Mastering @Transactional Annotations in Spring Boot

Hiten Pratap Singh Follow 6 min read · May 7, 2023

The @Transactional annotation is used to define the transaction boundaries at the method level in your Spring Boot application. When you apply this annotation to a method, Spring will manage the transaction on your behalf, taking care of beginning and committing or rolling back the transaction as needed. This dramatically simplifies your code and reduces the chances of bugs related to transaction handling.

Let's start with a simple example. Suppose we have an application that manages users and their accounts. We will create a service class to handle creating and updating user accounts.

```
@Service
public class AccountService {

    @Autowired
    private AccountRepository accountRepository;

    @Autowired
    private UserRepository userRepository;

    @Transactional
    public void createOrUpdateAccount(Account account, User user) {
        userRepository.save(user);
        accountRepository.save(account);
    }
}
```

In this example, we have annotated the `createOrUpdateAccount` method with @Transactional. This ensures that both the user and account are saved within the same transaction. If either operation fails, Spring will automatically roll back the transaction, ensuring data consistency.

Propagation

The @Transactional annotation provides different propagation behaviors that determine how transactions are managed when one method calls another. You can define the propagation behavior using the `propagation` attribute. Here are the available options:

- **REQUIRED:** This is the default behavior. If there's an existing transaction, the method will participate in it. If there's no transaction, a new one will be created.
- **REQUIRES_NEW:** The method will always run in a new transaction, suspending the existing one if available.
- **SUPPORTS:** The method will run in the existing transaction if available, otherwise it will run without a transaction.
- **NOT_SUPPORTED:** The method will always run without a transaction, suspending the existing one if available.
- **MANDATORY:** The method must run within an existing transaction, throwing an exception if there's no transaction.
- **NEVER:** The method must run without a transaction, throwing an exception if there's an existing transaction.
- **NESTED:** The method will run within a nested transaction if there's an existing transaction, otherwise, it will run in a new transaction.

Here's an example of using the `propagation` attribute:

```
@Transactional(propagation = Propagation.REQUIRES_NEW)
public void createAccount(Account account) {
    accountRepository.save(account);
}
```

Isolation

The `isolation` attribute of the @Transactional annotation allows you to define the transaction isolation level, which determines how concurrent transactions interact with each other. Here are the available options:

- **DEFAULT:** Uses the default isolation level of the underlying database.
- **READ_UNCOMMITTED:** Allows dirty reads, non-repeatable reads, and phantom reads.
- **READ_COMMITTED:** Prevents dirty reads but allows non-repeatable reads and phantom reads.
- **REPEATABLE_READ:** Prevents dirty reads and non-repeatable reads but allows phantom reads.
- **SERIALIZABLE:** Prevents dirty reads, non-repeatable reads, and phantom reads, providing the highest level of isolation.

Example of using the `isolation` attribute:

```
@Transactional(isolation = Isolation.SERIALIZABLE)
public void transferFunds(Account fromAccount, Account toAccount, BigDecimal amo
    fromAccount.debit(amount);
```

```
        toAccount.credit(amount);
        accountRepository.save(fromAccount);
        accountRepository.save(toAccount);
    }
```

Timeout and Read-only

The `timeout` attribute of the @Transactional annotation allows you to specify the maximum number of seconds a transaction can take before it times out and gets rolled back. This can be useful in preventing long-running transactions from blocking resources indefinitely.

Example of using the `timeout` attribute:

```
@Transactional(timeout = 10) // 10 seconds
public void transferFunds(Account fromAccount, Account toAccount, BigDecimal amo
    fromAccount.debit(amount);
    toAccount.credit(amount);
    accountRepository.save(fromAccount);
    accountRepository.save(toAccount);
}
```

The `readOnly` attribute of the @Transactional annotation indicates whether the transaction is read-only. If set to `true`, the transaction manager optimizes the transaction for read operations, potentially improving performance. It's important to note that marking a transaction as read-only when it involves write operations may result in unexpected behavior.

