }
    }
    ...

    Atomically acquire the write-lock (blocking if necessary) & increment the current mValue
```
• The SimpleAtomicLong class shows how to program with ReentrantReadWriteLock

```java
class SimpleAtomicLong {
  private long mValue;
  ...

  public long incrementAndGet() {
    mRWLock.writeLock().lock();
    try {
      return ++mValue;
    } finally {
      mRWLock.writeLock().unlock();
    }
  }
  ...
```

A write-lock is “pessimistic” since it assumes contention may occur, so no other thread can acquire the lock while it’s held, i.e., a write lock is “exclusive”
Applying the Java ReentrantReadWriteLock

- The SimpleAtomicLong class shows how to program with ReentrantReadWriteLock

```java
class SimpleAtomicLong {
    private long mValue;
    ...

    public long incrementAndGet() {
        mRWLock.writeLock().lock();
        try {
            return ++mValue;
        } finally {
            mRWLock.writeLock().unlock();
        }
    }
}
...
```

The “try/finally” idiom ensures the lock is always released

See docs.oracle.com/javase/tutorial/essential/exceptions/finally.html
The SimpleAtomicLong class shows how to program with ReentrantReadWriteLock.

```java
class SimpleAtomicLong {
    private long mValue;
    ...

    public long get() {
        mRWLock.readLock().lock();
        try {
            return mValue;
        } finally {
            mRWLock.readLock().unlock();
        }
    }
    ...

    This method reads mValue atomically.
```
The SimpleAtomicLong class shows how to program with ReentrantReadWriteLock.

```java
class SimpleAtomicLong {
    private long mValue;
    ...

    public long get() {
        mRWLock.readLock().lock();
        try {
            return mValue;
        } finally {
            mRWLock.readLock().unlock();
        }
    }
    ...
```

Atomically acquire the read-lock (blocking if necessary) & return current mValue.
Applying the Java ReentrantReadWriteLock

- The Simple Atomic Long class shows how to program with ReentrantReadWriteLock

```java
class SimpleAtomicLong {
    private long mValue;
    ...

    public long get() {
        mRWLock.readLock().lock();
        try {
            return mValue;
        } finally {
            mRWLock.readLock().unlock();
        }
    }
    ...
```

A read-lock is also “pessimistic” since it assumes contention may occur, though other threads can acquire the lock for reading, i.e., a read lock is “shared”
Applying the Java ReentrantReadWriteLock

- The SimpleAtomicLong class shows how to program with ReentrantReadWriteLock

```java
class SimpleAtomicLong {
    private long mValue;
    ...

    public long get() {
        mRWLock.readLock().lock();
        try {
            return mValue;
        } finally {
            mRWLock.readLock().unlock();
        }
    }
}
...
```

The "try/finally" idiom ensures the lock is always released

See docs.oracle.com/javase/tutorial/essential/exceptions/finally.html
Applying the Java ReentrantReadWriteLock

- The SimpleAtomicLong class shows how to program with ReentrantReadWriteLock
- “Lock downgrading” example

```java
class SimpleAtomicLong {
    ...

    public long getAndIncrement() {
        long value = 0;
        Lock lock = mRWLock.writeLock();
        lock.lock();
        try {
            mValue++;
            final Lock readLock = 
                mRWLock.readLock();
            readLock.lock();
            try {
                lock.unlock();
                value = mValue;
            } finally { lock = readLock; } 
        } finally { lock.unlock(); }
        return value - 1;
    }
}
```

See word-bits.flurg.com/safely-downgrading-a-write-lock-with-readwritelock
The SimpleAtomicLong class shows how to program with ReentrantReadWriteLock.

"Lock downgrading" example

```java
class SimpleAtomicLong {
    ...

    public long getAndIncrement() {
        long value = 0;
        Lock lock = mRWLock.writeLock();
        lock.lock();
        try {
            mValue++;
            final Lock readLock = mRWLock.readLock();
            readLock.lock();
            try {
                lock.unlock();
                value = mValue;
            } finally { lock = readLock; }
        } finally { lock.unlock(); }
        return value - 1;
    }
}
```

First obtain a write-lock
The SimpleAtomicLong class shows how to program with ReentrantReadWriteLock

“Lock downgrading” example

