Name:Yash Manoj Mahajan Class:SE IT B Roll No:04 PID:191061

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Class: SE-ITA/B, Semester: III

Subject: **Structured Query Lab**

Experiment – 10A): Simulation/Implementation of Concurrency Control Algorithm (2PL)

1. **Aim:** To Implement Concurrency Control Algorithm (2PL)
2. **Objective:**
   - After performing the experiment, the students will be able to use concurrency control algorithm i.e. 2 phase locking protocol

3. **Outcome:** L303.6: To Demonstrate the concept of transaction, concurrency and recovery.

4. **Prerequisite:** Understanding of Concurrency control, 2 phase locking protocol

5. **Requirements:** PC, Oracle 11g/SQL Server 2008 R2, Microsoft Word, Internet, MySQL, JDK Netbeans

6. **Pre-Experiment Exercise:**

Brief Theory :

What is concurrency control?

Explain Two-phase locking protocol technique and its types

7. **Laboratory Exercise**

A. Procedure:

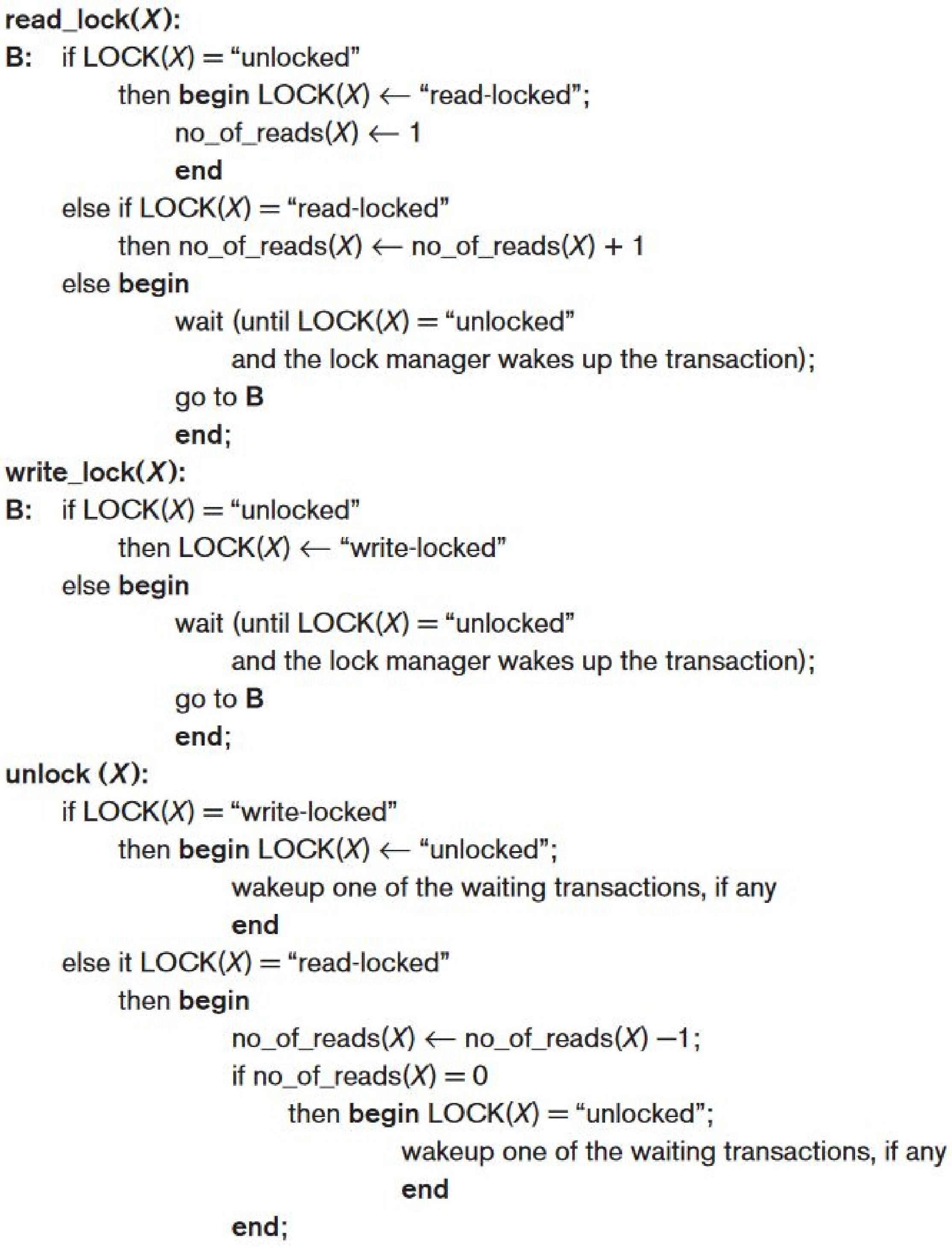
1. Consider below given input file

Input file

```
b1;
r1 (Y);
w1 (Y);
r1 (Z);
b2;
r2 (X);
w2 (X);
w1 (Z);
e1;
r2 (Y);
b3;
r3 (Z);
w3 (Z);
w2 (Y);
e2;
r3 (X);
w3 (X);
e3;
```

2. For above input file ,apply 2 PL technique as given below

Algorithm for 2PL:



```
read_lock(X):
B:  if LOCK(X) = "unlocked"
        then begin LOCK(X) ← "read-locked";
            no_of_reads(X) ← 1
            end
    else if LOCK(X) = "read-locked"
        then no_of_reads(X) ← no_of_reads(X) + 1
    else begin
            wait (until LOCK(X) = "unlocked"
                and the lock manager wakes up the transaction);
            go to B
            end;
write_lock(X):
B:  if LOCK(X) = "unlocked"
        then LOCK(X) ← "write-locked"
    else begin
