select * from t for update;

# 14.7.3 Locks Set by Different SQL Statements in InnoDB

A locking read, an UPDATE, or a DELETE generally set record locks on every index record that is scanned in the processing of the SQL statement. It does not matter whether there are WHERE conditions in the statement that would exclude the row. InnoDB does not remember the exact WHERE condition, but only knows which index ranges were scanned. The locks are normally next-key locks that also block inserts into the "gap" immediately before the record. However, gap locking can be disabled explicitly, which causes next-key locking not to be used. For more information, see Section 14.7.1, "InnoDB Locking". The transaction isolation level also can affect which locks are set; see Section 14.7.2.1, "Transaction Isolation Levels".

mysql 写不阻塞读(普通select),即普通select不加锁, 不存在加S的情况

If a secondary index is used in a search and index record locks to be set are exclusive, InnoDB also retrieves the corresponding clustered index records and sets locks on them.

除非手工select in share mode; 加S

If you have no indexes suitable for your statement and MySQL must scan the entire table to process the statement, every row of the table becomes locked, which in turn blocks all inserts by other users to the table. It is important to create good indexes so that your queries do not unnecessarily scan many rows.

阻塞所有的dml

InnoDB sets specific types of locks as follows.

普通select 不加锁

- SELECT ... FROM is a consistent read, reading a snapshot of the database and setting no locks unless the transaction isolation level is set to SERIALIZABLE. For SERIALIZABLE level, the search sets shared next-key locks on the index records it encounters. However, only an index record lock is required for statements that lock rows using a unique index to search for a unique row.

- For SELECT ... FOR UPDATE or SELECT ... LOCK IN SHARE MODE, locks are acquired for scanned rows, and expected to be released for rows that do not qualify for inclusion in the result set (for example, if they do not meet the criteria given in the WHERE clause). However, in some cases, rows might not be unlocked immediately because the relationship between a result row and its original source is lost during query execution. For example, in a UNION, scanned (and locked) rows from a table might be inserted into a temporary table before evaluation whether they qualify for the result set. In this circumstance, the relationship of the rows in the temporary table to the rows in the original table is lost and the latter rows are not unlocked until the end of query execution.

- SELECT ... LOCK IN SHARE MODE sets shared next-key locks on all index records the search encounters. However, only an index record lock is required for statements that lock rows using a unique index to search for a unique row.

- SELECT ... FOR UPDATE sets an exclusive next-key lock on every record the search encounters. However, only an index record lock is required for statements that lock rows using a unique index to search for a unique row.

  For index records the search encounters, SELECT ... FOR UPDATE blocks other sessions from doing SELECT ... LOCK IN SHARE MODE or from reading in certain transaction isolation levels. Consistent select for update；是当前读，只会读取当前版本，不会构造mvcc以前版本，应等同于update.

reads ignore any locks set on the records that exist in the read view.

- `UPDATE ... WHERE ...` sets an exclusive next-key lock on every record the search encounters. However, only an index record lock is required for statements that lock rows using a unique index to search for a unique row.

  隐式锁

- When `UPDATE` modifies a clustered index record, implicit locks are taken on affected secondary index records. The `UPDATE` operation also takes shared locks on affected secondary index records when performing duplicate check scans prior to inserting new secondary index records, and when inserting new secondary index records.

  update在插入新的二级索引之前的重复项检查时，或者是插入一个新二级索引项时，要在这个索引项上加S

- `DELETE FROM ... WHERE ...` sets an exclusive next-key lock on every record the search encounters. However, only an index record lock is required for statements that lock rows using a unique index to search for a unique row.

- `INSERT` sets an exclusive lock on the inserted row. This lock is an index-record lock, not a next-key lock (that is, there is no gap lock) and does not prevent other sessions from inserting into the gap before the inserted row.

  并不禁止其它session插入这条记录之前的gap

  Prior to inserting the row, a type of gap lock called an insert intention gap lock is set. This lock signals the intent to insert in such a way that multiple transactions inserting into the same index gap need not wait for each other if they are not inserting at the same position within the gap. Suppose that there are index records with values of 4 and 7. Separate transactions that attempt to insert values of 5 and 6 each lock the gap between 4 and 7 with insert intention locks prior to obtaining the exclusive lock on the inserted row, but do not block each other because the rows are nonconflicting.

  If a duplicate-key error occurs, a shared lock on the duplicate index record is set. This use of a shared lock can result in deadlock should there be multiple sessions trying to insert the same row if another session already has an exclusive lock. This can occur if another session deletes the row. Suppose that an `InnoDB` table `t1` has the following structure:

  ```
  CREATE TABLE t1 (i INT, PRIMARY KEY (i)) ENGINE = InnoDB;
  ```

  Now suppose that three sessions perform the following operations in order:

  Session 1:

  ```
  START TRANSACTION;
  INSERT INTO t1 VALUES(1);
  ```

  Session 2:

  ```
  START TRANSACTION;
  INSERT INTO t1 VALUES(1);
  ```

  Session 3:

```
START TRANSACTION;
INSERT INTO t1 VALUES(1);
```

Session 1:

```
ROLLBACK;
```

The first operation by session 1 acquires an exclusive lock for the row. The operations by sessions 2 and 3 both result in a duplicate-key error and they both request a shared lock for the row. When session 1 rolls back, it releases its exclusive lock on the row and the queued shared lock requests for sessions 2 and 3 are granted. At this point, sessions 2 and 3 deadlock: Neither can acquire an exclusive lock for the row because of the shared lock held by the other.

