Java多线程进阶（四）—— J.U.C之locks框架：ReentrantReadWriteLock

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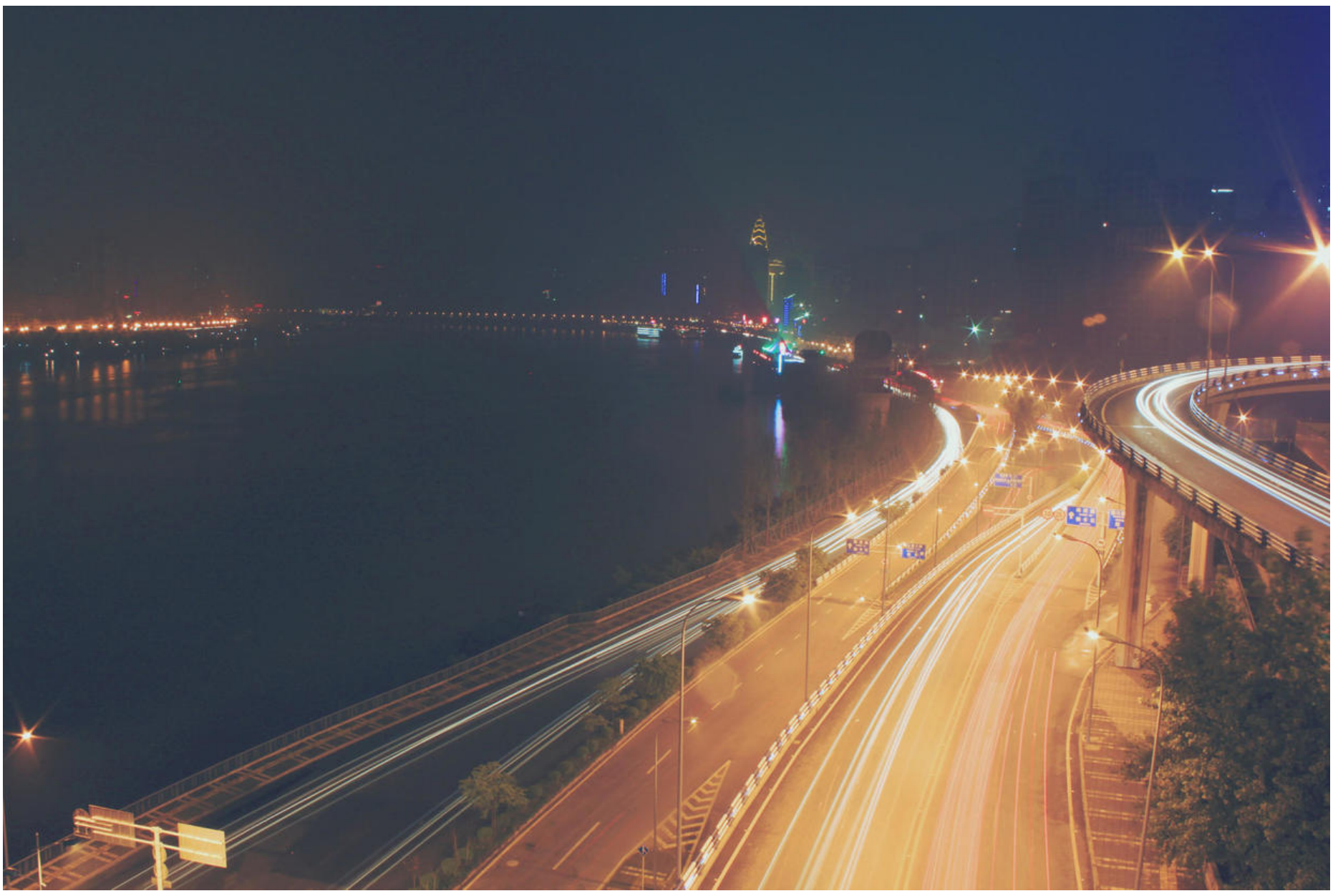

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一、ReentrantReadWriteLock类简介

ReentrantReadWriteLock类，顾名思义，是一种读写锁，它是ReadWriteLock接口的直接实现，该类在内部实现了具体**独占锁**特点的写锁，以及具有**共享锁**特点的读锁，和ReentrantLock一样，ReentrantReadWriteLock类也是通过定义内部类实现AQS框架的API来实现独占/共享的功能。

ReentrantReadWriteLock类具有如下特点：

1.1 支持公平/非公平策略

与ReadWriteLock类一样，ReentrantReadWriteLock对象在构造时，可以传入参数指定是公平锁还是非公平锁。

Constructor and Description
`ReentrantReadWriteLock()` Creates a new `ReentrantReadWriteLock` with default (nonfair) ordering properties.
`ReentrantReadWriteLock(boolean fair)` Creates a new `ReentrantReadWriteLock` with the given fairness policy.

