

# CSCI 6333/6315 Database Systems

Spring 2020

## ASSIGNMENT 5: Transaction Management

All answers shall be typed using a word processor and some drawing utilities. A cover page shall be prepared with course title, homework number, submitted date and time, and contact info including your email address.

**Due: Midnight, Sunday, May 3, 2020**

The total score of this assignment is 160. The 8 problems are equally weighted, with 20 points each.

Problem 1. Explain the distinction between the terms serial schedule and serializable schedule.

Problem 2. Consider the following two transactions:

$T_1$ :	read( $A$ );
	read( $B$ );
	if $A = 0$ then $B = B + 1$ ;
	write $B$ ;
$T_2$ :	read( $B$ );
	read( $A$ );
	if $B = 0$ then $A = A + 1$ ;
	write $A$ ;

Figure 1. Two transactions  $T_1$  and  $T_2$

Let the consistency requirement be  $A = 0 \vee B = 0$ , with  $A = B = 0$  the initial values.

- Show that every serial execution involving these two transactions preserves the consistency of the database.
- Show a concurrent execution of  $T_1$  and  $T_2$  that produces a nonserializable schedule.
- Is there a concurrent execution of  $T_1$  and  $T_2$  that produces a serializable schedule?

Problem 3. Consider the precedence graph in Figure 2. Is the corresponding schedule serializable?

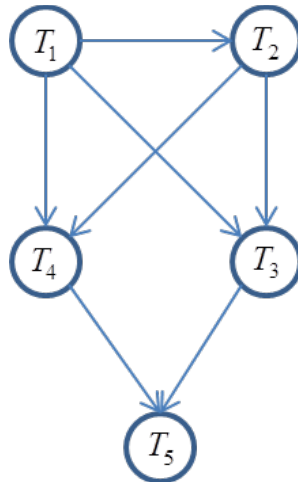


Figure 2. Precedence graph

Problem 4. Show that two-phase locking protocol ensures conflict serializability, and that transaction can be serialized according to their lock points.

Problem 5. Consider transactions  $T_1$  and  $T_2$  in Figure 1. Add lock and unlock instructions to them so that they observe the two-phase locking protocol. Can the execution of these two transactions result in a deadlock?

Problem 6. Show that there are schedules that are possible under the two-phase locking protocol, but are not possible under the timestamp protocol, and vice versa.

Problem 7. Explain the purpose of the checkpoint mechanism. How often should checkpoints be performed? How does the frequency of checkpoints affect

- System performance when no failure occurs
- The time it takes to recover from a system crash
- The time it takes to recover from a disk crash

Problem 8. When the system recovers from a crash, it constructs an undo-list and a redo-list. Explain why log records for transactions on the undo list must be processed in reverse order, while those log records for transactions on the redo-list are processed in a forward direction.