Assignment 5 Solution

Introduction to Databases

DataLab

CS, NTHU

Outline

- Solution
  - PrimaryKey
  - StoreProcedure
  - ConservativeConcurrencyMgr
  - ConservativeLockTable
- Chanllenge on TPC-C
- Questions

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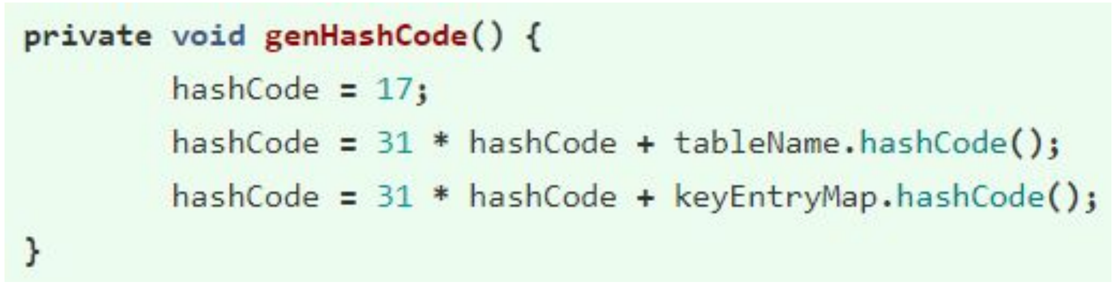
Solution

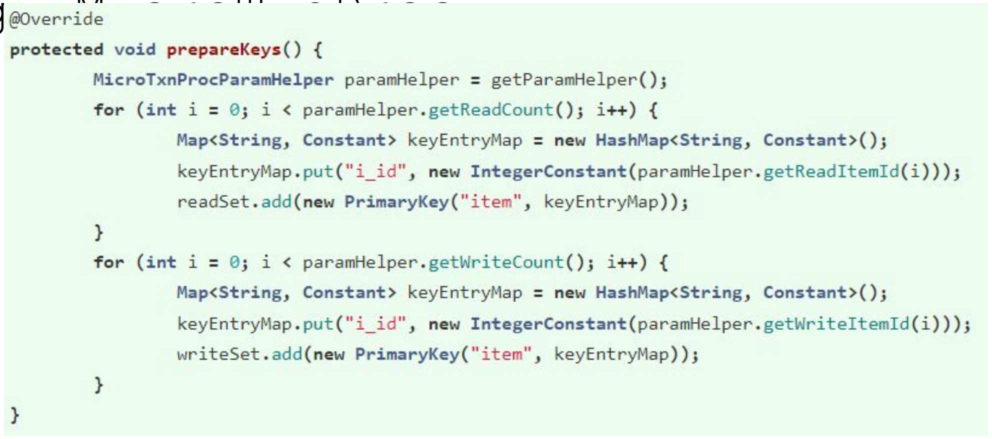
- PrimaryKey
  - An object as a lock in `ConservativeLockTable`
  - Hash tablename and keyentrymap into a hashcode to represent this object



```
private void genHashCode() {
        hashCode = 17;
        hashCode = 31 * hashCode + tableName.hashCode();
        hashCode = 31 * hashCode + keyEntryMap.hashCode();
}
```

Solution

- StoreProcedure
  - Abstract function `prepareKeys()`
    - prepare Read Write set of txn
    - E.g

