Spring transaction isolation level tutorial

30 January 2013

By Gonçalo Marques

java spring tx

In this tutorial you will learn about the transaction isolation level provided by the Spring framework.

Introduction

Transaction isolation level is a concept that is not exclusive to the Spring framework. It is applied to transactions in general and is directly related with the ACID transaction properties. Isolation level defines how the changes made to some data repository by one transaction affect other simultaneous concurrent transactions, and also how and when that changed data becomes available to other transactions. When we define a transaction using the Spring framework we are also able to configure in which isolation level that same transaction will be executed.

Usage example

Using the **@Transactional** annotation we can define the isolation level of a Spring managed bean transactional method. This means that the transaction in which this method is executed will run with that isolation level:

Isolation level in a transactional method

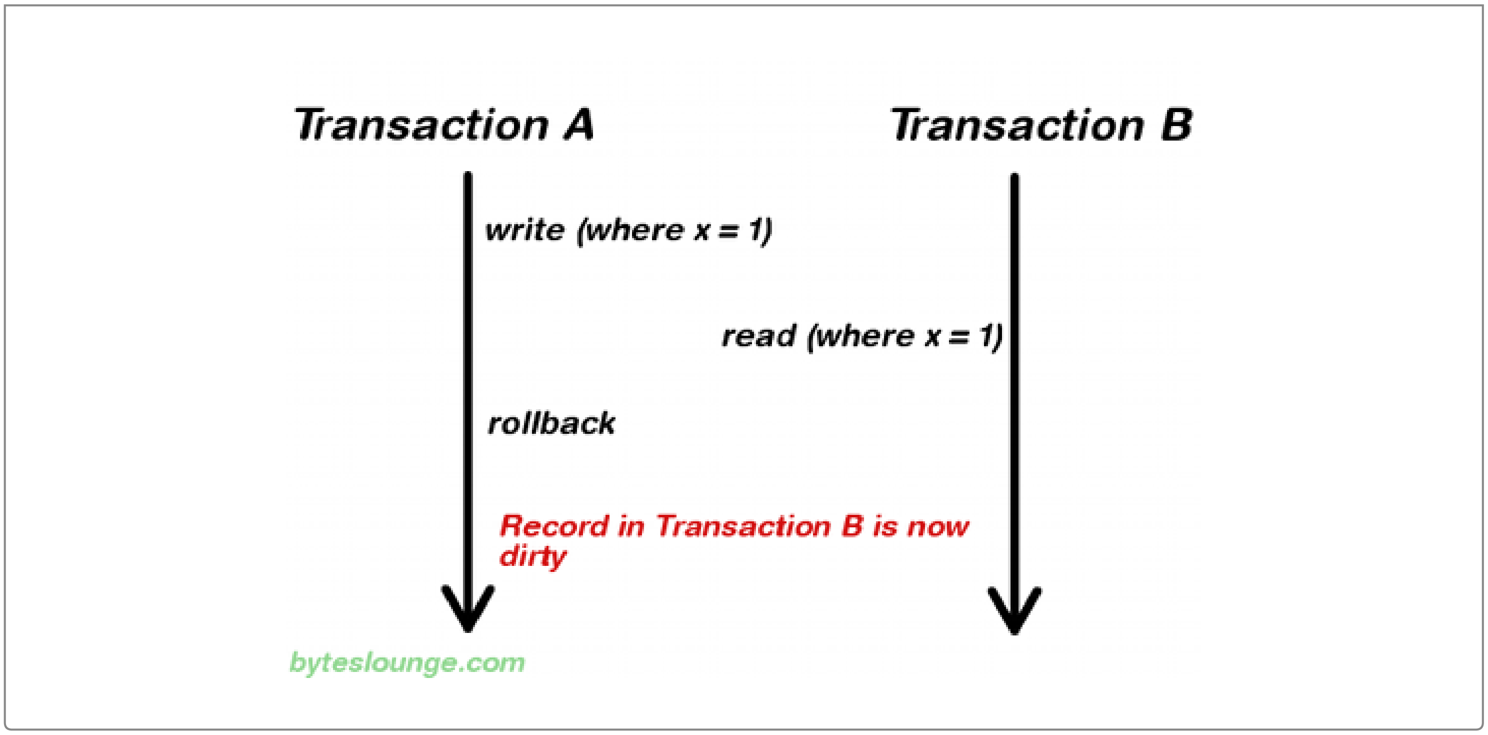
```
@Autowired
private TestDAO testDAO;

@Transactional(isolation=Isolation.READ_COMMITTED)
public void someTransactionalMethod(User user) {

  // Interact with testDAO

}
```

We are defining this method to be executed in a transaction which isolation level is **READ_COMMITTED**. We will see each isolation level in detail in the next sections.

