Chapter 7
Isolation Concepts
: InnoDB Isolation Levels

Mijin An
meeeeejin@gmail.com

VLDB Lab.

Overview

- InnoDB offers **four** transaction isolation levels:
  1. REPEATABLE READ
  2. READ COMMITTED
  3. READ UNCOMMITED
  4. SERIALIZABLE

REPEATABLE READ

- The **default** isolation level for InnoDB
- Consistent reads within the same transaction read the **snapshot** used by the first read

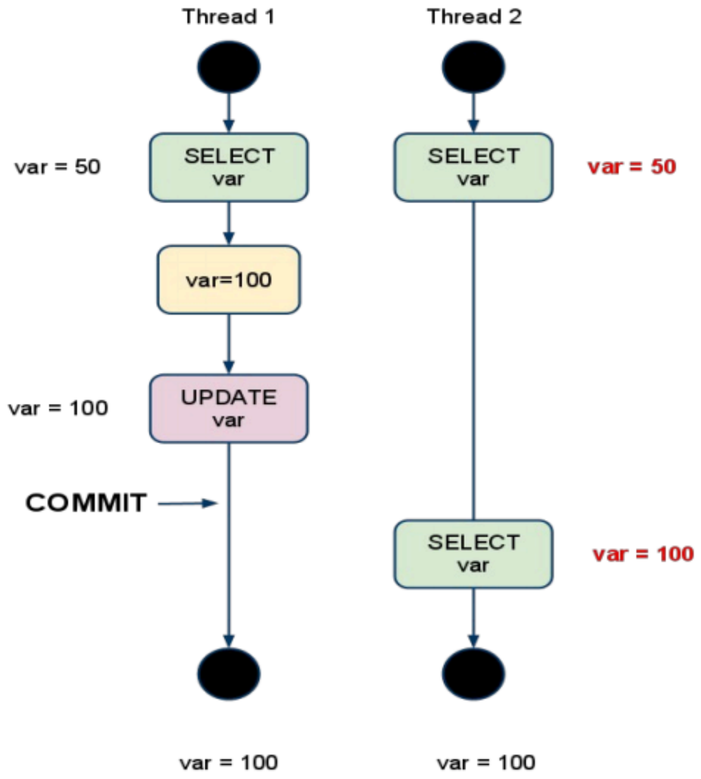
- For locking reads:
  - For a **unique index with a unique search condition**:
    - Use only the **index record lock**
  - For **other** search conditions:
    - Use **gap locks** or **next-key locks**

```
SELECT ... FOR UPDATE;
SELECT ... FOR SHARE;
```

- With **consistent non-locking read** (i.e., **snapshot**), there is **no phantom read problem**

READ COMMITTED

- The default isolation level with most of popular RDBMSs, but not with MySQL
- Each SELECT uses its own **snapshot** of the committed data
- When running multiple SELECT during the transaction, it could return different results
  - **NON-REPEATABLE READS**
  - **PHANTOM READS**
  - Use only the **index record lock**
- The recommended level for Galera and InnoDB clusters



REPEATABLE READ vs. READ COMMITTED

- There is a table `t` with two rows (`t.c1 = 13` and `t.c1 = 17`)
- Both transaction A and B is set to **READ COMMITTED**

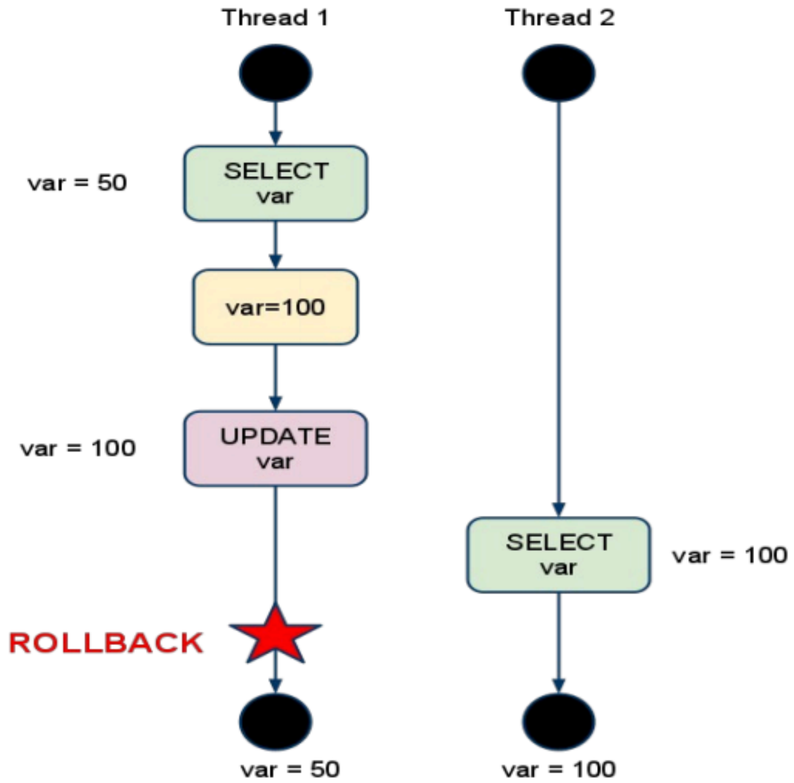
```
A-1> SELECT c1 FROM t WHERE c1 BETWEEN 10 and 20 FOR UPDATE;
B-1> INSERT INTO t values(15);
B-2> COMMIT;
A-2> SELECT c1 FROM t WHERE c1 BETWEEN 10 and 20 FOR UPDATE;
A-3> COMMIT;
```

- There is a **PHANTOM ROW** in A-2
  - If the level is set to **REPEATABLE READ**, there is **no PHANTOM ROW** in InnoDB

READ UNCOMMITTED

- The **lowest** level in isolation (i.e., **No locks**)
- A transaction can see changes to data made by other transactions that are not committed yet

- There is always **DIRTY READS**



SERIALIZABLE

- InnoDB implicitly converts all plain `SELECT` to `SELECT ... FOR SHARE`
- The **strongest** isolation level
- This level **completely isolates** the effect of one transaction from others
  - Similar to REPEATABLE READ with the additional restriction that row selected by one transaction cannot be changed by another until the first transaction finishes

The Matrix between Isolation Levels and Read Phenomena

Isolation Level	Dirty Read	Non-Repeatable Read	Phantom Read
READ UNCOMMITED	May occur	May occur	May occur
READ COMMITTED	Don’t occur	May occur	May occur
REPEATABLE READ	Don’t occur	Don’t occur	Don’t occur
SERIALIZABLE	Don’t occur	Don’t occur	Don’t occur

Reference

[1] Jim Gray and Andreas Reuter, “Transaction Processing: Concepts and Techniques”, Morgan Kaufmann, San Mateo, CA (1993)

[2] “15.7.2.1 Transaction Isolation Levels”, MySQL Internals Manual, https://dev.mysql.com/doc/refman/8.0/en/innodb-transaction-isolation-levels.html

[3] Kabilesh PR, “Back to basics: Isolation Levels In MySQL”, Mydbops, https://mydbops.wordpress.com/2018/06/22/back-to-basics-isolation-levels-in-mysql/

[4] Suhwan Jee, “Lock으로 이해하는 Transaction의 Isolation Level”, https://suhwan.dev/2019/06/09/transaction-isolation-level-and-lock/