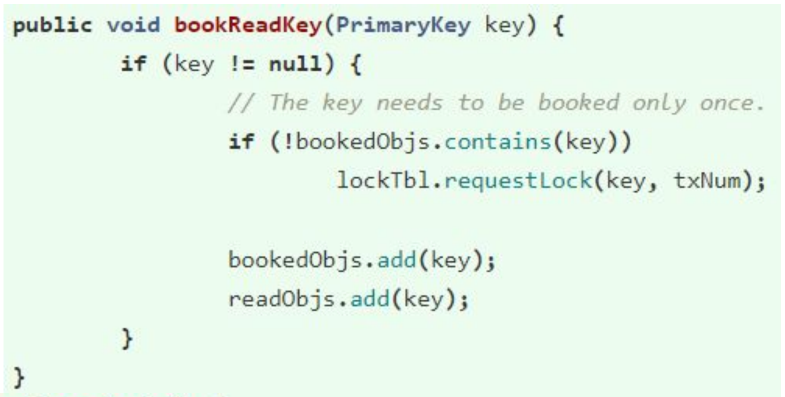


```
@Override
protected void prepareKeys() {
        MicroTxnProcParamHelper paramHelper = getParamHelper();
        for (int i = 0; i < paramHelper.getReadCount(); i++) {
                Map<String, Constant> keyEntryMap = new HashMap<String, Constant>();
                keyEntryMap.put("i_id", new IntegerConstant(paramHelper.getReadItemId(i)));
                readSet.add(new PrimaryKey("item", keyEntryMap));
        }
        for (int i = 0; i < paramHelper.getWriteCount(); i++) {
                Map<String, Constant> keyEntryMap = new HashMap<String, Constant>();
                keyEntryMap.put("i_id", new IntegerConstant(paramHelper.getWriteItemId(i)));
                writeSet.add(new PrimaryKey("item", keyEntryMap));
        }
}
```

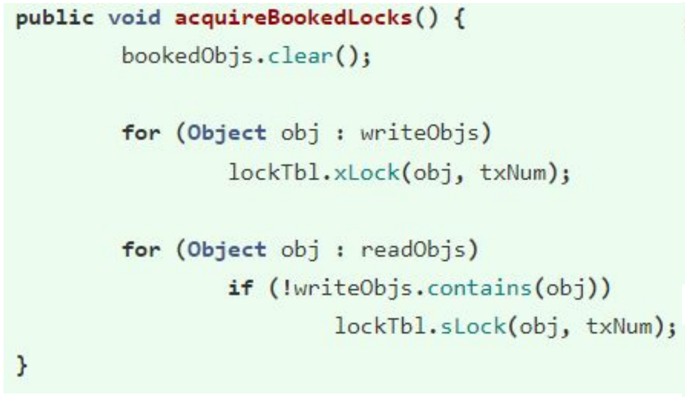
  - `scheduleTransactionSerially()`
    - Deterministic ordering

Solution

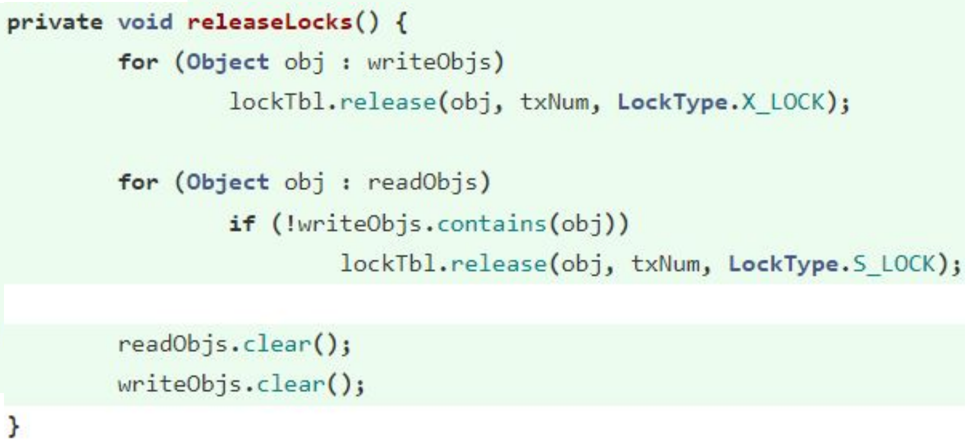
- ConservativeConcurrencyMgr
  - bookReadKey/ bookWriteKey
  - acquireBookLocks
  - releaseLocks



```java
public void bookReadKey(PrimaryKey key) {
        if (key != null) {
                // The key needs to be booked only once.
                if (!bookedObjs.contains(key))
                        lockTbl.requestLock(key, txNum);

                bookedObjs.add(key);
                readObjs.add(key);
        }
}
```