Example of using the `readOnly` attribute:

```
@Transactional(readOnly = true)
public List<Account> getAllAccounts() {
    return accountRepository.findAll();
}
```

Rollback

By default, the @Transactional annotation rolls back the transaction only when a runtime exception is thrown. You can customize this behavior using the `rollbackFor` and `noRollbackFor` attributes. The `rollbackFor` attribute defines a list of exception classes for which the transaction should be rolled back, while the `noRollbackFor` attribute defines a list of exception classes for which the transaction should not be rolled back.

Example of using the `rollbackFor` and `noRollbackFor` attributes:

```
@Transactional(rollbackFor = CustomException.class, noRollbackFor = MinorExcepti
public void processAccount(Account account) throws CustomException, MinorExcepti
    // Code that might throw CustomException or MinorException
}
```


behavior in your code. Some of the key benefits include:

1. **Declarative transaction management:** With the @Transactional annotation, you can manage transactions at the method level without

writing any explicit code for transaction handling. This declarative approach simplifies your code and makes it more readable, reducing the chances of bugs related to transaction management.

2. **Consistent transaction handling:** By using the @Transactional annotation, you can ensure consistent transaction handling across your application. This allows you to follow a uniform approach to transaction management, which makes the code easier to understand and maintain.
3. **Flexibility and configurability:** The @Transactional annotation provides several attributes that allow you to customize transaction behavior, such as propagation, isolation, timeout, read-only, and rollback rules. This flexibility enables you to optimize transaction handling for different use cases and requirements.
4. **Improved performance:** By marking transactions as read-only when appropriate, the transaction manager can optimize the transaction for read operations, potentially improving performance. Additionally, specifying a timeout for transactions helps prevent long-running transactions from blocking resources indefinitely.
5. **Automatic rollback:** With the @Transactional annotation, Spring automatically rolls back the transaction when an exception is thrown, ensuring data consistency. You can also customize the rollback behavior using the `rollbackFor` and `noRollbackFor` attributes, giving you fine-grained control over transaction handling.
6. **Integration with Spring ecosystem:** The @Transactional annotation is well-integrated with the Spring ecosystem, including Spring Boot, Spring Data, and Spring Security. This seamless integration ensures that transaction management works consistently across various components of your application.

7. **Improved testability:** Using the @Transactional annotation makes it easier to test transactional behavior in your code. You can create test methods with specific transaction configurations and easily verify the expected behavior in different scenarios.

Do's and Don'ts of @Transactional

When using the @Transactional annotation in Spring Boot applications, it's essential to follow certain best practices and avoid common pitfalls. Here are some do's and don'ts to help you use the @Transactional annotation effectively:

Do's

1. **Apply @Transactional at the service layer:** Transactions typically involve multiple operations that need to be executed together. Applying the @Transactional annotation at the service layer ensures that these operations are performed within a single transaction, maintaining data consistency.
2. **Use the appropriate propagation level:** Understand the different propagation behaviors and use the one that best suits your use case. Using the wrong propagation level can lead to undesired transaction behavior and resource management issues.
3. **Set the appropriate isolation level:** Choose the right isolation level based on your application requirements. Higher isolation levels provide better data consistency but may come at the cost of performance. Understand the trade-offs and choose the level that meets your needs.
4. **Use read-only transactions when applicable:** When a transaction only involves read operations, mark it as read-only using the `readOnly`

attribute. This can optimize performance by allowing the transaction manager to apply optimizations specific to read operations.

5. **Define rollback rules:** Customize the rollback behavior using the `rollbackFor` and `noRollbackFor` attributes. Specify the exception classes for which the transaction should be rolled back or not rolled back, providing finer control over transaction handling.
6. **Set a transaction timeout:** Specify a timeout value for transactions using the `timeout` attribute. This helps prevent long-running transactions from blocking resources indefinitely and can improve overall application performance.