READ_UNCOMMITTED

READ_UNCOMMITTED isolation level states that a transaction **may** read data that is still **uncommitted** by other transactions. This constraint is very relaxed in what matters to transactional concurrency but it may lead to some issues like **dirty reads**. Let's see the following image:

Dirty read



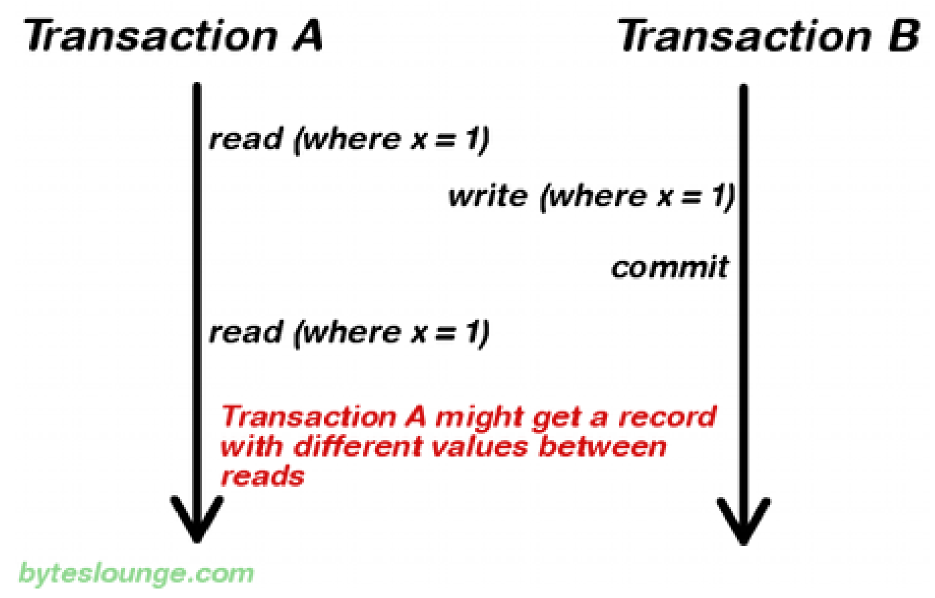
In this example **Transaction A** writes a record. Meanwhile **Transaction B** reads that same record before **Transaction A** commits. Later **Transaction A** decides to rollback and now we have changes in **Transaction B** that are inconsistent. This is a **dirty read**. **Transaction B** was running in **READ_UNCOMMITTED** isolation level so it was able to read **Transaction A** changes before a commit occurred.

Note: READ_UNCOMMITTED is also vulnerable to **non-repeatable reads** and **phantom reads**. We will also see these cases in detail in the next sections.

READ_COMMITTED

READ_COMMITTED isolation level states that a transaction can't read data that is **not** yet committed by other transactions. This means that the **dirty read** is no longer an issue, but even this way other issues may occur. Let's see the following image:

Non-repeatable read



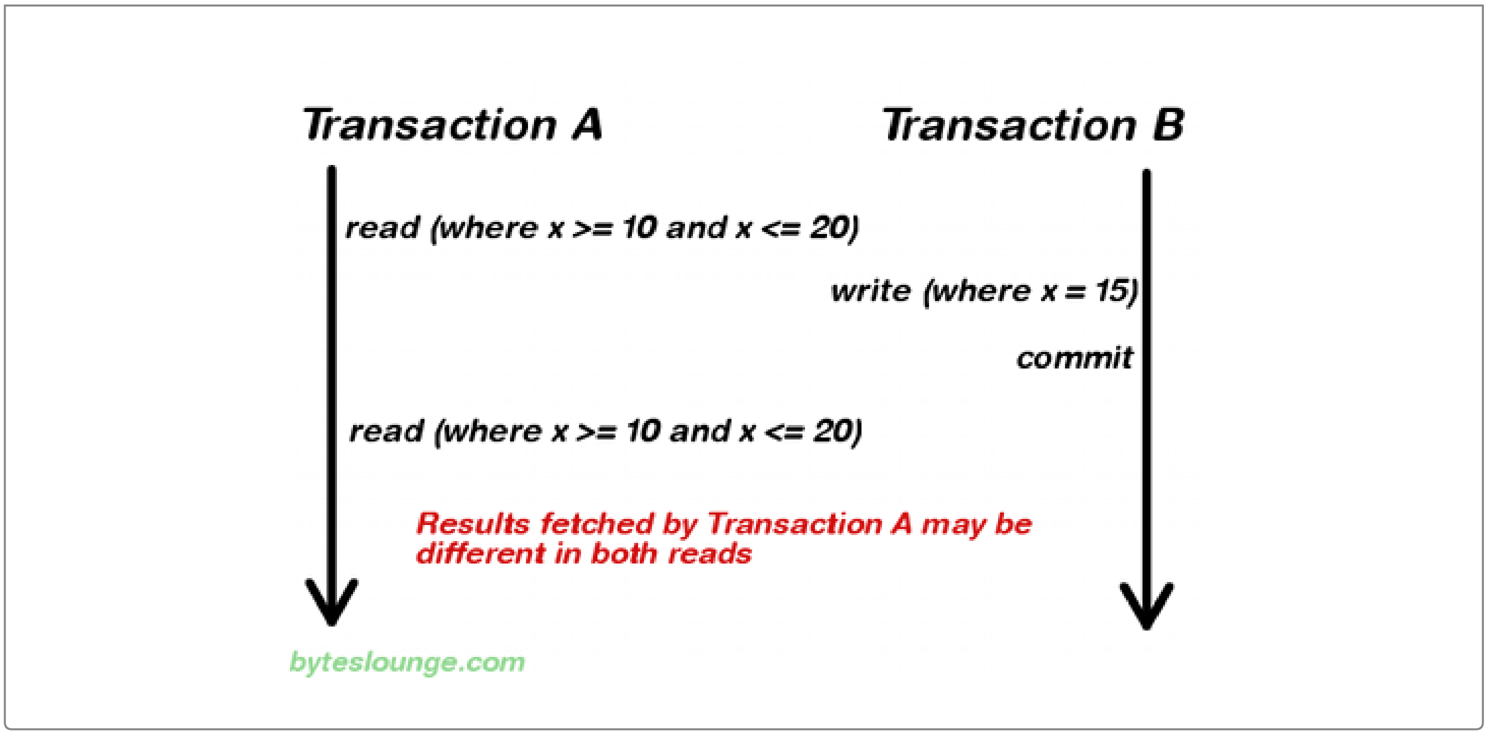
In this example **Transaction A** reads some record. Then **Transaction B** writes that same record and commits. Later **Transaction A** reads that same record again and may get different values because **Transaction B** made changes to that record and committed. This is a **non-repeatable read**.

Note: READ_COMMITTED is also vulnerable to **phantom reads**. We will also see this case in detail in the next section.

REPEATABLE_READ

REPEATABLE_READ isolation level states that if a transaction reads one record from the database multiple times the result of all those reading operations must always be the same. This eliminates both the **dirty read** and the **non-repeatable read** issues, but even this way other issues may occur. Let's see the following image:

Phantom read


Transaction A
Transaction B
read (where x >= 10 and x <= 20)
write (where x = 15)
commit
read (where x >= 10 and x <= 20)
Results fetched by Transaction A may be different in both reads
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In this example **Transaction A** reads a **range** of records. Meanwhile **Transaction B** inserts a new record in the same range that **Transaction A** initially fetched and commits. Later **Transaction A** reads the same range again and will also get the record that **Transaction B** just inserted. This is a **phantom read**: a transaction fetched a range of records multiple times from the database and obtained different result sets (containing phantom records).

SERIALIZABLE

SERIALIZABLE isolation level is the most restrictive of all isolation levels. Transactions are executed with locking at

SERIALIZABLE isolation level is the most restrictive of all isolation levels. Transactions are executed with locking at all levels (**read**, **range** and **write** locking) so they appear as if they were executed in a serialized way. This leads to a scenario where **none** of the issues mentioned above may occur, but in the other way we don't allow transaction concurrency and consequently introduce a performance penalty.

