

CSE 444 – Homework 3
Transactions Concurrency Control

Name: _____

Question	Points	Score
1	20	
2	20	
Total:	40	

1 Concurrency Control with Locking

1. (20 points)

(a) (5 points) Consider a database with objects X, Y, and Z and assume that there are two transactions T1 and T2. Transaction T1 reads objects X and Y, writes X, and commits. Transaction T2 reads objects X and Y, writes object Y. It then reads objects X and Y again, writes X. Finally, it reads object Z, writes it, and commits. Give three examples of schedules for the transactions T1 and T2 to illustrate each of the points below:

1. Your schedule should contain a write-read conflict that causes one of the transactions to perform a dirty read.
2. Your schedule should contain a read-write conflict that causes one of the transactions to encounter an unrepeatable read.
3. Your schedule should contain a write-write conflict that causes a lost update.

In each case, your schedule may contain additional conflicts, but should contain at least one conflict of the type indicated. (In particular you may give a single schedule, which illustrates all three conflicts!) In each case, indicate the conflict of the type you are illustrating.

- (b) (5 points) Consider the following three 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	Transaction T_2
$r_0[A]$		
$w_0[A]$		
		$r_2[A]$
		$w_2[A]$
	$r_1[A]$	
$r_0[B]$		
		$r_2[B]$
$w_0[B]$		
		$w_2[B]$
	$r_1[B]$	
	c_1	
c_0		
		c_2

- (c) (5 points) 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 .

(d) (5 points) If 2PL ensures conflict-serializability, why do we need *strict* 2PL?

2 Optimistic Concurrency Control

2. (20 points)

- (a) (10 points) Consider the following schedule. Explain what happens when transactions *try* to execute as per this schedule and the DBMS uses timestamp-based concurrency control. We use ST to denote the start of a transaction, C for commit, and A for abort.

$ST_1 \rightarrow ST_2 \rightarrow ST_3 \rightarrow ST_4 \rightarrow R_2(X) \rightarrow R_1(X) \rightarrow W_2(X) \rightarrow W_4(X) \rightarrow W_1(X) \rightarrow C_1 \rightarrow W_3(X) \rightarrow A_4 \rightarrow R_2(Y) \rightarrow W_2(Y) \rightarrow R_3(Y) \rightarrow C_2 \rightarrow W_3(Y) \rightarrow C_3$

Answer (Fill in the table below showing what happens as the transactions execute):

T_1	T_2	T_3	T_4	X	Y
1	2	3	4	RT=0	RT=0
				WT=0	WT=0
				C=true	C=true
			$R_2(X)$		

- (b) (10 points) Consider the following schedule. Explain what happens when transactions try to execute as per this schedule and the DBMS uses **multiversion** concurrency control:

$ST_1 \rightarrow ST_2 \rightarrow ST_3 \rightarrow ST_4 \rightarrow R_1(X) \rightarrow R_3(X) \rightarrow W_3(X) \rightarrow R_2(X) \rightarrow R_4(X) \rightarrow W_2(X) \rightarrow W_4(X)$

Answer

(Fill in the table below showing what happens as the transactions execute):

T_1	T_2	T_3	T_4	$X_0 \dots$
1	2	3	4	
$R_1(X)$				RT=1
...				