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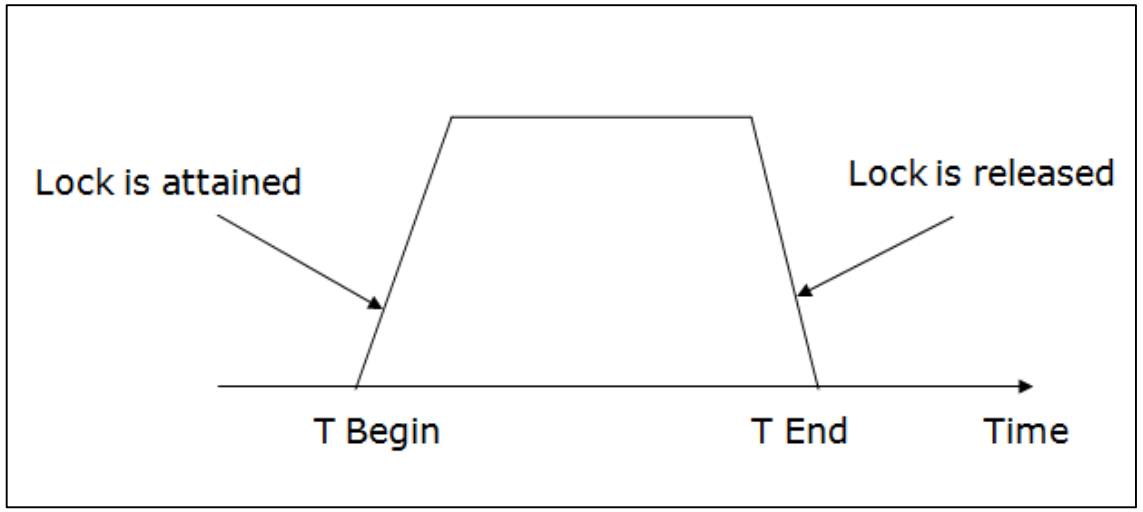
Database Management System (BCSC – 0003)

Topic: Concurrency Control Techniques



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Topics to be covered

- Concurrent execution in DBMS
- Problems with concurrent execution
- Concurrency Control Protocol
  - ❖Lock Based Protocol
  - ❖Timestamp Concurrency Control Protocol
  - ❖Validation Based Concurrency Control Protocol

Concurrent Execution in DBMS

- In a multi-user system, multiple users can access and use the same database at one time, which is known as the concurrent execution of the database.

- While working on the database transactions, there occurs the requirement of using the database by multiple users for performing different operations, and in that case, concurrent execution of the database is performed.

- The simultaneous execution that is performed should be done in an concurrent manner, and no operation should affect the other executing operations, thus maintaining the consistency of the database.

Problems with Concurrent Execution

In database transaction, READ & WRITE are two main operations. So, there is a need to manage these operations in the concurrent execution of the transactions. Otherwise data may be inconsistent & have following problems:

- Lost Update Problems: The problem occurs when two different database transactions perform the read/write operations on the same database items and update the values of the items incorrect.

- Dirty Read Problems: The dirty read problem occurs when one transaction updates an item of the database, and somehow the transaction fails, and before the data gets rollback, the updated database item is accessed by another transaction.

Concurrency Control Protocols

- Concurrency Control is the working concept that is required for controlling and managing the concurrent execution of database operations and thus avoiding the inconsistencies in the database. Thus, for maintaining the concurrency of the database, we have the concurrency control protocols.

- The concurrency control protocols ensure the atomicity, consistency, isolation, durability and serializability of the concurrent execution of the database transactions. Therefore, these protocols are categorized as:

  - ❖ Lock Based Concurrency Control Protocol
  - ❖ Time Stamp Concurrency Control Protocol
  - ❖ Validation Based Concurrency Control Protocol

Lock-Based Protocol

In this type of protocol, any transaction cannot read or write data until it acquires an appropriate lock on it. There are two types of lock:

1. Shared lock: It is also known as a Read-only lock. In a shared lock, the data item can only read by the transaction. It can be shared between the transactions because when the transaction holds a lock, then it can't update the data on the data item.

2. Exclusive lock: In the exclusive lock, the data item can be both reads as well as written by the transaction. This lock is exclusive, and in this lock, multiple transactions do not modify the same data simultaneously.

Two – Phase Locking (2PL)

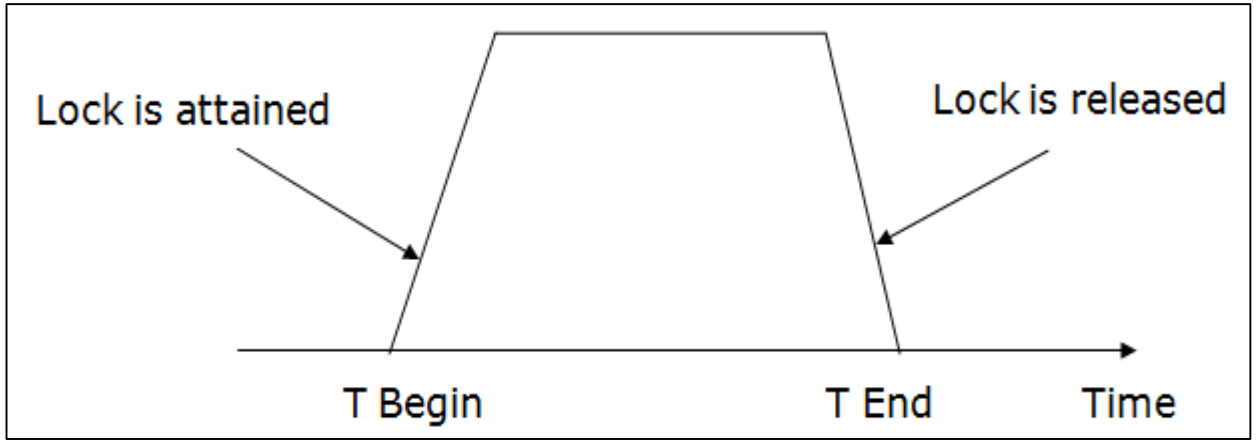
- The two-phase locking protocol divides the execution phase of the transaction into three parts.

- In the first part, when the execution of the transaction starts, it seeks permission for the lock it requires.

- In the second part, the transaction acquires all the locks.

- The third phase is started as soon as the transaction releases its first lock. In this phase, the transaction cannot demand any new locks. It only releases the acquired locks.

Two – Phase Locking (2PL)



There are two phases of 2PL:

- Growing phase: In the growing phase, a new lock on the data item may be acquired by the transaction, but none can be released.

- Shrinking phase: In the shrinking phase, existing lock held by the transaction may be released, but no new locks can be acquired.

Timestamp Ordering Protocol

- The Timestamp Ordering Protocol is used to order the transactions based on their Timestamps.
- The order of transaction is nothing but the ascending order of the transaction creation.
- The priority of the older transaction is higher that's why it executes first.
- To determine the timestamp of the transaction, this protocol uses system time.

Validation Based Protocol

It is also known as optimistic concurrency control technique. In the validation based protocol, the transaction is executed in the following three phases:

1. Read phase: In this phase, the transaction T is read and executed. It is used to read the value of various data items and stores them in temporary local variables. It can perform all the write operations on temporary variables without an update to the actual database.

2. Validation phase: In this phase, the temporary variable value will be validated against the actual data to see if it violates the serializability.

3. Write phase: If the validation of the transaction is validated, then the temporary results are written to the database or system otherwise the transaction is rolled back.

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Thank
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