DEFAULT

DEFAULT isolation level, as the name states, uses the default isolation level of the datastore we are actually connecting from our application.

Summary

To summarize, the existing relationship between isolation level and read phenomena may be expressed in the following table:

	dirty reads	non-repeatable reads	phantom reads
READ_UNCOMMITTED	yes	yes	yes
READ_COMMITTED	no	yes	yes
REPEATABLE_READ	no	no	yes
SERIALIZABLE	no	no	no

JPA

If you are using Spring with JPA you may come across the following exception when you use an isolation level that is different the default:

```
InvalidIsolationLevelException: Standard JPA does not support custom isolation levels - use a special
JpaDialect for your JPA implementation
at org.springframework.orm.jpa.DefaultJpaDialect.beginTransaction(DefaultJpaDialect.java:67)
at org.springframework.orm.jpa.JpaTransactionManager.doBegin(JpaTransactionManager.java:378)
at
org.springframework.transaction.support.AbstractPlatformTransactionManager.getTransaction(AbstractPlatforn
at
org.springframework.transaction.interceptor.TransactionAspectSupport.createTransactionIfNecessary(Transacti
at
org.springframework.transaction.interceptor.TransactionAspectSupport.invokeWithinTransaction(TransactionAs
at org.springframework.transaction.interceptor.TransactionInterceptor.invoke(TransactionInterceptor.java:94)
at
org.springframework.aop.framework.ReflectiveMethodInvocation.proceed(ReflectiveMethodInvocation.java:172
at org.springframework.aop.framework.JdkDynamicAopProxy.invoke(JdkDynamicAopProxy.java:204)
```

To solve this problem you must implement a custom JPA dialect which is explained in detail in the following article: **Spring - Change transaction isolation level example**.

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- Spring transaction propagation tutorial
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Comments

Post Comment

Francisco A. Lozano
31 January 2013
It's important to mention that setting a the right isolation level in the datasource or datastore's defaults instead of forcing to explicit isolation level in annotations, together with the right connection string parameters in MySQL (so that it doesn't change always isolation level) can boost performance quite a lot

Reply

gmarques
31 January 2013
Hello, Thank you for your feedback. Can you provide reference documentation on that assumption?

Reply

Kishore
22 April 2014
Dear Gonçalo Marques I help me a lot to understand how spring supports Isolation level. I hope i helps so many. Thank You very much.

Reply

Mohd Kose Avase
31 July 2014
Good explanation. Thank you very much

Reply

TechyKudos
16 March 2015
It is really helpful to me. Very nice to understand.
Thanks a lot for your efforts, really appreciable.

Reply

Felipe Gutierrez
17 March 2015
Very good explanation. Thanks for that!

Reply

About the author

Gonçalo Marques is a Software Engineer with several years of experience in software development and architecture definition. During this period his main focus was delivering software solutions in banking, telecommunications and governmental areas. He created the Bytes Lounge website with one ultimate goal: share his knowledge with the software development community. His main area of expertise is Java and open source.

GitHub profile: http://github.com/gonmarques

He is also the author of the **WiFi File Browser** Android application:

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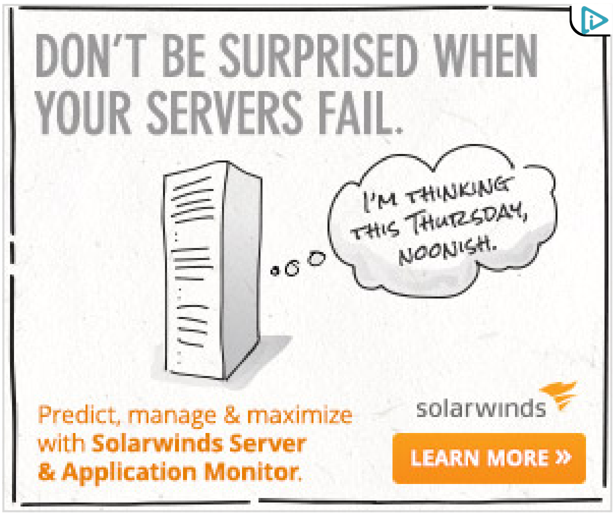
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