Don’ts

1. **Don’t use @Transactional on private, protected, or package-private methods:** The @Transactional annotation relies on Spring’s AOP proxies, which can only be created for public methods. If you apply @Transactional to non-public methods, it will be silently ignored, and no transaction will be created or managed.
2. **Don’t mix transaction management approaches:** Mixing different transaction management approaches, such as programmatic and declarative, can lead to confusion and inconsistencies. Stick to one approach (preferably declarative using @Transactional) for uniformity and easier maintainability.
3. **Don’t use @Transactional for non-transactional methods:** Avoid using the @Transactional annotation for methods that don’t need transaction management. This can lead to unnecessary overhead and potential performance degradation.
4. **Don’t ignore the impact of nested transactions:** Be cautious when using the NESTED propagation level, as it can have performance implications

and may cause deadlocks in certain situations. Understand the implications of nested transactions and use them judiciously.

5. **Don't mark transactions as read-only when they involve write operations:** Marking a transaction as read-only when it involves write operations can lead to unexpected behavior and data inconsistencies. Only use the `readOnly` attribute when a transaction exclusively involves read operations.

By following these do's and don'ts, you can effectively use the @Transactional annotation to manage transactions in your Spring Boot application, ensuring consistent transaction handling and maintainable code.

The @Transactional annotation in Spring Boot is a powerful feature that simplifies transaction management and improves code maintainability. By understanding its various attributes and their implications, you can effectively control transaction behavior in your application, ensuring data consistency and proper resource management.

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Mahammad Eminov
Sep 15, 2024

> Spring's AOP proxies

The type of proxy that Spring Boot uses for the @Transactional annotation depends on the following conditions:

1. If the class implements an interface:

Spring Boot will use JDK Dynamic Proxy by default.

2. If the class does not implement any interface:

Spring Boot will use CGLIB Proxy by default.

Reply

Nitin Agrawal
Feb 18, 2024

> Don’t use @Transactional on private, protected, or package-private methods

Can we say?- use @Transactional on public methods only.

Reply

Raj Saraogi
Jan 2, 2024

Hey like suppose I am fetching list of objects from DB, now i have two options either to add @transactional with read only at service function or to ignore @transactional annotation, so whats the impact of using either or

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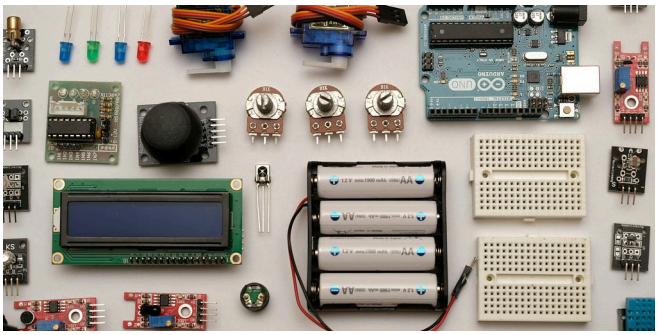

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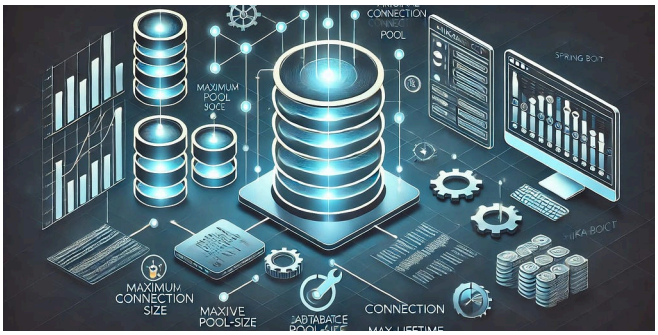

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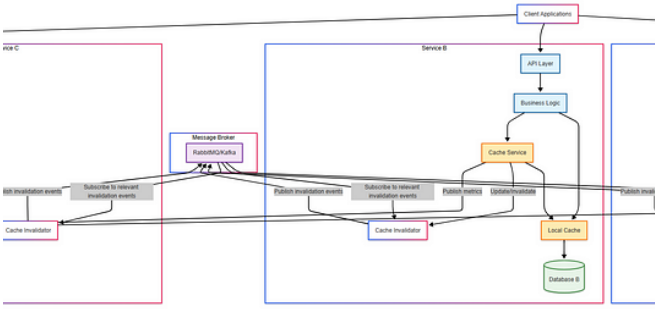

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