Transaction Isolation Levels in DBMS

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Definition

Isolation levels define the degree to which a transaction must be isolated from the data modifications made by any other transaction in the database system.

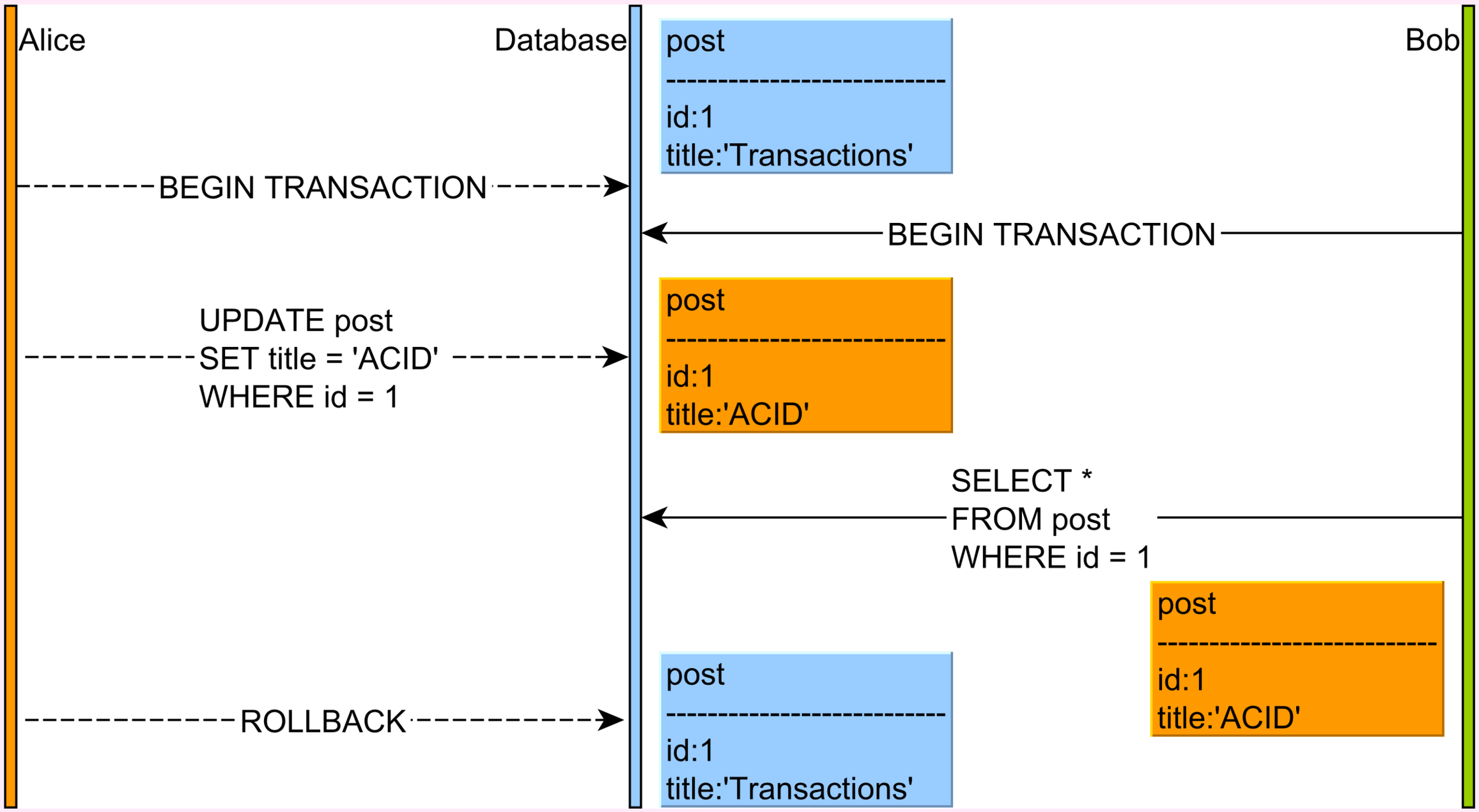