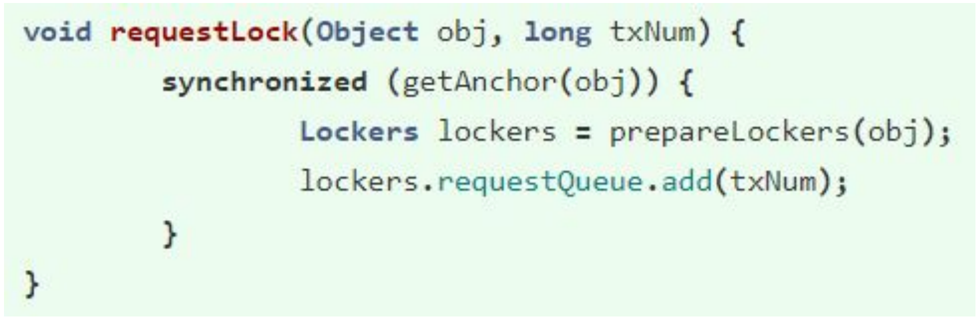
```java
public void acquireBookedLocks() {
        bookedObjs.clear();

        for (Object obj : writeObjs)
                lockTbl.xLock(obj, txNum);

        for (Object obj : readObjs)
                if (!writeObjs.contains(obj))
                        lockTbl.sLock(obj, txNum);
}
```



```java
private void releaseLocks() {
        for (Object obj : writeObjs)
            lockTbl.release(obj, txNum, LockType.X_LOCK);

        for (Object obj : readObjs)
            if (!writeObjs.contains(obj))
                lockTbl.release(obj, txNum, LockType.S_LOCK);

        readObjs.clear();
        writeObjs.clear();
}
```