            wait (until LOCK(X) = "unlocked"
                and the lock manager wakes up the transaction);
            go to B
            end;
unlock (X):
    if LOCK(X) = "write-locked"
        then begin LOCK(X) ← "unlocked";
                wakeup one of the waiting transactions, if any
                end
    else it LOCK(X) = "read-locked"
        then begin
                no_of_reads(X) ← no_of_reads(X) −1;
                if no_of_reads(X) = 0
                    then begin LOCK(X) = "unlocked";
                            wakeup one of the waiting transactions, if any
                            end
                end;
```

B. **Result/Observation/Program code:** Attach code with proper output

```
b1;:: TRANSACTION STARTED
r1(Y);:: READ LOCK ON Y BY TRANSACTION 1
w1(Y);
 w1Y;:: UPGRADED TO WRITE LOCK ON Y
r1(Z);:: READ LOCK ON Z BY TRANSACTION 1
b2;:: TRANSACTION STARTED
r2(X);:: READ LOCK ON X BY TRANSACTION 2
w2(X);
 w2X;:: UPGRADED TO WRITE LOCK ON X
w1(Z);
 w1Z;:: UPGRADED TO WRITE LOCK ON Z
e1;
 e1;:: TRANSACTION1 COMMITTED
r2(Y);:: READ LOCK ON Y BY TRANSACTION 2
b3;:: TRANSACTION STARTED
r3(Z);:: READ LOCK ON Z BY TRANSACTION 3
w3(Z);
 w3Z;:: UPGRADED TO WRITE LOCK ON Z
w2(Y);
 w2Y;:: UPGRADED TO WRITE LOCK ON Y
e2;
 e2;:: TRANSACTION2 COMMITTED
r3(X);:: READ LOCK ON X BY TRANSACTION 3
w3(X);
 w3X;:: UPGRADED TO WRITE LOCK ON X
e3;
 e3;:: TRANSACTION3 COMMITTED
```

8. Post Experimental Exercise-

A. Questions:

Database systems are typically implemented as a set of processes sharing a shared memory area.

1. How is access to the shared memory area controlled?
2. Is two-phase locking appropriate for serializing access to the data structure in shared memory? Explain your answer.

