# Multiversion Concurrency Control, Transaction Management

CS157B

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May 11, 2005.

# Outline

- Multiversion Timestamps
- Timestamps versus Locking
- Logging and Concurrency

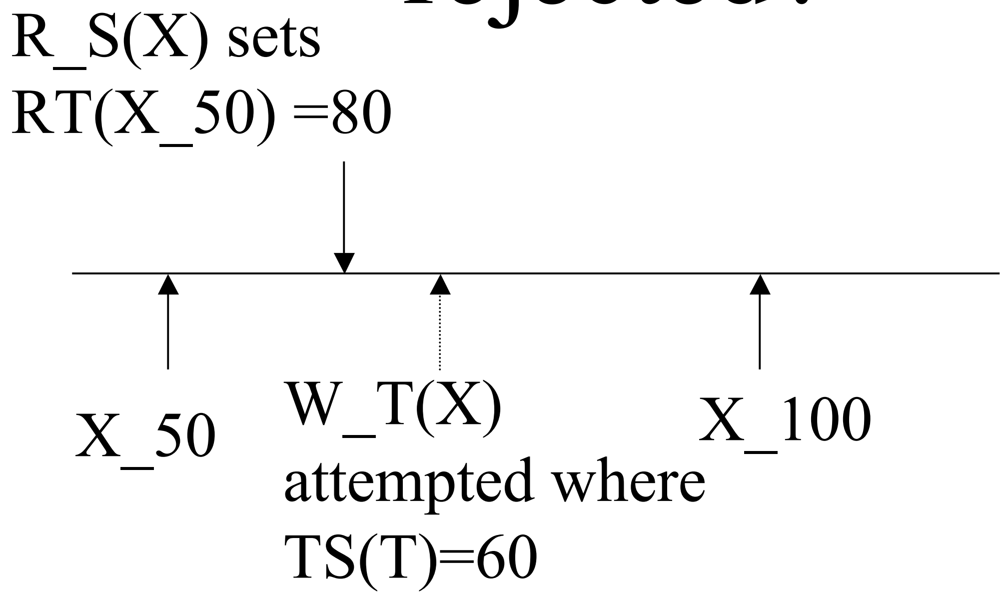
# Multiversion Timestamps

- We want to allow for greater concurrency than basic timestamping allows.
- To do this we will reduce the number of reads that cause transactions to abort.
- Suppose transactions arrive in the order: T1, T3, T2, T4. Consider the schedule: r_1(A), w_1(A), r_2(A), w_2(A), r_3(A), r_4(A). T3 must abort according to timestamping.
- However, if we had kept an old value of A around for T3 we might not need to abort it.

# More on Multiversion Timestamps

- How do we manage multiple versions of database elements?
  - When a write w_T(X) occurs, if it is legal, a new version of X is created. Its write time is TS(T) and we will call it X_t where t=TS(T).
  - When a r_T(X) occurs, the scheduler finds the first version of X_t of X such that t <= TS(T), and such that there is no X_t' with t < t' <=TS(T).
  - Write times are now associated with versions of an element and they never change.
  - Read times are associated with version. Read times are used to reject certain writes as will be indicated on the next slide.
  - When a version X_t has a time t such that no active transaction has a timestamp less than t, then we may delete any version X of previous to X_t.

# What kind of writing should be rejected?




– S whould have read T’s value but reads X_50 instead. So should abort T.

# Timestamps versus Locking

- Basic rule of thumb: timestamping works better when most transactions are read-only, or it is rare that concurrent transaction will read and write the same element.
- Locking works better in high conflict situations.
- The reasoning is:
  - Locking frequently delays transactions as they have to wait for locks and can lead to deadlocks.
  - If concurrent transactions have frequent reads and write in common then timestamping will tend to cause transactions to rollback frequently making the throughput less than with locking.
- Commercial DBMS systems try to get the best of both by allowing a read only isolation level which is handled using multiversion timestamping and otherwise use locking for other isolation levels.

# More on Transaction Management

- We have now talked about recovery and about serializability but we haven't said how to get these two components of the DBMS to work together.
- Our logging mechanisms make no mention of serializability and there is no guarantee when we do a recovery that the consistent state we get to corresponds to something that might have been produced by a serializable schedule.
- On the other hand, there is nothing about two phase locking that prevents a transaction from writing into the database uncommitted data.
- To finish up the semester we will give an example situation where logging and concurrency interact.

# Cascading Rollbacks

- Consider the schedule:
  - L_1(A), R_1(A), W_1(A), L_1(B), U_1(A),
    L_2(A), R_2(A), W_2(A), L_2(B) denied,
    R_1(B), A_1, U_1(B), L_2(B), U_2(A), R_2(B),
    W_2(B), U_2(B).
- If we are using timestamping with a commit bit the above schedule without the locks couldn't happen, but it is a legal 2PL schedule. However, T_2's value for A is dirty so we should rollback T_2 when T_1 aborts. This rollback that causes another rollback is called a *cascading rollback*.
- To avoid this problem, a transaction must not release any write locks until it either commits or aborts and the commit or abort log record is flushed to disk. This locking protocol is called *strict 2PL*. It shows that logging and concurrency do need to interact.
- Aside: A quick trick when blocks are locked rather than rows --that does not require interaction with the log -- is to require blocks written (and locked) by uncommitted transaction be pinned in main memory until the transaction commits or aborts.