Phenomena

A transaction isolation level is defined by the following phenomena

- Dirty Read
- Non-Repeatable Read
- Phantom Read

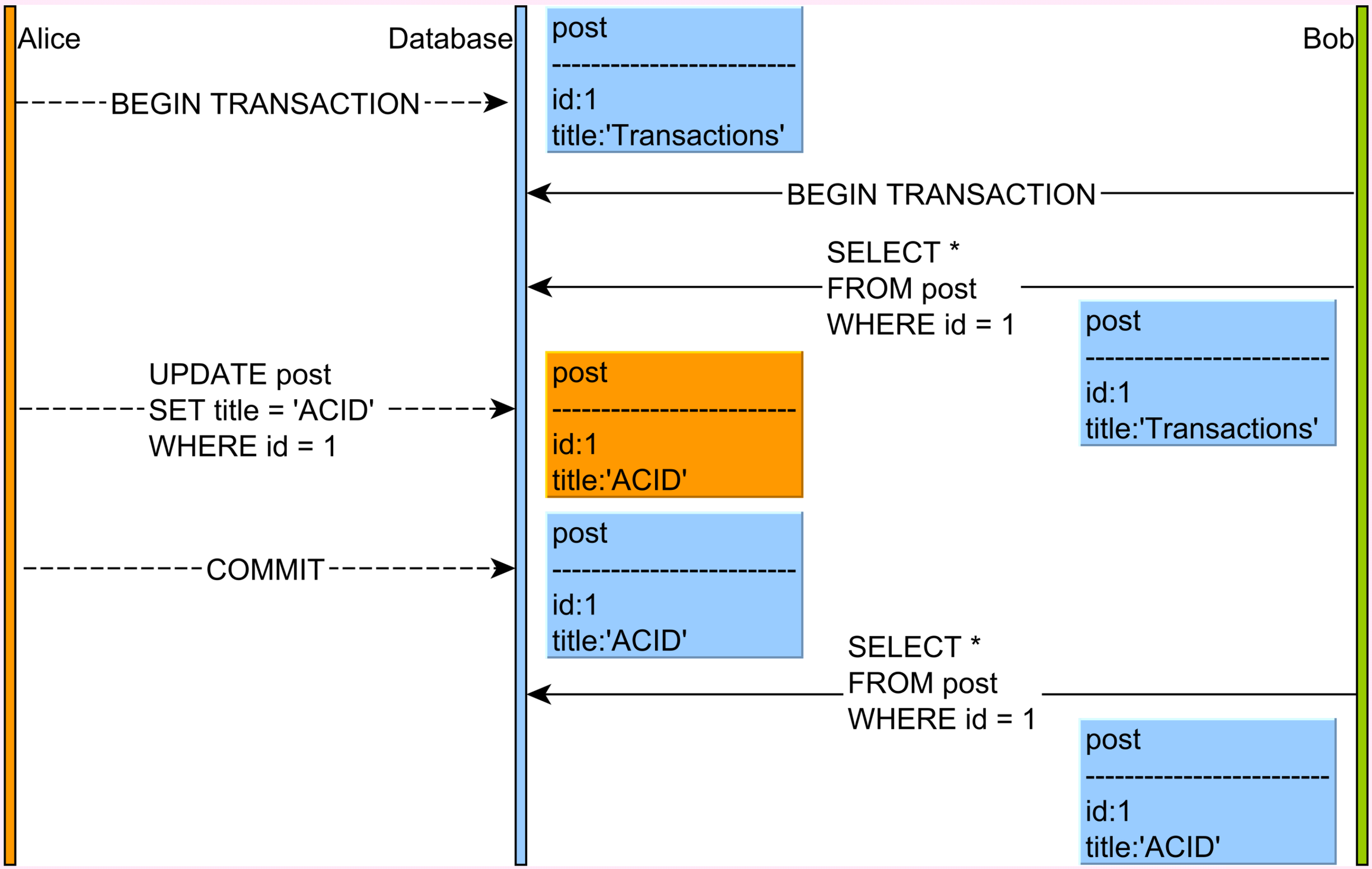
Dirty Read

A Dirty read is a situation when a transaction reads data that has not yet been committed.