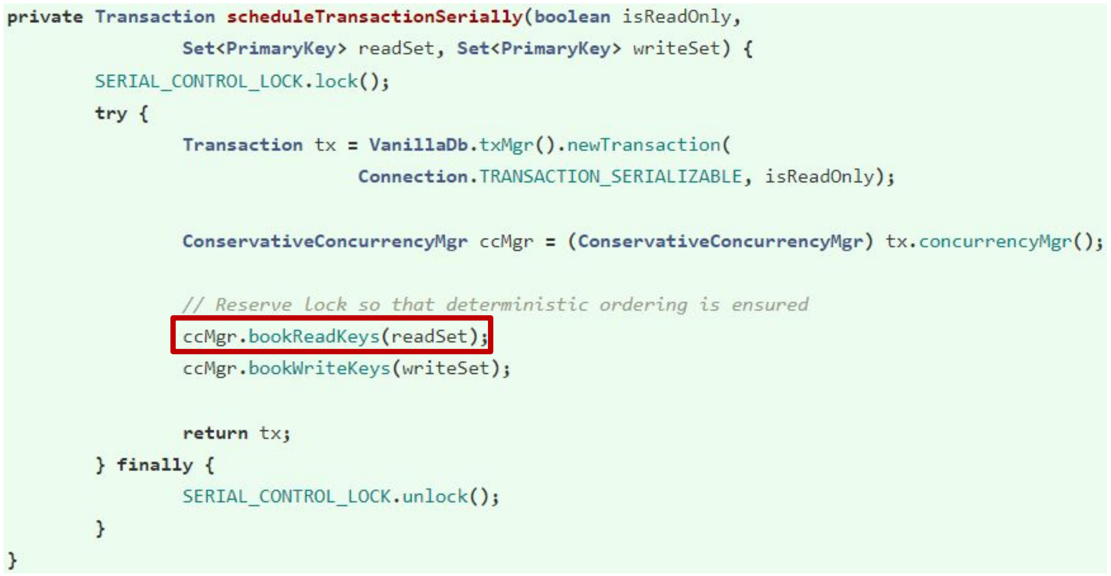
Solution

- ConservativeLockTable
  - requestQueue maintain deterministic property

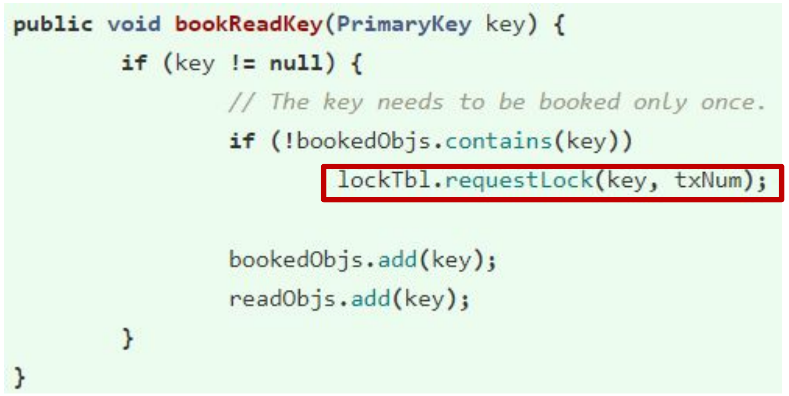


```
void requestLock(Object obj, long txNum) {
        synchronized (getAnchor(obj)) {
                Lockers lockers = prepareLockers(obj);
                lockers.requestQueue.add(txNum);
        }
}
```

Deterministic Order



```java
private Transaction scheduleTransactionSerially(boolean isReadOnly,
            Set<PrimaryKey> readSet, Set<PrimaryKey> writeSet) {
        SERIAL_CONTROL_LOCK.lock();
        try {
            Transaction tx = VanillaDb.txMgr().newTransaction(
                        Connection.TRANSACTION_SERIALIZABLE, isReadOnly);

            ConservativeConcurrencyMgr ccMgr = (ConservativeConcurrencyMgr) tx.concurrencyMgr();

            // Reserve lock so that deterministic ordering is ensured
            ccMgr.bookReadKeys(readSet);
            ccMgr.bookWriteKeys(writeSet);

            return tx;
        } finally {
            SERIAL_CONTROL_LOCK.unlock();
        }
}
```



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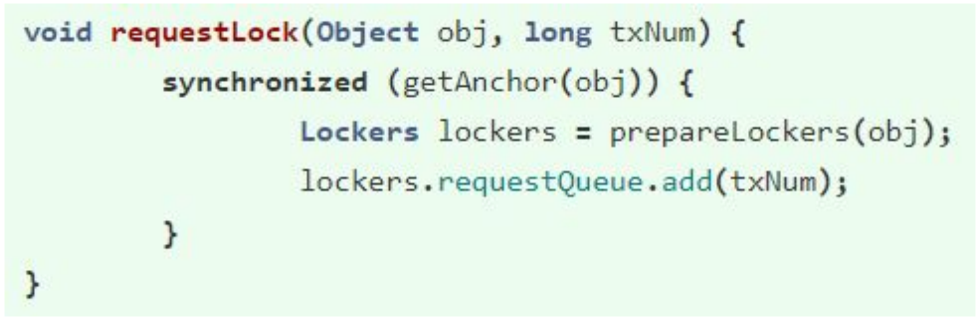