A similar situation occurs if the table already contains a row with key value 1 and three sessions perform the following operations in order:

Session 1:

```
START TRANSACTION;
DELETE FROM t1 WHERE i = 1;
```

Session 2:

```
START TRANSACTION;
INSERT INTO t1 VALUES(1);
```

Session 3:

```
START TRANSACTION;
INSERT INTO t1 VALUES(1);
```

Session 1:

```
COMMIT;
```

The first operation by session 1 acquires an exclusive lock for the row. The operations by sessions 2 and 3 both result in a duplicate-key error and they both request a shared lock for the row. When session 1 commits, it releases its exclusive lock on the row and the queued shared lock requests for sessions 2 and 3 are granted. At this point, sessions 2 and 3 deadlock: Neither can acquire an exclusive lock for the row because of the shared lock held by the other.

- `INSERT ... ON DUPLICATE KEY UPDATE` differs from a simple `INSERT` in that an exclusive lock rather than a shared lock is placed on the row to be updated when a duplicate-key error occurs. An exclusive index-record lock is taken for a duplicate primary key value. An exclusive next-key lock is taken for a duplicate unique key value.

主键索引加record lock,唯一索引加next key lock

- `REPLACE` is done like an `INSERT` if there is no collision on a unique key. Otherwise, an exclusive next-key lock is placed on the row to be replaced.

- `INSERT INTO T SELECT ... FROM S WHERE ...` sets an exclusive index record lock (without a gap lock) on each row inserted into `T`. If the transaction isolation level is `READ COMMITTED`, or `innodb_locks_unsafe_for_binlog` is enabled and the transaction isolation level is not `SERIALIZABLE`, `InnoDB` does the search on `S` as a consistent read (no locks). Otherwise, `InnoDB` sets shared next-key locks on rows from `S`. `InnoDB` has to set locks in the latter case: During roll-forward recovery using a statement-based binary log, every SQL statement must be executed in exactly the same way it was done originally.

  后一种情况,即加record lock,这样statement也没问题
  也就是说, innodb_locks_unsafe_for_binlog=true,则必须设为row.

  `CREATE TABLE ... SELECT ...` performs the `SELECT` with shared next-key locks or as a consistent read, as for `INSERT ... SELECT`.

  When a `SELECT` is used in the constructs `REPLACE INTO t SELECT ... FROM s WHERE ...` or `UPDATE t ... WHERE col IN (SELECT ... FROM s ...)`, `InnoDB` sets shared next-key locks on rows from table `s`.

- `InnoDB` sets an exclusive lock on the end of the index associated with the `AUTO_INCREMENT` column while initializing a previously specified `AUTO_INCREMENT` column on a table. 有auto_increment列的索引

  With `innodb_autoinc_lock_mode=0`, `InnoDB` uses a special `AUTO-INC` table lock mode where the lock is obtained and held to the end of the current SQL statement (not to the end of the entire transaction) while accessing the auto-increment counter. Other clients cannot insert into the table while the `AUTO-INC` table lock is held. The same behavior occurs for "bulk inserts" with `innodb_autoinc_lock_mode=1`. Table-level `AUTO-INC` locks are not used with `innodb_autoinc_lock_mode=2`. For more information, See Section 14.6.1.6, "AUTO_INCREMENT Handling in InnoDB".

  `InnoDB` fetches the value of a previously initialized `AUTO_INCREMENT` column without setting any locks.

- If a `FOREIGN KEY` constraint is defined on a table, any insert, update, or delete that requires the constraint condition to be checked sets shared record-level locks on the records that it looks at to check the constraint. `InnoDB` also sets these locks in the case where the constraint fails.

  约束失败时对应的记录也加

- `LOCK TABLES` sets table locks, but it is the higher MySQL layer above the `InnoDB` layer that sets these locks. `InnoDB` is aware of table locks if `innodb_table_locks = 1` (the default) and `autocommit = 0`, and the MySQL layer above `InnoDB` knows about row-level locks. innodb 和 mysql 互相知道锁的存在

  Otherwise, `InnoDB`'s automatic deadlock detection cannot detect deadlocks where such table locks are involved. Also, because in this case the higher MySQL layer does not know about row-level locks, it is possible to get a table lock on a table where another session currently has row-level locks. However, this does not endanger transaction integrity, as discussed in Section 14.7.5.2, "Deadlock Detection and Rollback".

- `LOCK TABLES` acquires two locks on each table if `innodb_table_locks=1` (the default). In addition to a table lock on the MySQL layer, it also acquires an `InnoDB` table lock. Versions of MySQL before 4.1.2

did not acquire `InnoDB` table locks; the old behavior can be selected by setting `innodb_table_locks=0`. If no `InnoDB` table lock is acquired, `LOCK TABLES` completes even if some records of the tables are being locked by other transactions.

显示

In MySQL 5.7, `innodb_table_locks=0` has no effect for tables locked explicitly with `LOCK TABLES ... WRITE`. It does have an effect for tables locked for read or write by `LOCK TABLES ... WRITE` implicitly (for example, through triggers) or by `LOCK TABLES ... READ`.

隐式

- All `InnoDB` locks held by a transaction are released when the transaction is committed or aborted. Thus, it does not make much sense to invoke `LOCK TABLES` on `InnoDB` tables in `autocommit=1` mode because the acquired `InnoDB` table locks would be released immediately.

- You cannot lock additional tables in the middle of a transaction because `LOCK TABLES` performs an implicit `COMMIT` and `UNLOCK TABLES`.