1.2 支持锁重入

- 同一读线程在获取了读锁后还可以获取读锁；
- 同一写线程在获取了写锁之后既可以再次获取写锁又可以获取读锁；

1.3 支持锁降级

所谓锁降级，就是：先获取写锁，然后获取读锁，最后释放写锁，这样写锁就降级成了读锁。但是，读锁不能升级到写锁。简言之，就是：

> 写锁可以降级成读锁，读锁不能升级成写锁。

1.4 Condition条件支持

ReentrantReadWriteLock的内部读锁类、写锁类实现了Lock接口，所以可以通过`newCondition()`方法获取Condition对象。但是这里要注意，读锁是没法获取Condition对象的，读锁调用`newCondition()`方法会直接抛出`UnsupportedOperationException`。

> 我们知道，condition的作用其实是对Object类的`wait()`和`notify()`的增强，是为了让线程在指定对象上等待，是一种线程之间进行协调的工具。
> 当线程调用condition对象的`await`方法时，必须拿到和这个condition对象关联的锁。由于线程对读锁的访问是不受限制的（在写锁未被占用的情况下），那么即使拿到了和读锁关联的condition对象也是没有意义的，因为读线程之前不需要进行协调。

1.5 使用示例

以下是Oracle官方给出的一个例子：

使用ReentrantReadWriteLock控制对TreeMap的访问（利用读锁控制读操作的访问，利用写锁控制修改操作的访问），将TreeMap包装成一个线程安全的集合，并且利用了读写锁的特性来提高并发访问。

```
public class RWTreeMap {
    private final Map<String, Data> m = new TreeMap<String, Data>();
    private final ReentrantReadWriteLock rwl = new ReentrantReadWriteLock();
    private final Lock r = rwl.readLock();
    private final Lock w = rwl.writeLock();

    public Data get(String key) {
        r.lock();
        try {
            return m.get(key);
        } finally {
            r.unlock();
        }
    }

    public String[] allKeys() {
        r.lock();
        try {
            return (String[]) m.keySet().toArray();
        } finally {
            r.unlock();
        }
    }

    public Data put(String key, Data value) {
        w.lock();
        try {
            return m.put(key, value);
        } finally {
            w.unlock();
        }
    }

    public void clear() {
        w.lock();
        try {
            m.clear();
        } finally {
            w.unlock();
        }
    }
}
```

二、ReentrantReadWriteLock类/方法声明

2.1 类声明

```
public class ReentrantReadWriteLock
extends Object
implements ReadWriteLock, Serializable
```

内部嵌套类声明：
ReentrantReadWriteLock类有两个内部嵌套类`ReadLock`和`WriteLock`，这两个内部类的实例会在ReentrantReadWriteLock类的构造器中创建，并通过ReentrantReadWriteLock类的`readLock()`和`writeLock()`方法访问。

ReadLock：

```
public static class ReentrantReadWriteLock.ReadLock
extends Object
implements Lock, Serializable
```

WriteLock：

```
public static class ReentrantReadWriteLock.WriteLock
extends Object
implements Lock, Serializable
```

2.2 方法声明

ReentrantReadWriteLock类的核心方法其实就两个：`readLock()`和`writeLock()`，其它都是一些用来监控系统状态的方法，返回的都是某一时刻点的近似值。

Modifier and Type	Method and Description
`protected Thread`	`getOwner()` Returns the thread that currently owns the write lock, or `null` if not owned.
`protected Collection<Thread>`	`getQueuedReaderThreads()` Returns a collection containing threads that may be waiting to acquire the read lock.
`protected Collection<Thread>`	`getQueuedThreads()` Returns a collection containing threads that may be waiting to acquire either the read or write lock.
`protected Collection<Thread>`	`getQueuedWriterThreads()` Returns a collection containing threads that may be waiting to acquire the write lock.
`int`	`getQueueLength()` Returns an estimate of the number of threads waiting to acquire either the read or write lock.
`int`	`getReadHoldCount()` Queries the number of reentrant read holds on this lock by the current thread.
`int`	`getReadLockCount()` Queries the number of read locks held for this lock.
`protected Collection<Thread>`	`getWaitingThreads(Condition condition)` Returns a collection containing those threads that may be waiting on the given condition associated with the write lock.
`int`	`getWaitQueueLength(Condition condition)` Returns an estimate of the number of threads waiting on the given condition associated with the write lock.
`int`	`getWriteHoldCount()` Queries the number of reentrant write holds on this lock by the current thread.
`boolean`	`hasQueuedThread(Thread thread)` Queries whether the given thread is waiting to acquire either the read or write lock.
`boolean`	`hasQueuedThreads()` Queries whether any threads are waiting to acquire the read or write lock.
`boolean`	`hasWaiters(Condition condition)` Queries whether any threads are waiting on the given condition associated with the write lock.
`boolean`	`isFair()` Returns `true` if this lock has fairness set true.
`boolean`	`isWriteLocked()` Queries if the write lock is held by any thread.
`boolean`	`isWriteLockedByCurrentThread()` Queries if the write lock is held by the current thread.
`ReentrantReadWriteLock.ReadLock`	`readLock()` Returns the lock used for reading.
`String`	`toString()` Returns a string identifying this lock, as well as its lock state.
`ReentrantReadWriteLock.WriteLock`	`writeLock()` Returns the lock used for writing.

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