B. Conclusion:

1. Write what was performed in the experiment
2. Mention a few applications of what was studied.
3. Write the significance of the studied topic

C. **References:**

[1] Elmasri and Navathe, “Fundamentals of Database Systems”, 5th Edition, PEARSON Education.

[2] Korth, Silberchatz, Sudarshan, “Database System Concepts”, 6th Edition, McGraw – Hill

[3] https://www.w3schools.com/sql/sql_default.asp

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6. Pre-Experiment Exercise :-

Brief Theory :-

What is concurrency control ?:-

In a multiprogramming enviroment where multiple transactions can be executed simultaneously, it is highly important to control ~~protocols~~ concurrency of the transactions. We have concurrency control protocols to ensure atomicity, isolation and serializability of concurrent transactions. Concurrency control protocols can be ~~to~~ broadly divided into two categories :-

Lock based protocols

Time stamp based protocols.

Explain Two phase locking protocols and it's types

Two phase locking protocol also known as 2PL protocol is a method of concurrency control in DBMS that ensures serializability by applying lock to the transaction data which blocks other transactions from accessing the same data simultaneously. The two phase locking protocol allows each transaction to make a lock or release a lock request in two steps:

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Growing ~~z~~ Phase:- In this phase a transaction may not release any locks but may obtain locks.

Shrinking Phase:- ~~Qa~~ In this phase, a transaction may release locks but not obtain any new lock.

The types of two phase locking protocol are :-

Conservative 2PL:- This requires a transaction to lock all the items it accesses before the transaction begins execution, by predeclaring it's read-set and ~~re~~ write-~~st~~ set. Conservative 2PL is deadlock free:

Strict 2PL:- In this protocol transaction T does not release any of it's exclusive locks until after it commits or aborts. No other transaction can read or write an item written by T unless T has committed. This helps in recoverability but it is not deadlock free.

Rigorous 2PL:- This is a more restrictive version of strict 2PL. In this variation, transaction T does not release any of its locks until after it commits or aborts and so it is ~~more~~ easier to implement than strict 2PL.

Attitude

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8. Post Experiment Excercise :-

A. Questions :-

Database Systems are typically implemented as a set of processes sharing a shared memory area.

1. How is access to the shared memory area controlled.

When several transactions execute concurrently in the database the isolation property may no longer be preserved. To ensure that it is preserved, the system must control the interaction among concurrent transactions; this control is achieved through one of a variety of mechanisms called concurrency control schemes. One important set of protocols - known as ~~two~~ two - phase locking protocols - employs the technique of locking data items to prevent multiple transactions accessing the items concurrently. Locking protocols are used in some comercial RDBMS, but they are considered to have a high overhead. Another concurrency control protocol uses timestamps. A timestamp is a unique identifier for each transaction, generated by

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the system; Timestamp values are generated in the same order as the transaction start times. ~~Timestamp~~ Concurrency control protocols that use Timestamp ordering ensure serializability.

2. Is two-phase locking appropriate for serializing access to a data~~base~~ structure in shared memory? Explain your answer.

A transaction is said to follow the two phase locking protocol if all locking operations precede the first unlock operation in the transaction. It can be proved ~~to~~ that, if every transaction in a schedule follows the twophase locking protocol, the schedule is guaranteed to be serializable, obviating the need to test for serializibility of schedules. The locking protocol, by enforcing two phase locking rules, also enforces serializability. Twophase locking may limit the amount of concurrency that can occur in a schedule. This is the price for guaranteeing serializability of all schedules ~~wit~~ without having to check the schedules themselves. Although two phase locking protocol guarantee serializability it does not permit all possible serializable schedules.

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B) Conclusion:-

In this experiment we have studied about concurrency control; how to achieve concurrency control and two phase locking protocol

2PL is a concurrency control protocol which guarantees serializability. It utilises locks, applied by transaction to data which may block other transactions from accessing that data.

Concurrency is the ability ~~to~~ of two transactions to use same data the the same time. But to ensure data isolation we have to implement concurrency controls protocols like 2PL.