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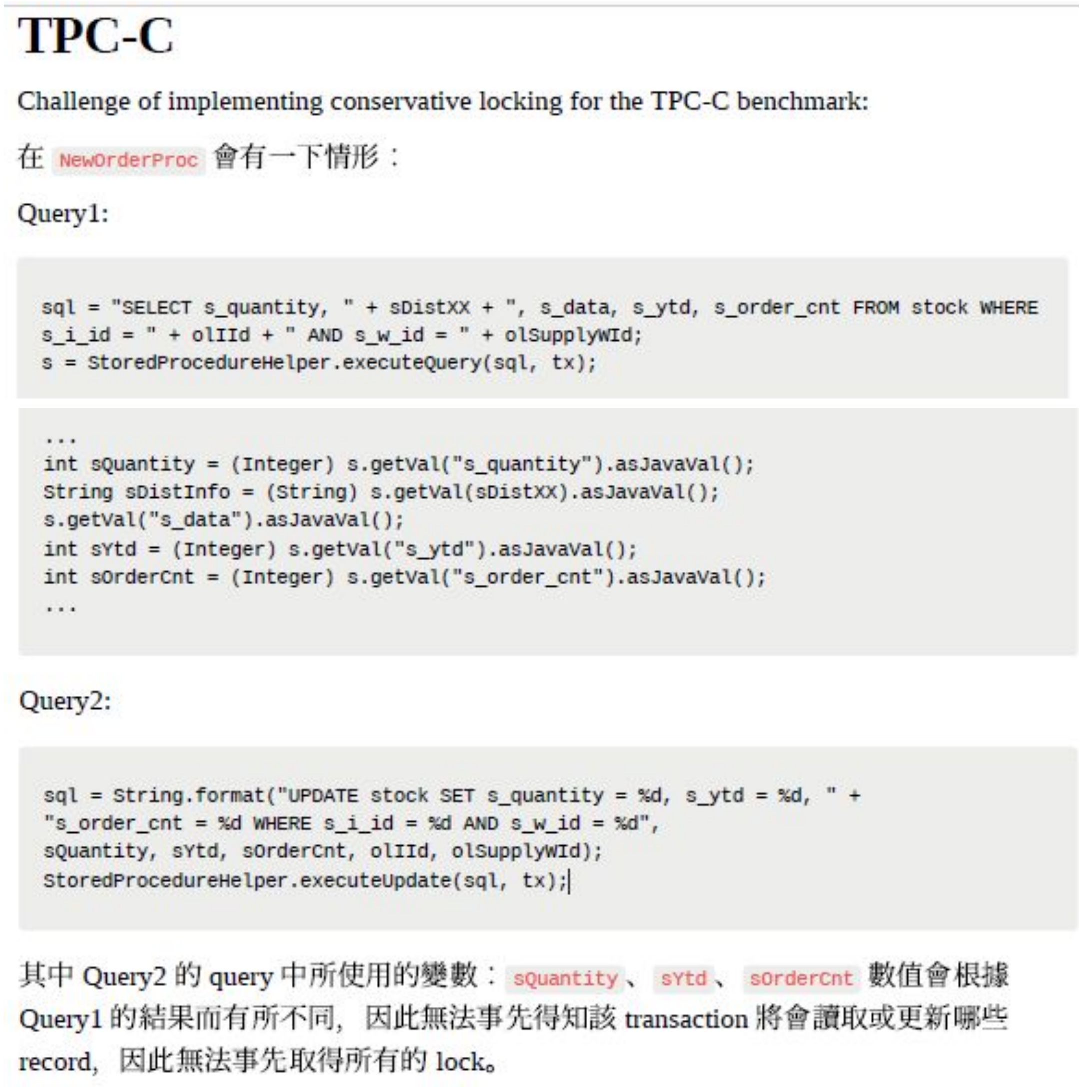
Challenge of TPC-C

- Team3



TPC-C

Challenge of implementing conservative locking for the TPC-C benchmark:

在 `NewOrderProc` 會有一下情形：

Query1:

```
sql = "SELECT s_quantity, " + sDistXX + ", s_data, s_ytd, s_order_cnt FROM stock WHERE
s_i_id = " + olIId + " AND s_w_id = " + olSupplyWId;
s = StoredProcedureHelper.executeQuery(sql, tx);
```

```
...
int sQuantity = (Integer) s.getVal("s_quantity").asJavaVal();
String sDistInfo = (String) s.getVal(sDistXX).asJavaVal();
s.getVal("s_data").asJavaVal();
int sYtd = (Integer) s.getVal("s_ytd").asJavaVal();
int sOrderCnt = (Integer) s.getVal("s_order_cnt").asJavaVal();
...
```

Query2:

```
sql = String.format("UPDATE stock SET s_quantity = %d, s_ytd = %d, " +
"s_order_cnt = %d WHERE s_i_id = %d AND s_w_id = %d",
sQuantity, sYtd, sOrderCnt, olIId, olSupplyWId);
StoredProcedureHelper.executeUpdate(sql, tx);
```

其中 Query2 的 query 中所使用的變數：`sQuantity`、 `sYtd`、 `sOrderCnt` 數值會根據 Query1 的結果而有所不同，因此無法事先得知該 transaction 將會讀取或更新哪些 record，因此無法事先取得所有的 lock。

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Questions

1. Can solution guarantee that each transaction is processed in ascending order?
2. Declaring prepareKey in SP may cause some subclass override an useless empty function.
3. Instead of using PrimaryKey, use recordID or blkID to build RW set.
4. Without creating new locktable, use the original one.