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## CONCURRENCY CONTROL IN DBMS WITH TIMESTAMPS

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### ABSTRACT

In this paper I have discussed the why Time stamping technique is used in concurrency control in DBMS and how it can be implemented. Here, as in locking technique problem of deadlock is found which is very important to resolve. So time stamping can resolve this issue to some extent. It can be implemented by two ways Formal and Informal. Timestamping refers to the use of an electronic timestamp to provide a temporal order among a set of events. Timestamping techniques are used in a variety of computing fields, from network management and computer security to concurrency control. Here, I will discuss in concurrency control. The timestamp ordering protocol ensures that any pair of conflicting read/write operations will be executed in their respective timestamp order. This is an alternative solution to using locks.

### KEYWORDS

time stamping, multiversion concurrency control, formal timestamping, informal timestamping.

### INTRODUCTION

Multiversion concurrency control (MVCC), in the database field of computer science, is a concurrency control method commonly used by database management systems to provide concurrent access to the database and in programming languages to implement transactional memory. Here, a database will implement updates not by deleting an old piece of data and overwriting it with a new one, but instead by marking the old data as obsolete and adding the newer *version*. Thus there are multiple versions stored, but only one is the latest. This allows the database to avoid overhead of filling in holes in memory or disk structures but requires generally the system to periodically sweep through and delete the old, obsolete data objects. MVCC also provides potential *point in time* consistent views. In fact read transactions under MVCC typically use a timestamp or transaction ID to determine what state of the DB to read, and read these *versions* of the data. This avoids managing locks for read transactions because writes can be isolated by virtue of the old versions being maintained, rather than through a process of locks. Writes affect future *version* but at the transaction ID that the read is working at, everything is guaranteed to be consistent because the writes are occurring at a later transaction ID. In other words, MVCC provides each user connected to the database with a *snapshot* of the database for that person to work with. Any changes made will not be seen by other users of the database until the transaction has been committed.

### TIMESTAMP

One of the techniques used in MVCC is time stamping. In computing timestamping refers to the use of an electronic timestamp to provide a temporal order among a set of events. Time stamping techniques are used in a variety of computing fields, from network management and computer security to concurrency control. Here, I will discuss its role in concurrency control in DBMS. Time stamp is a monotonically increasing variable (integer) indicating the age of an operation or a transaction. A larger timestamp indicates a more recent transaction. Timestamp Ordering Algorithm: Basically three algorithms are used.

- Basic Timestamp Ordering
- Strict Timestamp Ordering
- Thomas's Write Rule

### OPERATION

Following assumptions are made here.

- Every timestamp value is unique and accurately represents an instant in time.
- No two timestamps can be the same.
- A higher-valued timestamp occurs later in time than a lower-valued timestamp.

Timestamps can be generated in several ways.

1. One possibility is to use a counter that is incremented each time its value is assigned to a transaction. The transaction timestamps are numbered 1, 2, 3, . . . in this scheme. A computer counter has a finite maximum value, so the system must periodically reset the counter to zero when no transactions are executing for some short period of time.
2. Another way to implement timestamps is to use the current date/time value of the system clock and ensure that no two timestamp values are generated during the same tick of the clock.
3. A combination of the above two methods.

Time stamping technique is operated by two ways.

1. Formal
2. Informal

(Here TS is time stamp, A is action, T is transaction, O is object, WTS is write timestamp and RTS is write time stamp.)

Each transaction ( $T_i$ ) is an ordered list of actions ( $A_{i,x}$ ). Before the transaction performs its first action ( $A_{i,1}$ ), it is marked with the current timestamp, or any other strictly totally ordered sequence:  $TS(T_i) = NOW()$ . Every transaction is also given an initially empty set of transactions upon which it depends,  $DEP(T_i) = []$ , and an initially empty set of old objects which it updated,  $OLD(T_i) = []$ .

Each object ( $O_j$ ) in the database is given two timestamp fields which are not used other than for concurrency control:  $RTS(O_j)$  is the time at which the value of object was last used by a transaction,  $WTS(O_j)$  is the time at which the value of the object was last updated by a transaction.

For all  $T_i$ :

For each action  $A_{i,x}$ :

If  $A_{i,x}$  wishes to use the value of  $O_j$ :

If  $WTS(O_j) > TS(T_i)$  then **abort** (a more recent thread has overwritten the value),  
 Otherwise update the set of dependencies  $DEP(T_i).add(WTS(O_j))$  and set  
 $RTS(O_j) = \max(RTS(O_j), TS(T_i))$ ,  
 If  $A_i$  wishes to update the value of  $O_j$ :  
 If  $RTS(O_j) > TS(T_i)$  then **abort** (a more recent thread is already relying on the old value),  
 If  $WTS(O_j) > TS(T_i)$  then **skip** (the Thomas Write Rule),  
 Otherwise store the previous values,  $OLD(T_i).add(O_j, WTS(O_j))$ , set  $WTS(O_j) = TS(T_i)$ , and update the  
 value of  $O_j$ .  
 While there is a transaction in  $DEP(T_i)$  that has not ended: **wait**  
 If there is a transaction in  $DEP(T_i)$  that aborted then **abort**  
 Otherwise: **commit**.  
 To **abort**:  
 For each  $(oldO_j, oldWTS(O_j))$  in  $OLD(T_i)$   
 If  $WTS(O_j) \text{ equals } TS(T_i)$  then restore  $O_j = oldO_j$  and  $WTS(O_j) = oldWTS(O_j)$

## 2. INFORMAL

Whenever a transaction starts, it is given a timestamp. This is so we can tell which order that the transactions are supposed to be applied in. So given two transactions that affect the same object, the transaction that has the earlier timestamp is meant to be applied before the other one. However, if the wrong transaction is actually presented first, it is aborted and must be restarted.

Every object in the database has a read timestamp, which is updated whenever the object's data is read, and a write timestamp, which is updated whenever the object's data is changed.

If a transaction wants to read an object,

- but the transaction started *before* the object's write timestamp it means that something changed the object's data after the transaction started. In this case, the transaction is canceled and must be restarted.
- and the transaction started *after* the object's write timestamp, it means that it is *safe* to read the object. In this case, if the transaction timestamp is after the object's read timestamp, the read timestamp is set to the transaction timestamp.

If a transaction wants to write to an object,

- but the transaction started *before* the object's read timestamp it means that something has had a look at the object, and we assume it took a copy of the object's data. So we can't write to the object as that would make any copied data invalid, so the transaction is aborted and must be restarted.
- and the transaction started *before* the object's write timestamp it means that something has changed the object since we started our transaction. In this case we use the Thomas Write Rule and simply skip our write operation and continue as normal; the transaction does not have to be aborted or restarted
- otherwise, the transaction writes to the object, and the object's write timestamp is set to the transaction's timestamp.

## CONCLUSION

Multi-version concurrency control (MVCC) is a common way today to increase concurrency and performance by generating a new version of a database object each time the object is written, and allowing transactions' read operations of several last relevant versions (of each object), depending on scheduling method. A timestamp is a unique identifier created by the DBMS to identify a transaction. Typically, timestamp values are assigned in the order in which the transactions are submitted to the system, so a timestamp can be thought of as the *transaction start time*. We will refer to the timestamp of transaction T as TS(T). Concurrency control techniques based on timestamp ordering do not use locks; hence, *deadlocks cannot occur*.

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