MySQL

Transactions

Intel (TX memory):
Transactional
Synchronization
Extensions (TSX)

PostgreSQL

Goal – A Distributed Transaction

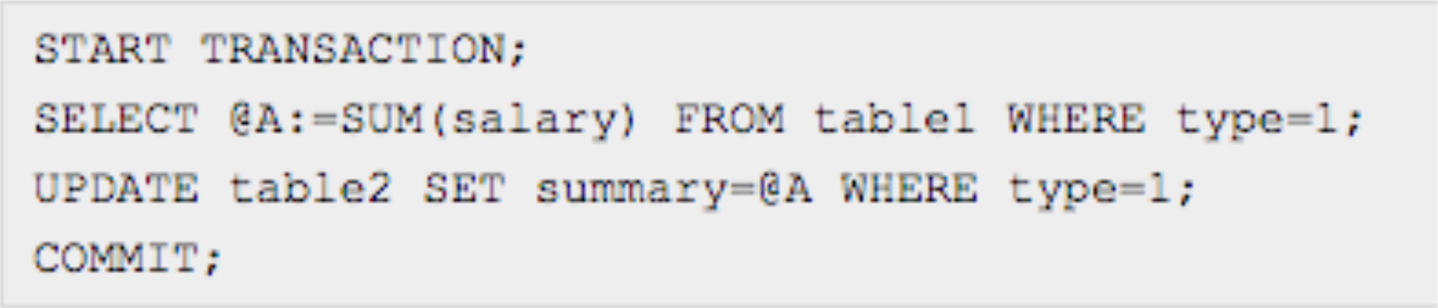
- We want a transaction that involves multiple nodes
- Review of transactions and their properties
- Things we need to implement transactions
  - Locks
  - Achieving atomicity through logging
    - Roll ahead, roll back, write ahead logging
- Finally, 2 Phase Commit (aka 2PC) and 3PC
- Lead into Paxos (again!)

Transactions - Definition

- A transaction is a sequence of data operations with the following properties:
  - A Atomic
    - All or nothing
  - C Consistent
    - Consistent state in => consistent state out
  - I Independent
    - Partial results are not visible to concurrent transactions
  - D Durable
    - Once completed, new state survives crashes

Transactional API

- Interface
  - tran = TranMonitor.**begin** ()
  - tran.**commit**()
  - tran.**abort**()



```
START TRANSACTION;
SELECT @A:=SUM(salary) FROM table1 WHERE type=1;
UPDATE table2 SET summary=@A WHERE type=1;
COMMIT;
```

Importance of independence

- Possible problems if we don't have it
  - lost update
    - t1 and t2 read *x* and then write *x*, t1's update is lost
  - inconsistent retrieval
    - Intermediate state may be inconsistent
  - dirty read
    - t1 updates *x*, t2 reads *x*, t1 aborts; t2 has dirty value of *x*
  - premature write
    - t1 and t2 update *x*, t1 aborts; t2's update is lost

Serializability

- A set of transactions is serializable iff
  - resulting state is equivalent to that produced by some serial ordering of those transactions
- They don’t actually have to run in serial order
  - system just ensures that actual outcome is the same as if they had

Two Possible Approaches

- Two Phase Locking
- Strict Two Phase Locking

Two Phase Locking

- Locks
  - reader/writer locks
  - acquired **as** transaction proceeds
  - no more acquires after first release
- Phase 1
  - acquire locks and access data, but release no locks
- Phase 2
  - access data, release locks, but acquire no new locks

Q Semantics of two-phase locking

- Does the Two-Phase Locking protocol ensure
  - serializability?
  - independence?

- How?

Semantics of two-phase locking

- Ensures serializability
  - if transactions have no conflicting lock access
    - order arbitrarily
  - for any transactions with conflicting lock access
    - order transactions based on order lock is acquired
  - transactions are serialized
    - because, no lock is acquired after first release
    - deadlocks are still possible
- Does not ensure independence
  - we still have *premature write* problem
  - t1 releases x, t2 acquires x, then t1 aborts

Strict two phase locking

- Like two-phase locking, but
  - release no locks until transaction commits
- Phase 1:
  - acquire locks and access data, but release no locks
- Phase 2:
  - Commit/abort transaction and then release all locks
- Ensures both serializability and independence