CSE 444 Practice Problems

Transactions: Concurrency Control

1. **Schedules, Serializability, and Locking**

   (a) Consider the following two transactions and schedule (time goes from top to bottom). Is this schedule conflict-serializable? Explain why or why not.

Transaction T_0	Transaction T_1
$r_0[A]$	
$w_0[A]$	
	$r_1[A]$
	$r_1[B]$
	c_1
$r_0[B]$	
$w_0[B]$	
c_0	

(b) Show how 2PL can ensure a conflict-serializable schedule for the same transactions above. Use the notation $L_i[A]$ to indicate that transaction i acquires the lock on element A and $U_i[A]$ to indicate that transaction i releases its lock on A.

(c) Show how the use of locks without 2PL can lead to a schedule that is NOT conflict serializable.

2. **More serializability and locking**

Consider a database with objects X and Y and assume that there are two transactions T_1 and T_2. T_1 first reads X and Y and then writes X and Y. T_2 reads and writes X then reads and writes Y.

(a) Give an example schedule that is not serializable. Explain why your schedule is not serializable.

(b) Show that strict 2PL disallows this schedule.

(c) What are the differences between the four levels of isolation?

3. **Optimistic Concurrency Control**

Consider a concurrency control manager by timestamps. Below are several sequences of events, including start events, where sti means that transaction Ti starts and coi means Ti commits. These sequences represent real time, and the timestamp-based scheduler will allocate timestamps to transactions in the order of their starts. In each case below, say what happens with the last request.

You have to choose between one of the following four possible answers:

(a) the request is accepted,

(b) the request is ignored,

(c) the transaction is delayed,

(d) the transaction is rolled back.

(a) st1; st2; r1(A); r2(A); w1(B); w2(B);
The system will perform the following action for w2(B): _____

(b) st1; st2; r2(A); co2; r1(A); w1(A)
The system will perform the following action for w1(A): _____

(c) st1; st2; st3; r1(A); w3(A); co3; r2(B); w2(A)
The system will perform the following action for w2(A): _____

(d) st1; st2; st3; r1(A); w1(A); r2(A);
The system will perform the following action for r2(A): _____

(e) st1; st2; st3; r1(A); w2(A); w3(A); r2(A);
The system will perform the following action for r2(A): _____

4. **Miscellaneous**

For each statement below, indicate if it is true or false.

(a) Serializability is the property that a (possibly interleaved) execution of a group of transactions has the same effect on the database and produces the same output as some serial execution of those transactions.

TRUE FALSE

(b) The following schedule is serializable:
$r_0[A] \rightarrow w_0[A] \rightarrow r_1[B] \rightarrow w_1[B] \rightarrow r_1[A] \rightarrow w_1[A] \rightarrow r_0[C] \rightarrow w_0[C] \rightarrow c_0 \rightarrow c_1$

TRUE FALSE

(c) A NO-STEAL buffer manager policy means that all pages modified by a transaction are forced to disk before the transaction commits.

TRUE FALSE

(d) Strict two-phase locking (2PL) ensures that transactions never deadlock.

TRUE FALSE

(e) Strict two-phase locking (2PL) ensures serializability.
Note: This question can be confusing. Be careful! To get serializability, one needs both strict 2PL and predicate locking. Strict 2PL alone guarantees only conflict serializability. Please see book and notes for more details.

TRUE FALSE

(f) In the ARIES protocol, at the end of the analysis phase, the Dirty Page Table contains the exact list of all pages dirty at the moment of the crash.

TRUE FALSE

(g) The ARIES protocol uses the "repeating history" paradigm, which means that updates for all transactions (committed or otherwise) are redone during the REDO phase.

TRUE FALSE