CMPT506 – Advanced Database System
Fall 2016 – Homework 3

Due Thursday 29/12/2016 at 11pm – Submit your softcopy to blackboard.

Exercise 1 [6 points]
Consider the following 2 transactions T1 and T2:

T_1	T_2
read(X);	read(X);
X:=X-10;	X:= X*1.02;
write(X);	read(Y);
read(Y);	Y:= Y*1.02;
Y:=Y+10;	write(X);
write(Y);	write(Y);

a. [2 pts] Give a *serial schedule* for these transactions
b. [4 pts] Give an *equivalent conflict-serializable schedule* for these transactions.

Exercise 2 [12 points]
Consider the following 2 transactions T_1 and T_2:

T_1	T_2

read(X);
read(Y);
if X > 0 then Y := Y + 10;
write(Y);
	read(Y);
	read(X);
	if Y > 0 then X := X + 20;
	write(X);

a. [6pts] Add lock and unlock instructions to transactions T_1 and T_2 such that they conform to the two-phase locking protocol.
b. [6pts] Present a schedule where the execution of these 2 transactions can result in deadlock.

Exercise 3 [12 points]
Draw the precedence graph for the following schedule and test whether it is conflict serializable or not.

T1	T2	T3
W(A)		
R(B)		
R(C)		
		W(B)
W(B)		
		W(C)
	R(C)	
	W(B)	
	W(C)	
		R(A)

Exercise 4 [20 points]
Consider the three transactions T1, T2, and T3, and the schedules S1 and S2 given below. Draw the serializibility (precedence) graphs for S1 and S2 and state whether each schedule is serializable or not. If a schedule is serializable, give the equivalent serial schedule (i.e., just write the order of the transactions).

T1: r1(x); r1(z); w1(x)
T2: r2(z); r2(y); w2(z); w2(y)
T3: r3(x); r3(y); w3(y)
S1: r1(x); r2(z); r1(x); r3(x); r3(y); w1(x); w3(y); r2(y); w2(z); w2(y)
S2: r1(x); r2(z); r3(x); r1(z); r2(y); r3(y); w1(x); w2(z); w3(y); w2(y)

(*r* means read operation and *w* means write operation)

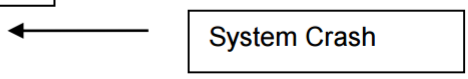
Exercise 5 [20 points]

Consider the following transaction log from the start of the execution of a database system that is capable of running undo/redo logging with checkpointing:
(1) < START T1 >
(2) <T1, A, 55, 20>
(3) <T1, B, 255, 20>
(4) <START T2>
(5) <T1, A, 89, 45>
(6) <T2, C, 40, 20>
(7) <COMMIT T1>
(8) <START T3>
(9) <T3, E, 50, 20>
(10) <T2, D, 50, 20>
(11) <START CKPT (T2,T3)>
(12) <T2, C, 70, 30>
(13) <COMMIT T2>
(14) <START T4>
(15) <T4, F, 105, 20>
(16) <COMMIT T3>
(17) <END CKPT>
(18) <T4, F, 155, 95>
(19) <COMMIT T4>
Suppose the log entries are in the format < T_{id}, Variable, Newvalue, Oldvalue >. What is the value of the data items A, B, C, D, E, and F on disk after recovery:
(1) if the system crashes just before line 10 is written to disk?
(2) if the system crashes just before line 13 is written to disk?
(3) if the system crashes just before line 14 is written to disk?
(4) if the system crashes just before line 19 is written to disk?
(5) if the system crashes just after line 19 is written to disk?

Question 6 [18 Points]

The table below shows the log corresponding to a particular schedule at the point of a system crash for the four transactions T1, T2, T3, and T4. Suppose that we use the immediate update protocol with check pointing. Describe the recovery process at the database restart after a system crash. Specify which transactions are rolled back, which operations in the log are redone and which (if any) are undone, and whether any cascading rollback takes place. Assume strict 2PL was followed as the concurrency control technique.

[Start_transaction, T1]
[read_item, T1, A]
[read_item, T1,D]
[write_item, T1, D, 20,25]
[Commit, T1]
[checkpoint]
[start_transaction, T2]
[read_item, T2, B]
[write_item, T2, B, 12, 18]
[start_transaction, T4]
[read_item, T4, D]
[write_item, T4, D, 25, 15]
[start_transaction, T3]
[write_item, T3, C, 30, 40]
[read_item, T4, A]
[write_item, T4, A, 30, 20]
[read_item,T2, B]
[write_item, T2, B, 15, 35]
[commit, T3]



Exercise 7 [12 points]

Consider a distributed database transaction processing system that manages data replicated across two or more servers. A transaction that updates a data item must change all replicas to ensure that after a transaction is committed all replicas has exactly the same data.

Prepare and explain scenarios of violation of the ACID properties on such a system.