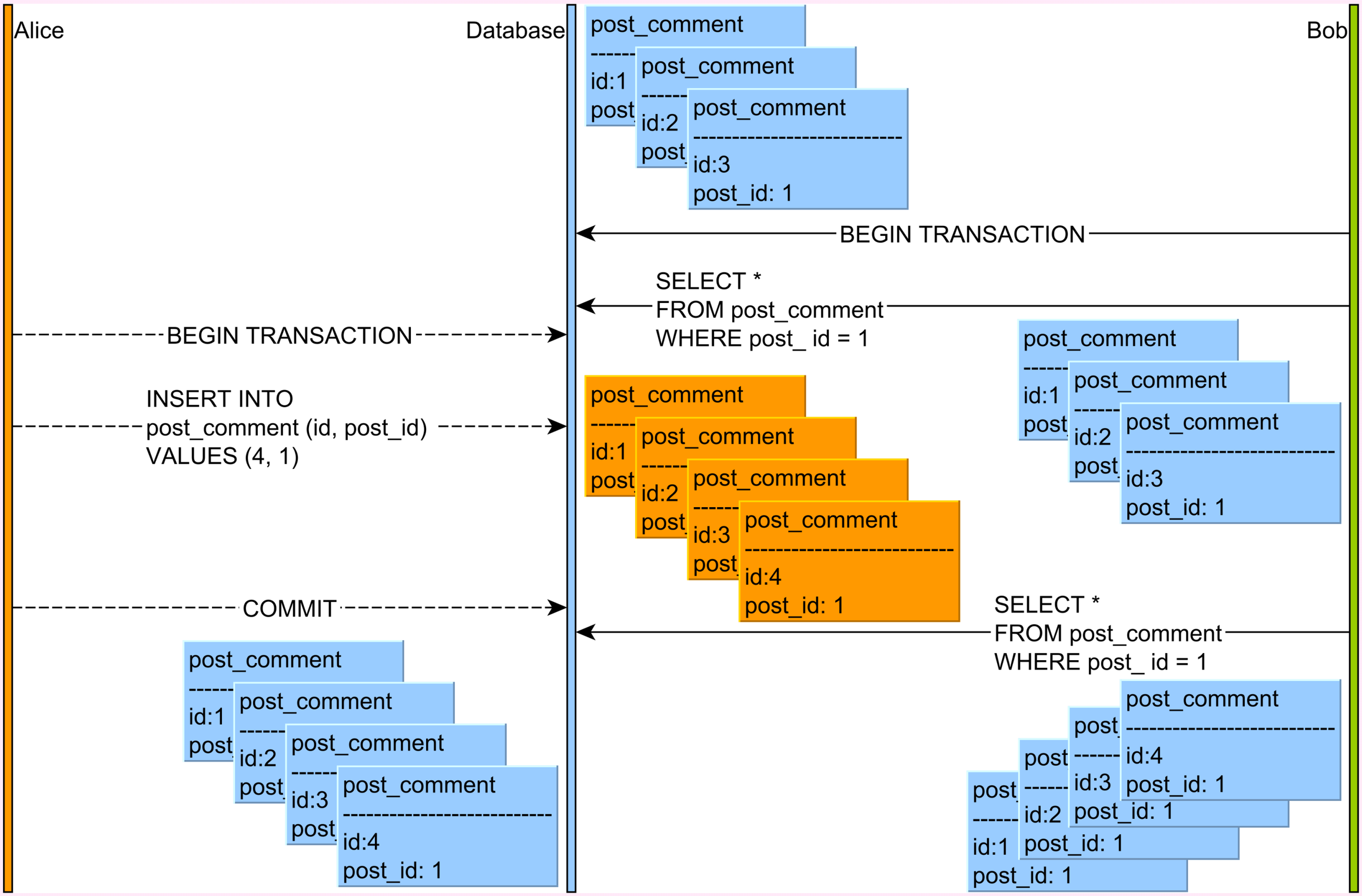
Non Repeatable read

Non-realatable read occurs when a transaction reads the same row twice and gets a different value each time.



Phantom Read

Phantom Read occurs when two same queries are executed, but the rows retrieved by the two, are different.



Isolation Levels

Based on these phenomena, The SQL standard defines four isolation levels:

- Read Uncommitted
- Read Committed
- Repeatable Read
- Serializable

Read Uncommitted

Read Uncommitted is the lowest isolation level.

In this level, one transaction may read not yet committed changes made by other transactions, thereby allowing dirty reads.

At this level, transactions are not isolated from each other.

Read Committed

This isolation level guarantees that any data read is committed at the moment it is read.

Thus it does not allow dirty read.

The transaction holds a read or write lock on the current row, and thus prevents other transactions from reading, updating, or deleting it.

Repeatable Read

This is the most restrictive isolation level.

The transaction holds read locks on all rows it references and writes locks on referenced rows for update and delete actions.

Since other transactions cannot read, update or delete these rows, consequently it avoids non-repeatable read.

Serializable

This is the highest isolation level.

A serializable execution is guaranteed to be serializable.

Serializable execution is defined to be an execution of operations in which concurrently executing transactions appears to be serially executing.

Conclusion

The choice of isolation level depends on the specific requirements of the application.

Higher isolation levels offer stronger data consistency but can also result in longer lock times and increased contention, leading to decreased concurrency and performance.

Lower isolation levels provide more concurrency but can result in data inconsistencies.

See Also

In addition to the standard isolation levels, some DBMS may also support additional custom isolation levels or features such as snapshot isolation and multi-version concurrency control (MVCC) that provide alternative solutions to the problems addressed by the standard isolation levels.