```java
class SimpleAtomicLong {
    ...
    public long getAndIncrement() {
        long value = 0;
        Lock lock = mRWLock.writeLock();
        lock.lock();
        try {
            mValue++;
            final Lock readLock = mRWLock.readLock();
            readLock.lock();
            try {
                lock.unlock();
                value = mValue;
            } finally { lock = readLock; }
        } finally { lock.unlock(); }
        return value - 1;
    }
}
```

Atomically increment mValue with the write-lock held
Applying the Java ReentrantReadWriteLock

• The SimpleAtomicLong class shows how to program with ReentrantReadWriteLock
• “Lock downgrading” example

```java
class SimpleAtomicLong {
    ...
    public long getAndIncrement() {
        long value = 0;
        Lock lock = mRWLock.writeLock();
        lock.lock();
        try {
            mValue++;
            final Lock readLock = mRWLock.readLock();
            readLock.lock();
            try {
                lock.unlock();
                value = mValue;
            } finally { lock = readLock; }
        } finally { lock.unlock(); }
        return value - 1;
    }
}
```

Next downgrade the write-lock to a read-lock
Applying the Java ReentrantReadWriteLock

- The SimpleAtomicLong class shows how to program with ReentrantReadWriteLock

- “Lock downgrading” example

```java
class SimpleAtomicLong {
    ...
    public long getAndIncrement() {
        long value = 0;
        Lock lock = mRWLock.writeLock();
        lock.lock();
        try {
            mValue++;
            final Lock readLock = mRWLock.readLock();
            readLock.lock();
            try {
                lock.unlock();
                value = mValue;
            } finally { lock = readLock; }
        } finally { lock.unlock(); }
        return value - 1;
    }
}
```

Unlock write-lock & read the mValue with read-lock still held

Other readers threads can now access this value, but any writer threads must wait
The SimpleAtomicLong class shows how to program with ReentrantReadWriteLock

"Lock downgrading" example

class SimpleAtomicLong {
    ...
    public long getAndIncrement() {
        long value = 0;
        Lock lock = mRWLock.writeLock();
        lock.lock();
        try {
            mValue++;
            final Lock readLock =
                mRWLock.readLock();
            readLock.lock();
            try {
                lock.unlock();
                value = mValue;
            } finally {
                lock = readLock;
            }
        } finally {
            lock.unlock();
        }
        return value - 1;
    }
}
Applying the Java ReentrantReadWriteLock

- The SimpleAtomicLong class shows how to program with ReentrantReadWriteLock
- “Lock downgrading” example

```java
class SimpleAtomicLong {
    ...
    public long getAndIncrement() {
        long value = 0;
        Lock lock = mRWLock.writeLock();
        lock.lock();
        try {
            mValue++;
            final Lock readLock =
                mRWLock.readLock();
            readLock.lock();
            try {
                lock.unlock();
                value = mValue;
            } finally {
                lock = readLock;
            }
        } finally {
            lock.unlock();
        }
        return value - 1;
    }
}
```

*Return the original (non-incremented) value*

No need to lock 'value' since it’s local to the activation record of the thread’s stack!
The SimpleAtomicLong class shows how to program with ReentrantReadWriteLock

“Lock downgrading” example

```
class SimpleAtomicLong {
    ...
    public long getAndIncrement() {
        long value = 0;
        Lock lock = mRWLock.writeLock();
        lock.lock();
        try {
            mValue++;
            final Lock readLock =
                mRWLock.readLock();
            readLock.lock();
            try {
                lock.unlock();
                value = mValue;
            } finally { lock = readLock; }  
        } finally { lock.unlock(); }
        return value - 1;
    }
}
```

Lock downgrading is overkill for the SimpleAtomicLong!
End of Java ReentrantReadWriteLock: Example Application